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**मयुराक्षी ग्रामीण महाविद्यालय, रानीश्वर**  
पो०-रानीश्वर, जिला-दुमका (झारखण्ड)  
**MAYURAKSHI GRAMIN COLLEGE**  
P.O.-RANISHWAR :: DIST.-DUMKA (Jharkhand)  
**S.K.M UNIVERSITY, DUMKA**

NAAC ACCREDITED GRADE 'B'

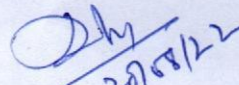
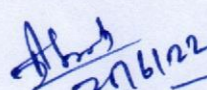
पत्रांक : .....

दिनांक : .....

1.3.2 The Consolidated list showing the total number of Courses that include experiential learning through project work/ Field Work etc. year wise during the all assessment years.

2020-21	2019-20	2018-19	2017-18	2016-17
83	83	83	83	36

We have attached herewith Weblink of the documents.

  
27/5/22  
Principal  
Mayurakshi Gramin College  
Ranishwar Dumka  
  
27/6/22



**SIDO KANHU MURMU UNIVERSITY, DUMKA**

## **DEPARTMENT OF GEOGRAPHY**

**UNDERGRADUATE COURSES OF STUDY**

**B.A. (General) Geography**

***UNDER***

***CHOICE BASED CREDIT SYSTEM (CBCS)***

***INTRODUCED FROM SESSION 2016-19***

## **SEMESTER – I**

### **Core Course: Geography - I**

#### **Introduction of Geography**

**(Credits: Theory-4, Practicals-2)**

##### **THEORY**

**Lectures: 60**

**Full Marks: 75/60/15**

**Time: 03 Hrs.**

#### **Module I**

Introduction:- The nature of Geography, objective and relevance. Role of Geography in the classification of Science, Geography , Major themes and sub themes.

#### **Module II**

Geography as the study of environment, Man environment, environment relationship, ecology and ecosystem. Environmental determinism, possibilism.

#### **Module III**

Recent trends in geography with special reference to India. Environmental degradation, Disaster and environmental Management .

#### **Module IV**

Issues related to human resources:- Carrying capacity of the earth. Indicator of develop regional imbalances.

## **Practical**

**FM: 25/20/5**

**Time:3 Hrs**

**Module –I** History of Cartography , types of maps, Scale simple compound, Diagonal; Maps enlargement and reduction

– 10

**Module – II** Modern Techniques of map making components of computer cartography ( GIS)

- 10

**Module – III** PNB + Viva – Voce

-5



## **SEMESTER – II**

### **Core Course: Geography - II**

#### **Physical Geography**

**(Credits: Theory-4, Practicals-2)**

##### **THEORY**

**Lectures: 60**

**Full Marks: 75/60/15**

**Time: 03 Hrs.**

**Module – I**      Origin of the earth ( Theories) Jeans & Jeffry & Otto Schmidt , Interior of the earth condimental Drift Theory, Plate tectonics and Mountain Building, Isostasy.

**Module- II**      Cycle of erosion ( Davis & Penck) Topography- Fluvial, Arid, Glacial, Karst, Coastal, Volcanic eruption & Earthquake .

**Module-III**      Composition & structure of the Earth Atmosphere, Air Masses and fronts, classification of climate – Koeppen, Temperate & Tropical Cyclones, Heat Budget of the earth- Green House effect, Global warming .

**Module – IV** Bottom relief of Indian & Atlantic Ocean; Salinity of

Ocean water, Tides, Ocean Deposits, Coral Reefs.

**Practical**

**FM: 25/20/05**

**Time:3 Hrs.**

**Module – I** Drawing of Climograph and Hythergraph and their interpretation , Isopleth of climate . 10

Module –II Study Topographical Map of India with respect of Relief, Drainage, Settlement & Communication Pattern. 10

**Module- III** Project Report Viva- Voce. 05

## **SEMESTER – III**

### **Core Course: Geography - III**

### **Geography of India and Jharkhand**

**(Credits: Theory-4, Practicals-2)**

#### **THEORY**

**Lectures: 60**

**Full Marks: 75/60/15**

**Time: 03 Hrs.**

**Module- I** Physical geography of India, geological structure of Himalaya Mountain. Indian climate, Drainage System of India and their functional significance .

**Module –II** Soil types of India. Their distribution and characteristics. vegetation types and their distribution forest resource. Minerals and power resource. The status of their use and need of conservation. Geographical region- Middle Ganga plains, Tamil Region.

**Module- III** Spatial distribution of population and density, population explosion, Sex composition Causes and effects. Regional disparities in Social and economic development .

**Module – IV** Resources – Forest and minerals habitat and Economy of Santhal and Oraon, Tourism development and its prospects, Environment of tourism and tourism policy in Jharkhand.

### **Practical**

**FM: 25/20/05**

**Time: 3Hrs.**

**Module- I** Basic principles of land surveying with ( prismatic Compass ) open and close Travers , Plane Table, Radiation & intersection, Indian Clinometer – 10

**Module- II** Projection:- Conical Projection with one standard parallel and Two standard Parallel , Simple cylindrical equal Area and Equidistant Projection. – 10

**Module- III** Project Report Viva- Voce. 05



## **SEMESTER – IV**

### **Core Course: Geography - IV**

#### **Human Geography**

**(Credits: Theory-4, Practicals-2)**

##### **THEORY**

**Lectures: 60**

**Full Marks: 75/60/15**

**Time: 03 Hrs.**

**Module- I** Nature and scope of human geography, Branches of human Geography. Physical and social profile of social groups. Ethnic groups, tribal groups and religion groups in India.

**Module- II** Early economic activities of mankind, food , gathering, Hunting, fishing and shifting Cultivation . Human Adaptation to the environment (i) Cold region - Eskimo (ii) Hot region- Bushman.

**Module- III** Distribution of Population :- World distribution pattern, Geographical factors of distribution concepts of over population, under population and optimum population, Slump population and environment in India .

**Module- IV** Migration :- Push and Pull Factors; National and International Types; Population Policy in India.

**Practical**

**FM: 25/20/05**

**Time: 3 Hrs.**

**Module- I** Statistical Methods:- Use of mean, Median, Mode and Standard deviation in data analysis and Mapping.

-10

**Module- II** Map Projection:- Polyconic, Bonnes, Zenithal equal- Area and Equidistant.

-10

**Module- III** Project Report Viva- Voce .

-5

## **SEMESTER – V**

### **Discipline Specific Elective (DSE): Geography - V**

**(Any one Paper: Environmental Geography/Population Geography)**

### **Environmental Geography**

**(Credits: Theory-4, Practicals-2)**

#### **THEORY**

**Lectures: 60**

**Full Marks: 75/60/15**

**Time: 03 Hrs.**

**Module- I**      Meaning and importance of environmental Geography- concept of Environment Relationship of environmental Geography with earth Science, Physical Science and Biological Sciences.

**Module- II**      Meaning and structure of Environment, components of Environment Meaning of Ecology and Ecosystem, types and functioning of Ecosystem Productivity and stability- biosphere as an ecosystem.

**Module- III**      Energy flow in the ecosystem tropic levels food chains and food web- ecological pyramids- Circulation of elements in the ecosystem Biochemical cycles. Biomes- Biomes of tropical rainforests, Tropical

deciduous and savanna biomes. Human impact on Environment- Environmental pollution (i) Air Pollution (ii) Water Pollution (iii) Noise Pollution (iv) Land Pollution, Depletion of ozone layer, Green House Effect , Environmental impact Assessment (EIA)

#### **Module- IV Natural Hazards and degradation of Environment**

Volcanoes earthquakes and cyclones. Conservation and Management of Physical and cultural environment.

International and national policies on protection of earth environment- Role of UNO.

### **Population Geography**

**(Credits: Theory-4, Practicals-2)**

#### **THEORY**

**Lectures: 60**

**Full Marks: 75/60/15**

**Time: 03 Hrs.**

#### **Module -I**

Nature and scope of population geography; Sources and types of population data: census, sample survey (NSS) and vital registration system.



## **Module -II**

World population: growth, causes and consequences;  
Factors affecting population distribution; Migration: types  
and determinants; Urbanization: trends and pattern

## **Module -III**

Population dynamics: fertility and mortality, age and sex  
structure; Occupational structure; Malthusian Theory and  
Demographic transition theory; human resource  
development: indicators and patterns.

## **Module -IV**

INDIA:- Population growth; Distribution of population; Density  
types; Population problems; Population Policy.

## **Practical**

**FM: 25/20/05**

**Time: 3 Hrs.**

**Module- I** Maps- meaning classification- Atlas wall Maps, Wall Maps, Topographical, Cadastral Maps Physical and cultural maps. 10

**Module– II** Scales:- Meaning, significance, types statement-RF, Conversion of Scales Graphical Scale, Linear and Diagonal Scales with illustration. 10

## **SEMESTER – VI**

### **Discipline Specific Elective (DSE): Geography - VI**

#### **(Any one Paper: Field Work (Socio-Economic)/Social Geography)**

#### **Field work ( Socio- Economic)**

**(Credits: Theory-4, Practicals-2)**

##### **THEORY**

**Lectures: 60**

**Full Marks: 75/60/15**

**Time: 03 Hrs.**

#### **Objectives :**

Main objective of the field work is to provide the students with the understanding of ground reality of a chosen village/town by observation; mapping of land quality, land-use and cropping pattern and conducting Socio- economic survey of the households with help of a specially prepared questionnaire .

#### **Course Contents :**

**Module- I** To procure Topographic map of 1:50,000 or 1:25,000 Scale; To study the settlements Selected in its regional setting. Collect demographic, Social & economic data of the village/town from census reports

to study the temporal changes in the profile of such characteristics .

**Module- II** Procure a cadastral map of the Village/town for filed mapping of the features of land- use and land quality. Procure/ prepare the settlement site map through rapid survey to map the residential commercial recreational ( Parks; Playgrounds), educational religious and other prominent features.

**Module- III** Conduct a Socio-economic Survey of the households with a structured questionnaire. Supplement the information by personal observations and perceptions.

**Module- IV** Based on results of the land use and socio-economic enquiry of the households, prepare a critical field survey report, Photographs and sketches, in addition to maps and diagrams may supplement the report .



# **Social Geography**

**(Credits: Theory-4, Practicals-2)**

**THEORY**

**Lectures: 60**

**Full Marks: 75/60/15**

**Time: 03 Hrs.**

## **Module - I**

Meaning and scope of social geography; Social differentiation and stratification; Social morphology.

## **Module - II**

Social region formation: Bases of social region formation; Evolution of socio-cultural regions of India; Role of race, caste, tribe, religion and languages; India — unity in diversity

### **Module – III**

Concept of social wellbeing; Physical quality of life; Human development: concept and measurements; Health care, education and shelter; Gender issues in India

### **Module - IV**

Public policy and social planning in India; Appraisal of Five-Year Plans and social policies in India; Social policy and planning for drought and flood prone areas;

### **Practical**

**FM: 25/20/05**

**Time: 3 Hrs.**

**Module- I** Importance of field instrument survey- scope and purpose, principals and application of selected survey instruments.

**Module- II** Chain survey:- Use of tapes- open traverse, triangulation survey; plane table. Plan preparation resection- one point and two point problem, three point problem , Tracing paper method.

**Module-III** Prismatic compass:- Open and closed traverse, elimination error, Bowditch method

**Module- IV** Dumpy level:- Traverse survey, contour plan preparation. Theodolite- horizontal and vertical( height) measures, accessible and inaccessible method.

**Module- V** Other smaller instruments- Sextant, Abney level and Indian clinometer, height measurements; coastal instruments mapping; Survey of a selected area. Preparation of base map by the use of surveying instruments; environmental impact assessments of an area where base maps are not available .

## **Skill Enhancement Courses (SEC)**

### **Skill Enhancement Course (SEC)**

#### **Maps and Scales**

**(Credits 2)**

**Lectures: 30**

**Full Marks: 75**

**Time: 03 Hrs.**

#### **Module I**

Map Reading/Appreciation: Basics of Map Reading; Map as a tool of Information; Bases of Map Classification; Directions: Cardinal Directions; Primary Inter- Cardinal; Secondary Inter- Cardinal; Locational System: Dates and time; latitude; Longitude and Graticule; Time Zone and International Date Line; Geographic Locations: Continents and Oceans; Nations; State Capital; Major Cities of the World; Mountains and Rivers.

#### **Module II**



Elements of Maps; Scales: types- simple, diagonal and comparative and conversions; Types of Maps – Topographical Maps, Weather Maps, Thematic Maps;

### **Module III**

Art and Science of Map Making; Projections – Concepts, Terminologies and Classification; Construction of Graticules – Principles; Mapping Organisations – Survey of India, Geological Survey of India, National Atlas and Thematic Mapping Organisation.

### **Module IV**

Mapping Techniques and Technologies: Data Mapping; Visualisation of Themes – Bar Diagrams, Pie Diagrams, Isopleth Maps, Choropleth Maps; Satellite Imaging Systems; Digital Images and Maps; Using Open Source Geospatial Datasets – Google Earth and Wikimap.

**Skill Enhancement Course (SEC)**

**Modern Techniques of Spatial Analysis**

**(Credits 2)**

**Lectures: 30**

**Full Marks: 75**

**Time: 03 Hrs.**

**Module I**

Remote Sensing: Concept and Scope; Types of Remote Sensing:  
Air borne and Space borne; Aerial photos: Types and  
Characteristics; Remote Sensing satellites: Platforms and sensors;

## **Module II**

GPS - Principles and Components; India's Space Programme - Satellites, Data products and their Applications; Remote Sensing application in resource mapping and environmental monitoring.

## **Module III**

Theoretical Basis of a GIS Definitions, Historical Development, Components of a GIS Types of Geospatial datasets: Raster, Vector, Surface - Attributes and Functionality.

## **Module IV**

Applications of GIS; Nature of GIS Applications Studies on Land cover and Land use; Change in Forest Areas Mapping and Predicting Environmental Hazards; Prospects in GIS.

### **Skill Enhancement Course (SEC)**

### **Disaster Management**

**(Credits 2)**

**Lectures: 30**

**Full Marks: 75**

**Time: 03 Hrs.**

## **Module – I**

Disasters: Definition and Concepts: Hazards, Disasters; Risk and Vulnerability; Classification

## **Module- II**

Disaster in India: (a) Flood: Causes, Impact, Distribution and Mapping; (b) Drought: Causes, Impact, Distribution and Mapping

## **Module-III**

Disaster in India: (a) Earthquake and Tsunami: Causes, Impact, Distribution and Mapping; (b) Manmade disasters: Causes, Impact, Distribution and Mapping

## **Module -IV**

Response and Mitigation to Disasters: Mitigation and Preparedness, NDMA and NIDM; Indigenous Knowledge and Community-Based Disaster Management; Do's and Don'ts during Disasters

# **Sustainable Development**

**(Credits 2)**

**Lectures: 30**

**Full Marks: 75**

**Time: 03 Hrs.**

## **Module –I**

Sustainable Development: Definition, Components, Historical Background and Scope; The role of higher education in sustainable development;

## **Module –II**

The Millennium Development Goals: National Strategies and International Experiences

## **Module –III**

Sustainable Regional Development: Need and examples from Cities and Mountains; The human right to health; Poverty and disease; The Challenges of Health Coverage in High-Income Countries;

## **Module –IV**

Inclusive Development: Education, Health; Climate Change: Policies and Global Cooperation for Climate Change; Sustainable Development Policies and Programmes: The proposal for SDGs at Rio+20; Illustrative SDGs; Goal-Based Development; Financing for Sustainable Development; Principles of Good Governance; National Environmental Policy.

*Details of Courses of Study*

**SIDO-KANHU MURMU UNIVERSITY, DUMKA**

**TEACHING PLAN (SEMETER WISE) FOR CHOICE BASED  
CREDIT SYSTEM IN UNDERGRADUATE  
BOTANY PROGRAMME (MAJOR)**

**SEMESTER – I**

Paper	Subject type	Topics	Total marks
BOT101M	Core 1	Microbiology	
BOT102M	Core 2	Algae & Fungi	
Practical		Practical Based on Paper BOT101M & BOT102M	

**SEMESTER – II**

Paper	Subject type	Topics	Total marks
BOT201M	Core 3	Bryophytes & Pteridophytes	
BOT202M	Core 4	Paleobotany & Gymnosperm	
Practical		Practical Based on Paper BOT201M & BOT202M	

**SEMESTER – III**

Paper	Subject type	Topics	Total marks
BOT301M	Core 5	Morphology and Systematic of Angiosperms	
BOT302M	Core 6	Histology & Anatomy	
BOT303M	Core 7	Plant Pathology	
Practical		Practical Based on Paper BOT301M, BOT302M & BOT303	

**SEMESTER – IV**

Paper	Subject type	Topics	Total marks
BOT401M	Core 8	Embryology & Economic Botany	
BOT402M	Core 9	Cell Biology	
BOT403M	Core 10	Physiology and Metabolism	
Practical		Practical Based on Paper BOT401M, BOT402M & BOT403	

**SEMESTER – V**

Paper	Subject type	Topics	Total marks
BOT501M	Core 11	Molecular Biology	
BOT502M	Core 12	Genetics & Plant Breeding	
Practical		Practical Based on Paper BOT501M & BOT502M	

**SEMESTER – VI**

Paper	Subject type	Topics	Total marks
BOT601M	Core 13	Biochemistry & Biotechnology	
BOT602M	Core 14	Ecology & Environmental Biology	
Practical		Practical Based on Paper BOT601M & BOT602M	



## **SEMESTER – I**

### **BOT101M – Microbiology**

**Methods of Microbiology:** Staining, Sterilization, Isolation, Culture and Culture media.

**Viruses:** General account of TMV and Bacteriophage.

**Mycoplasma:** Structure and reproduction.

**Bacteria:** General characters, classification, cell structure, reproduction and economic importance.

**Cyanobacteria:** General characters, classification, cell structure, reproduction and life history of *Nostoc*, *Oscillatoria* and *Rivularia*.

### **BOT102M – Algae and Fungi**

**Algae:** General characters, classification, economic importance and life history of *Oedogonium*, *Chara*, *Vaucheria*, *Sargassum* and *Polysiphonia*.

**Fungi:** General characters, classification, economic importance and life history of *Phytophthora*, *Peziza*, *Puccinia*, *Argicus* and *Colletotrichum*.

### **Practical – (Based on Paper BOT101M and BOT102M)**

## **SEMESTER – II**

### **BOT201M – Bryophytes and Pteridophytes**

**Bryophytes:** General account, classification, progressive sterilization of sporogeneous tissue, economic importance and life history of *Marchantia*, *Anthoceros*, *Sphagnum* and *Polytrichum*.

**Pteridophytes:** General account, anatomy, stellar evolution, heterospory and seed habit and life history of *Psilotum*, *Selaginella*, *Equisetum*, *Marsilia* and *Pteris*.

### **BOT202M – Paleobotany & Gymnosperms**

**Fossil:** Types, process of fossilization, importance of fossils, geographical time scale, major sites of fossils in Jharkhand. General account and life history of *Rhynia*, *Calamites*, *Lepidodendron*, *Pentoxylum* and *Williamsonia*.

**Gymnosperm:** General account, anatomy, reproduction and comparative account of *Cycas*, *Pinus*, *Taxus* and *Gnetum*.

### **Practical – (Based on Paper BOT201M and BOT202M)**

## **SEMESTER – III**

### **BOT301M – Morphology & Systematic of Angiosperms**

**Morphology:** Types of Root, Stem, Leaves, Inflorescence, Flower, Pollination and Fruit. Dispersal of fruit and seed.

#### **Systematic of Angiosperms:**

**Introduction:** Aims and Objectives of Plant taxonomy.

**Systematic in practice:** Herbarium – Importance, their preparation, role of herbaria.

**Botanical nomenclature:** Binomial nomenclature; principles and rules; typification; principle of priority and its limitations.

**System of classification:** Bentham and Hooker's system, Hutchinson system and Takhtajan's system.

**Modern trends in Plant taxonomy:** Taxonomy in relation to Embryology, Cytology (Cytotaxonomy), Chemotaxonomy and Numerical taxonomy.

**Study of important families:** *Ranunculaceae*, *Acanthaceae*, *Apocynaceae*, *Verbenaceae*, *Rubiaceae*, *Lamiaceae*, *Euphorbiaceae*, *Poaceae* and *Cyperaceae*.

### **BOT302M – Histology & Anatomy**

**Tissue:** Meristematic, simple, complex and mechanical.

**Tissue System:** Dermal, ground and vascular tissue system.

**Primary structure:** Stem and Root of Dicotylendons and Monocotylendons. Leaf-Dorsiventral and Isobilateral.

**Cambium:** Origin, structure and function.

**Periderm:** Origin, structure and function.

**Secondary growth:** Anamolous secondary growth in *Achyranthus*, *Boerhaavia* and *Dracaena*.

### **BOT303M – Plant Pathology**

**Disease development:** Pathogenesis and Host-Parasite relationship.

**Plant disease epidemiology:** Transmission and spread of plant pathogens, disease cycles and epidemics.

**Defense mechanisms:** Structural and Biochemical defense.

**Plant disease management:** Chemical, Biological and Cultural methods.

**Plant Diseases:** A general account of late blight of potato, Early blight of potato, Citrus Canker, Red rot of sugarcane, Loose smut of wheat, Rust of wheat, Bacterial blight of rice, TMV, Leaf curl of papaya, Yellow vein mosaic of Bhindi and Little leaf of Brinjal.

### **Practical – (Based on Paper BOT301M, BOT302M & BOT303M)**

## **SEMESTER – IV**

### **BOT401M – Embryology & Economic Botany**

#### **Embryology**

**Sporogenesis:** Microsporogenesis and Megasporogenesis.

**Gametogenesis:** Male and Female gametophyte.

**Fertilization:** Fertilization and double fertilization.

**Embryogenesis:** Embryo development in Dicot and Monocot.

**Endosperm:** Types, structure and function, polyembryony.

#### **Economic Botany**

**Food plants:** A general account of Cereals (Wheat, Rice & Maize), Pulses (Pigeon pea, Gram, Black Gram, Green Gram & Lentil)

**Oil yielding sources:** Edible (Mustard, Sunflower, Sesame & Soya bean) and Non edible (Castor, Karanj, Eucalyptus & Lemongrass).

**Plant fibers:** A general account of common fiber plants (Cotton, Jute, Bamboos, Flax and Patson).

**Timber:** A general account (Sal, Teak, Sissoo, Siris & Gambhar).

**Medicinal plants:** A brief account of common medicinal Plants of Jharkhand (Ashwagandha, Sarpagandha, Kalmegh, Centella, Arjuna, Adhatoda, Tulsi, Nux-vomica, Triphala & Chitrak).

### **BOT402M – Cell Biology**

**Cellular organization:** Structure and function of Plasma membrane, Cell wall, Nucleus, Chloroplast, Mitochondria, Golgi complex, Endoplasmic reticulum and Ribosome.

**Cell Division:** Mitosis and Meiosis.

**Chromosome:** Morphology, structure, nucleosome model, chemical composition, salivary lampbrush and  $\beta$ -chromosome.

## **BOT403M – Physiology & Metabolism**

### **Physiology**

**Plant – Water relation:** Diffusion and osmosis; water potential and chemical potential; absorption of water; Ascent of sap; transpiration and its significance; mechanism of stomatal movement.

**Mineral nutrition:** Role of macro and micro nutrients in plants. Translocation of solutes, mechanism of mineral salt absorption.

### **Metabolism**

**Photosynthesis:** Photochemical reactions; Photophosphorylation; Calvin cycle; C4 cycle and Photorespiration.

**Respiration:** Glycolysis; TCA cycle; Oxidative Phosphorylation; Pentose Phosphate Pathway.

**Nitrogen metabolism:** Biological nitrogen fixation; reduction of nitrate into ammonia.

**Growth and development:** General aspects of growth; Physiology of Photoperiodism and vernalization.

**Physiology of seed dormancy and germination:** Role and mechanism of action of the Phytohormones; Auxin, Cytokinins and Gibberellins.

### **Practical (Based on Paper BOT401M, BOT402M & BOT403M)**

## **SEMESTER – V**

### **BOT501M – Molecular Biology**

**Gene:** Organization of gene in prokaryotes and eukaryotes. Genetic code, transcription, translation, regulation of genes in prokaryotes, operon concept, interrupted genes in eukaryotes and RNA splicing.

**Recombinant DNA technology:** Restriction endonuclease; plasmid; technique of RDT, gene mapping and DNA finger printing especially RELP, RAPD and PCR, Chromosome walking; northern and southern analysis.

**Chromatography:** TLC, GLC, HPLC, Spectroscopy.

### **BOT502M – Genetics & Plant Breeding**

#### **Genetics**

**Mendelism:** Mendel's law of inheritance, back cross and test cross.

**Interaction of genes:** Complementary; supplementary; duplicate and epistatic factors.

**Linkage and recombination:** Coupling and repulsion; two and three point test crosses with their significance in chromosome mapping; theories, mechanism and significance of recombination.

**Determination of sex:** Mechanism of sex determination in Plants; sex linked inheritance in *Drosophila* and man.

**Maternal influence of inheritance:** Cytoplasmic inheritance in *Mirabilis*, snail and yeast.

**Gene mutation:** Molecular basis of gene mutation; frame shift mutation and substitution mutation; spontaneous and induced mutation; mutagens – type and mode of action.

**Structural changes in chromosomes:** Origin, types and effects of duplications, deletions, inversions and translocations.

**Numerical changes in chromosomes:** Origin, types and effects of auto and allopolyploidy, origin and meiosis of aneuploidy.

#### **Plant Breeding**

**Plant breeding:** Vegetative and sexual.

**Methods of plant improvement:** Introduction and acclimatization, selection – pure line and mass selection, hybridization in self and cross pollinated crops, hybrid, vigour, role of polyploidy and mutation in speciation.

### **Practical (Based on Paper BOT501M & BOT 502M)**

## **SEMESTER –VI**

### **BOT601M – Biochemistry & Biotechnology**

#### **Biochemistry**

**Carbohydrate:** Classification; structure of some representative examples of monosaccharide's disaccharides and polysaccharides.

**Lipid:** Saturated and unsaturated fatty acids; fatty acid biosynthesis; oxidation of fatty acids; storage and mobilization of fatty acids and lipids.

**Nucleic acids:** Composition of nucleic acids; DNA structure and replication. Different forms of RNA and their role.

**Enzymes:** Characteristic, types, classification and mode of action.

**Amino acid and protein metabolism:** Structure, characteristic and classification of amino acids; protein and non-protein amino acids; amino acid biosynthesis; structure of proteins; protein biosynthesis and its regulation.

#### **Biotechnology**

**Plant Biotechnology:** Cellular differentiation and totipotency; organogenesis and embryogenesis; protoplast isolation and culture; somatic hybridization; clonal propagation; genetic engineering of plants. Role of biotechnology in crop improvement (with suitable examples)

### **BOT601M – Ecology & Environmental Biology**

#### **Ecology**

**Ecological adaption:** Hydrophytes and xerophytes.

**Population:** Concept, density and pattern, population growth and population interactions.

**Community:** Community characteristics and their measurement; species diversity; (alpha, beta and gamma).

**Ecosystem:** Structure, function and components of ecosystem; Ecological Pyramids; Energy and its flow in ecosystem; Diversity of ecosystem; Aquatic (fresh water); terrestrial (forest/grassland); Biogeochemical cycles.

#### **Environmental Biology**

**Phytogeography:** Introduction; endemism, an account of vegetation of India.

**Ecological management:** renewable and non-renewable natural resources and their management.

**Biodiversity and their Conservation:** Definition, types, significance and conservation of biodiversity; IUCN threats of categories.

**Impact of human activities:** Pollution- Air, Water and Soil pollution; prevention and control of pollution; global warming and ozone depletion.

**Bioremediation:** Environmental monitoring and impact assessment, important legislations related to environmental management.

### **Practical (Based on Paper BOT601M & BOT602M)**

# **SIDO KANHU MURMU UNIVERSITY, DUMKA**



## **CBCS BASED COURSE CURRICULUM (ZOOLOGY) *For* UNDERGRADUATE PROGRAMME**

[ B.Sc. (Honours) / (Subsidiary/ General) ]  
**ACADEMIC SESSION**  
**2017-2019**

UNIVERSITY DEPARTMENT OF ZOOLOGY  
S.K.M.UNIVERSITY, DUMKA - 814101  
JHARKHAND

Dr. A.K. Nath  
Prof. & Head  
Dept. of Zoology  
S.K.B. Univ. Purulia (WB)

Dr.P.K.Verma

Dr. G.K. Thakur

Dr. K.S. Awasthy

Dr. N. Tripathi

Dr. P. Hembrom



**B.Sc. ZOOLOGY (HONOURS) SEMESTER SYSTEM  
(S.K.M.UNIVERSITY, DUMKA)**

**ABSTRACT OF SYLLABUS OF CORE SUBJECT  
(3 YR DEGREE COURSE UNDER SEMESTER SYSTEM)**

YEAR	SEMESTER	T H E O R Y			PRACTICAL FULL MARKS	TOTAL MARK S (T+P)
		PAPER CODE	COURSE TITLE	FULL MARK S		
1st	Sem- I	ZOO-101C	Animal diversity(Non chordates)- 1	75	50	200
		ZOO-102C	(A) Animal Diversity(Non chordates(-2 (B )Animal behaviour	75		
	Sem- II	ZOO-203C	Animal Diversity(Chordates)	75	50	200
		ZOO-204C	(A) Comparative Anatomy of vertebrates (B) Ecology & Environmental Biology	75		
2nd	Sem- III	ZOO-305C	(A) Biostatistics (B) Evolution	75	50	200
		ZOO-306C	Biochemistry	75		
	Sem- IV	ZOO-407C	(A) Palaeontology (B) Genetics	75	50	200
		ZOO-408C	Molecular Biology	75		
3rd	Sem- V	ZOO-509C	(A) Toxicology (B) Biotechnology (C) Zoogeography	100		400
		ZOO-510C	Endocrinology & Reproductive Biology	100		
		ZOO-511C	Cell Biology	100		
		ZOO-512C	(A) Practical – 75 (B) Project - 25		100	
	Sem- VI	ZOO-613C	(A) Applied & Economic zoology (B) Immunology	100		400
		ZOO-614C	Mammalian Physiology	100		
		ZOO-615C	Developmental Biology	100		
		ZOO-616C	(A) Practical – 75 (B) Project - 25		100	

**THEORY: END SEMESTER EXAMINATION**  
**Pattern of questions & Distribution of Marks**

<b>Group</b>	<b>Theory Full Marks : 75 Time : 3 hours</b>	<b>Theory Full Marks : 100 Time : 3 hours</b>
<b>A</b>	Objective Type Multiple Choice Questions : 10 x 2 = 20 Marks	Objective Type Multiple Choice Questions : 10 x 2 = 20 Marks
<b>B</b>	Short Answer Type Questions Five questions (Out of ten questions ) 5 x 5 = 25	Short Answer Type Questions Five questions ( Out of ten questions ) 5 x 8 = 40
<b>C</b>	Long Answer Type Questions Two questions (Out of Four Questions ) 2 x 15 = 30 Marks	Long Answer Type Questions Two questions ( Out of Four Questions) 2 x 20 = 40 Marks

## P R A T I C A L (HONOURS): END SEMESTER EXAMINATION

### MODEL OF QUESTIONS & DISTRIBUTION OF MARKS

<b>SEMESTER ; I<sup>ST</sup></b> <b>Full Marks : 50</b>			<b>SEMESTER : II<sup>ND</sup></b> <b>Full Marks : 50 Time : 3 hrs</b>		
SN	Model of questions	Marks	SN	Model of questions	Marks
1	Dissection	10	1	Dissection	10
2	Mounting	5	2	Mounting	5
3	Spotting(Slides 4 +Specimen 2)	12	3	Spotting(Slides 4 +Specimen 2)	12
4	Animal Behaviour	8	4	Ecology &Environmental biology:1exp	8
5	Viva	5	5	Viva	5
6	Collection/Record	10	6	Collection/Record	10
TOTAL		50	TOTAL		50
<b>SEMESTER : III<sup>RD</sup></b> <b>Full Marks : 50</b>			<b>SEMESTER : IV<sup>TH</sup></b> <b>Full Marks : 50</b>		
Time : 3 hrs			Time : 3 hrs		
SN	Model of questions	Marks	SN	Model of questions	Marks
1	Biostatistics	10	1	Palaeontology	10
2	Evolution	5	2	Genetics	10
3	Osteology-2	8	3	Molecular biology	5
4	Biochemistry:1exp	12	4	Osteology -2	10
5	Viva	5	5	Viva	5
6	Collection/Record	10	6	Collection/Record	10
TOTAL		50	TOTAL		50
<b>SEMESTER : V<sup>TH</sup></b> <b>Full Marks : 100</b>			<b>SEMESTER : VI<sup>TH</sup></b> <b>Full Marks :100</b>		
Time : 3Hrs			Time : 3 Hrs		
(A)Practical – 75			(A)Practical – 75		
(B)Project - 25			(B)Project - 25		
SN	Model of questions	Marks	SN	Model of questions	Marks
1	Endocrinology &Reproductive biology	15	1	Applied economic zoology	15
2	Biotechnology	10	2	Immunology	10
3	Toxicology	15	3	Mammalian physiology	15
4	Cell biology	15	4	Developmental biology	15
5	Viva	10	5	Viva	10
6	Collection/Record	10	6	Collection/Record	10
T O T A L		75	T O T A L		75
PROJECT		25	PROJECT		25

**S.K.M.University, Dumka**  
**B.Sc: ZOOLOGY (HONOURS) SEMESTER SYSTEM**

**1<sup>st</sup> year**

**Semester – I**

**THEORY (CORE)**

**Paper- 1<sup>ST</sup> (ZOO – 101C)**

**Full Marks: 75**

**Animal diversity (Non chordates): I**

1. Preliminary knowledge of classification of Non-chordates.
2. Protozoa
  - (i) Type study- Entamoeba histolytica
  - (ii) Nutrition and Reproduction in protozoa
3. Porifera-
  - (i) Type study- Scypha
  - (ii) Canal system in Porifera.
4. Coelenterata
  - (i) Type study-Obelia
  - (ii) Coral and coral reef formation.
5. Ctenophora: General organization and affinities of Hormiphora
6. Helminthes.
  - (i) Type study-Faciola hepatica,Wucheria bancrofti
  - (ii) Parasitic adaptations.
7. Annelida:
  - (i) Type study: Leech
  - (ii) Coelom & Excretory system in annelids

**A. Animal diversity (Non chordates) : II**

1. Mollusca
  - (i) Type study- Pila
  - (ii) Torsion and detorsion in Gastropods
2. Arthropoda
  - (i) Type study- Peripatus
  - (ii) Crustacean larvae
  - (iii) Mouth parts in insects.
3. Echinodermata
  - (i) Type study -Asterias
  - (ii) Larval forms of Echinoderms
  - (iii) Water vascular system in Echinoderms
4. Hemichordata- General characters and affinities.

**B. Animal behaviour**

1. Scope and concept of animal behaviour
2. Innate and learned behaviour
3. Social behaviour in insects(a) Honey bee(b)Termites
4. Parental care in fishes
5. Parental care in amphibians
6. Nesting and brooding behaviour in birds

**P R A C T I C A L**

**FULL MARKS: 50**

**List of Practical**

**1. Dissections**

- Earthworm:- Alimentary canal, Nervous system
- Pila : Nervous system
- Prawn: Nervous system

**2. Mounting**

- Coelenterata- Obelia
- Earthworm :-Setae,Spermathecae,Ovary,Septal nephridia
- Arthropoda :- statocyst of Prawn
- Mollusca :- Osphradium,Radula-Pila, statocyst

### 3. Study of Microscopic Slides

- Protozoa- Amoeba, Entamoeba, Euglena, Vorticella, Plasmodium, Paramecium.
- Porifera : Sycon, Spicules
- Coelentrata : Hydra, Obelia
- Helminthes: Ascaris : T.S Body wall (Male, Female), Larvae of F. hepatica
- Annelida- Earthworm: T.S-through pharynx, gizzard, spermatheca, seminal vesicles
- Arthropoda: Crustacean -Nauplius, Zoea, Megalopa, Mysis, (Larva)  
Cyclops, Cypris, Daphnia
- Hemichordata: T.S. through branchiogenital region of  
Balanoglossus, M.L.S. through anterior part of Balanoglossus

### 4. Study of Museum Specimens

- Porifera: Sycon
- Coelentrata : Aurelia, Porpita, Physalia, Velella, Metridium, Tubipora
- Ctenophora : Hormiphora
- Helminthes : Taenia solium, Fasciola hepatica, Ascaris
- Annelida: Nereis, Aphrodite, Sipunculus
- Arthropoda: Limulus, Sacculina, Julus, Praying mantis, Dragon fly
- Mollusca :- Chiton, Cypraea, Sepia, Pecten, Octopus.
- Echinodermata:- Star fish, Cucumaria
- Hemichordata : Balanoglossus

### 5. Animal behaviour

- Study of specimens showing parental care in fishes /amphibia
- 2. Comment upon models of animal behaviour
- Study trip to Zoo for observing behaviour of animals.
- Field survey of animal behaviour

**Semester – II**

**THEORY (CORE)**

**Paper- 3rd (ZOO – 203C)**

**Full Marks: 75**

**Animal Diversity-Chordates**

1. Origin and general characters of chordates.
2. Outline Classification of chordates
3. Protochordata-General organisation of Urochordates and Cephalochordates.
4. Agnatha-Petromyzon-general organisation.
5. Fishes- (i) Type study- Scoliodon  
(ii) Dipnoi-general organisation and affinities.
6. Amphibia-Origin and evolution of amphibian
7. Reptilia- Origin and evolution of reptiles
8. Aves-(i) Origin of birds (ii) Flight adaptation.
9. Mammals-General organisation, distribution and affinities of Prototheria and metatheria.

**PAPER: 4<sup>TH</sup> (ZOO – 204C)**

**FULL MARKS: 75**

**A.Comparative anatomy of vertebrates**

Integument, Heart, Aortic arches, Urinogenital system and Brain.

**B. Ecology and Environmental Biology**

- 1 .Concept of Ecology and Environmental Biology.
- 2 .Concept of Biosphere(Lithosphere,Hydrosphere and Atmosphere).
- 3 .Ecosystem-Definition,structure and function of a typical ecosystem.
4. Major ecosystems of the world.5.Biogeochemical cycles.
- 5 .Concept of flow of energy in an ecosystem.
- 6 .Biogeochemical cycles.
7. Community structure and ecological succession.
8. Concept of global warming and its remedies.
9. Wild life management.

## PRACTICAL

FULL MARKS: 50

### List of Practical

#### 1. DISSECTIONI.

- Scoliodon: Afferent and efferent blood vessels, Cranial nerves (5<sup>th</sup>, 7<sup>th</sup>, 9<sup>th</sup>, 10<sup>th</sup>)
- Bony fish- (Video graphic demonstration)
- General anatomy- Pigeon (CD-Rom or Video graphic demonstration)
- Rat : General anatomy (CD-Rom or Video demonstration or Model or casts)

#### 2. MOUNTING

- FISH:- Placoid, Cycloid, Ctenoid and Rhomboid Scales, Ampula of Lorenzini.
- Aves :- Feathers, Pecten of pigeon (Still photographs on TV or Computer monitor demonstration)

#### 3. STUDY OF PERMANENT SLIDES

- **Amphioxus**:- W.M., T.S. Pharynx, Intestine, Caudal region
- **Fish : scales (w.m)**
- Mammals : Skin, Stomach, Intestine, Liver, Kidney, Ovary, Testis, Spinal cord

#### 4. STUDY OF MUSEUM SPECIMENS

- Urochordata :- Herdmania
- Cyclostomes :- Petromyzon
- Fishes : Torpedo, Hammer headed shark, Hippocampus, Exocoetus, Sucking fish, Anabas testudineus, Channa punctatus, Clarias batrachus, Heteropneustes fossilis, Catla catla, Labeo rohita,
- Amphibia : Ichthyophis, Axolotl larva, Salamandra, Hyla, Alytes
- Reptilia : Tortoise, Sphenodon, Chameleon, Draco Python, Bungarus, Naja, Sea snake
- Aves- Owl, Pigeon
- Mammal- Bat

#### 5. Ecology and Environmental Biology

- General ecological survey of- Pond, Riverine, Grass land, Forest ecosystems of your locality.- survey report
- Limnological studies of Pond- Temperature, pH, Dissolved oxygen turbidity Plank tonic studies
- Community structure analysis of grassland
- Physical characteristics of soil sample
- Moisture and water holding capacity of



**2<sup>nd</sup> year**

**Semester – III**

**THEORY (CORE)**

**Paper- 5th <sup>T</sup> (ZOO – 305C)**

**Full Marks: 75**

**A. Biostatistics**

1. Concept and scope of biostatistics.
2. Normal distribution and mean, mode and median
3. Standard deviation and standard error.
4. Students 't' test
5. Chi square test.

**B. Evolution**

1. Origin and evolution of life on earth
2. Concept and theories of evolution-Lamarckism, NeoLamarckism, Darwinism and Neo Darwinism.
3. Synthetic theory of evolution
3. Causes of hereditary variations and role in evolution.
4. Concept of isolating mechanism and its role in evolution.
5. Speciation and natural selection.

**Paper- 6th (ZOO – 306C)**

**Full Marks: 75**

**Biochemistry**

1. Carbohydrates- structure, classification and significance
2. Protein -Structure, classification and significance.
4. Lipids- structure, classification and significance.
5. Amino acids-structure and properties.
6. Enzymes-Classification, nature and mechanism of action.
7. Vitamins-Discovery, sources and deficiency states.
8. Metabolic pathways-Glycolysis, glycogenesis, Gluconeogenesis, Krebs cycle,  $\beta$  oxidation of fatty acids.

## **P R A C T I C A L**

**FULL MARKS: 50**

### **LIST OF PRACTICALS**

#### **Biostatistics:**

**Calculation, evaluation and inter presentation of result on the basis of statistical analysis of the provided sample data (with the help of calculator)**

1. Arithmetic mean      2. Mode      3. Median
4. Standard deviation and standard error      5. Students'- t test

#### **Evolution**

1. Experiment showing Homology and analogy in wings of bird, bat and Butterfly
2. Experiment showing serial Homology in appendages of Prawn.
3. Experiment showing adaptive radiation in beak of birds
4. Experiment showing adaptive radiation in feet of birds
5. Experiment showing adaptive radiation in dentition of Mammal

#### **OSTEOLOGY**

**-Study of Vertebrae & Limb bones of Frog, Amphibia, Reptilia, Aves and Mammal**

#### **Biochemistry**

1. Tests for carbohydrates-Iodine test,Benedict's test
2. Tests for proteins-Biuret test,Millons test'
3. Tests for lipids-solubility test,Acrolein test,
4. Test for salivary amylase enzyme activity and impact of temperature and pH on salivary amylase activity.
9. Separation blood corpuscles and plasma by centrifugation

**Semester – IV**

**THEORY (CORE)**

**Paper- 7<sup>TH</sup> (ZOO – 407C)**

**Full Marks: 75**

**A. Palaeontology**

1. Fossils and methods of fossil formation.
2. Geological time scale and distribution of animals.
3. Phylogeny of horse
4. Phylogeny of Man.

**B. Genetics**

1. Concept of Mendelism and Mehdel's laws.
2. Linkage and Crossing over.
3. Cytoplasmic inheritance.
4. Chromosomal aberrations with cytological and genetic; manifestations.
5. Gene mutation.
6. Interaction of genes.

**Paper- 8<sup>TH</sup> (ZOO – 408C)**

**Full Marks: 75**

**Molecular Biology**

1. DNA-structure and types.
2. DNA-replication.
3. DNA damage and repair
4. RNA-its various types.
5. Transcription and genetic code.
6. Protein synthesis.
7. Regulation of gene expression

## PRACTICAL

**FULL MARKS: 50**

### List of Practical

#### Palaeontology

1. Study and comment upon the fossil or models of fossil provided.-
2. Models of extinct reptiles, Archaeopteryx

**GENETICS:** Calculation and interpretation of result of sample data showing-

1. Mendelian monohybrid cross, dihybrid cross
2. Ratio of crosses of sex linked inheritance.
3. Study of Phenotypic traits in Drosophila
4. Study of Phenotypic traits in Pea plant

#### Molecular Biology

- i. Genomic DNA extraction from whole human blood
- ii. Technique of DNA Finger printing

#### Osteology:

Study of Girdles & skull bones of Frog, Amphibia, Reptilia, Aves and Mammal

**3rd year**

**Semester – V**

### THEORY (CORE)

**Paper- 9<sup>TH</sup> (ZOO – 509C)**

**Full Marks: 100**

#### A. Toxicology

1. Introduction, basic concepts of Toxicology.
2. Toxicological testing methods-Acute toxicity tests, subacute toxicity tests and chronic toxicity tests.
3. Toxicants of public health hazards-toxic chemicals-pesticides, heavy metals, fertilizers, food additives, automobile emissions, radioactive substances.

#### B. Biotechnology

1. Introduction and scope of biotechnology
2. Brief idea of recombinant DNA technology and genetic engineering.
3. Transgenic animals.

#### C. Zoogeography

1. Various Zoogeographical regions of the world
2. Geographical areas, physical features, and distribution of animals of Australian, Oriental and Ethiopian regions

**Paper- 10<sup>TH</sup> (ZOO – 510C )**

**Full Marks:- 100**

**Endocrinology and Reproductive Biology**

1. Anatomy, histology and nature and function of hormones secreted by Pituitary, Thyroid, Adrenal, Gonad and Islets of Langerhans.
2. Reproductive cycles in mammals. Oestrous and menstrual cycles.
3. Vertebrate
4. Invertebrate neuroendocrine system.
5. Mechanism of hormonal action.
6. Hormonal regulation of gametogenesis in males and females.
7. Accessory sex organs and their dependence on sex hormones.
8. Human genetic disorders related to endocrine system

**Paper- 11<sup>TH</sup> (ZOO – 511C)**

**Full Marks: 100**

**Cell Biology**

1. Structure and functions of various cell organelles-Plasma membrane, Endoplasmic reticulum, Mitochondria, Golgi complex, Ribosomes, Lysosomes, Nucleus, Nucleolus
2. Fine structure of chromatin fibres.
3. Cell cycles-Mitosis and Meiosis.

**Paper- 12<sup>TH</sup> (ZOO –512C)**

**Full Marks: 100**

**A. PRACTICAL : 75**

**Endocrinology and Reproductive Biology**

1. Slides-T.S-Pituitary, Thyroid, Adrenal, Pancreas, Ovary, Testis
2. Dissection of Rat showing-Pituitary, Thyroid, Adrenal, Pancreas, Ovary, Testis

**Biotechnology**

1. Principles of PCR
2. Principles techniques and use of recombinant DNA technology

**Toxicology**

1. Reading of opercular beating time and effects of various toxicants in air breathing fishes.
2. Reading of surfacing time and effects of various toxicants in air breathing fishes

**Cell Biology**

1. Demonstration of Mitochondria in human buccal epithelium-vital staining by Janus green.
2. Demonstration of secretory granules-salivary gland of Cockroach-by neutral red
3. Demonstration of salivary gland chromosome in Chironomous larva.
4. Demonstration of different stages of mitosis in onion root tip-by acetocarmine
5. Demonstration of different stages of meiosis in grass hopper testis.

**B.PROJECT : 25**

**Will be decided & assigned by faculty members**

**Semester – VI**  
**THEORY (CORE)**  
**Paper- 13<sup>TH</sup> (ZOO – 613C)**

**Full Marks: 100**

**A. Applied and Economic Zoology**

1. Introduction and scope of applied and economic zoology.
2. Inland and marine fisheries in India
3. Sericulture
4. Lac culture
5. Apiculture
6. Prawn culture
7. Pearl culture.

**B. Immunology**

1. Introduction and scope of Immunology.
2. Immunity-cells,tissue,and molecules of immune system.
3. Antigens and antibodies - types, structure and interactions.
4. Monoclonal antibodies.
5. Cytokines.
6. ELISA and vaccines

**Paper- 14<sup>TH</sup> (ZOO – 614C )**

**Full Marks:- 100**

**Mammalian Physiology**

1. Blood-Composition and function of blood and lymph.
2. Cardiac cycle and ECG.
3. Respiration-
  - (a) Mechanism and control of breathing.
  - (b) Transport of Oxygen and Carbon dioxide.
4. Digestion and absorption of dietary constituents.
5. Physiology of urine formation and acid base balance.
6. Physiology of muscle contraction(Skeletal muscles).
7. Physiology of nerve conduction and synaptic transmission(Neuronal function).

**Paper- 15<sup>TH</sup> (ZOO – 615C)**

**Full Marks: 100**

**Developmental Biology**

1. Gametogenesis.
2. Fertilization.
3. Parthenogenesis.
4. Types of eggs and pattern of cleavage and significance.
5. Process of gastrulation in frog and chick.
6. Development of chick upto three germ layers.
7. Development and functions of extra embryonic membranes in chick
8. Organogenesis of heart, brain and eye in chick.
9. Placenta in mammals.

**A. PRACTICAL :- 75**

**Applied and Economic Zoology**

Comment upon the economic importance of specimens provided-

- (i) Life cycle of silk worm
  - (ii) Honey bee
  - (iii) Lac insects
  - (iv) Fishes-*Labeo, Catla, Channa, Clarias, Mystus, Heteropneustes* .
  - (v) Survey of animals of your locality having economic importance
- a brief survey report

**Immunology**

- 1. Determination of human blood group
- 2. Principles of ELISA

**Mammalian Physiology**

- 1. RBC total count.-Frog
- 2. WBC total count.-Frog
- 3. Estimation of Haemoglobin-Frog
- 4. Bleeding and clotting time.
- 5. Preparation and staining of blood film and interpretation of result after light microscopy

**Developmental Biology: Slides-**

- (i) Morula, Blastula, Gastrula of frog
- (ii) Whole mount of-chick embryo-18, 24,33,48,72 and 96 hrs

**A. PROJECT :- 25**

Will be decided & assigned by faculty members



## Skill Enhancement Course (SEC)

### Semester III

#### SEC – 1

#### Fish Farming

Credit 2

Teaching Hrs – 24

FM – 50

UNIT – 1 -

Fish resources in India

UNIT – 2

Induced breeding and seed production of carps

UNIT – 3

Polyculture of fin fishes and exotic fishes (Methods Problem and Precaution)

UNIT – 4

Fish By Product

UNIT – 5

Fish Diseases (Pathogen Symptoms and control)

Semester IV  
SEC – 2  
Vermi-culture & composting  
Teaching Hrs.– 24

Credit 2

FM–50

- UNIT – 1 : Physical properties of the soil – texture, colour and types of soils, soil organisms.
- UNIT – 2 : Chemical properties of soil – pH, Conductivity, organic matter, Nitrogen, Phosphate and Potassium.
- UNIT – 3 : Composting – anaerobic composing, aerobic composing, vermin compost – earthworm species used.
- UNIT – 4 : Vermicompost and role of vermicompost in organic farming – its quality and advantages over chemical inputs.

Semester V  
SEC – 3  
Museum- Collection & Preservation  
Credit 2                      Teaching Hrs – 24                      FM–50

- UNIT – 1 : Preservative – Types of preservatives, their preparation  
UNIT – 2: Collection – Equipments used in collection (Insect Net, Aspirator,),  
Methods of Collection.  
UNIT – 3 : Storage and preservation of specimens  
UNIT – 4 : Taxonomic documentation  
UNIT – 5 : Maintenance of Museum Specimens

Semester VI  
SEC – 4  
Aquarium & Fish Keeping  
Teaching Hrs. – 24

Credit 2

FM – 50

- UNIT – 1 : Scope of aquarium fish as a Cottage Industry. Exotic and Endemic species of Aquarium fishes.
- UNIT – 2 : Common Characters and sexual dimorphism of fresh water and marine Aquarium fishes.
- UNIT -3 : Food and feeding of Aquarium fishes – Use of live fish feed organisms. Preparation and composition of fish feed.
- UNIT – 4 : Live fish transport – Fish handling Packing and transport techniques
- UNIT – 5 : General Aquarium maintenance – budget for setting up an aquarium fish farm as a cottage industry.

## Semester II

Teaching Hrs. – 60

FM – 75

Credit - 4

Ability Enhancement Compulsion Course – (AECC)

### **Environmental Science**

UNIT – 1 : General Concept

1.1 Components of ecosystem.

1.2 Energy flow in ecosystem.

1.3 Food chain and food web.

1.4 Biogeochemical cycle.

1.4.1 Water cycle

1.4.2 Carbon cycle and Nitrogen cycle

UNIT – 2 Population communities

2.1 Population characteristics – Density, Natality, Mortality

2.2 Nature, Structure and attributes of biological communities

2.3 Ecological succession and concept of climax

UNIT – 3 Pollution

3.1 Sources of impact of environmental pollutants – air, water and soil.

3.2 Global environmental changes – Green house gases and their effects

3.3 Acid rain and global warming

UNIT-4 Natural resources

4.1 Soil, water, mineral resources and their conservation

4.2 Biodiversity – Benefits, hotspots, threats and conservation

4.3 Human impact on mineral resources.

4.4 Renewable and non renewable source of energy.

## **Practical Environmental Science**

Credit – 2

Hours of working – 30

FM-25

Time – 1.30 Hrs.

1. Ecological practical –	10
2. Spotting	
a. Slides	02 x 2 = 04
b. Specimen	02 x 3 = 06
3. Practical record and viva	05
	<hr/>
	25

List of suggested practical

1. Estimation of dissolved oxygen
2. Estimation of free carbon dioxide.
3. Study of food chain through model.

**S.K.M.UNIVERSITY, DUMKA**  
**B.Sc.: ZOOLOGY (Subsidiary /General) SEMESTER SYSTEM**

**ABSTRACT OF SYLLABUS**

Year	Semester	T H E O R Y			P R A C T I C A L			MARKS (T + P )
		PAPE R	COURSE TITLE	FULL MARKS	MODEL OF QUESTIONS			
1 <sup>st</sup> yr ( S/G )	SEM. -I	Z-101	A.Animal Diversity(Non chordate)-I  B. Animal behaviour	75	S N	Model of questions	Marks	100
					1	Dissection	4	
					2	Mounting	2	
					3	Spotting:4(slides-2 +specimens-2)	6	
					4	Animal behaviour	4	
					5	Viva	5	
					6	Collection/Record	4	
				T o t a l	25			
	SEM.II	Z-202	A.Animal diversity(Non chordates) – II)  B.Ecology	75	SN	Model of questions	Marks	100
					1	Dissection	4	
					2	Mounting	2	
					3	Spotting:4 (Slides-2 + specimens-2)	6	
					4	Ecology	4	
					5	Viva	5	
6					Collection/Record	4		
			T o t a l	25				
2 <sup>nd</sup> yr ( S/G )	SEM-III	Z-303	A. Animal Diversity(Chordat es) B. Endocrinology	75	SN	Model of questions	Marks	100
					1	Dissection	4	
					2	Mounting	2	
					3	Spotting:4(slides- 2+specimens-2+Bones- 2)	6	
					4	Endocrinology (slide)	4	
					5	Viva	5	
					6	Collection/Record	4	
				T o t a l	25			
	SEM-IV	Z-404	A.Evolution B.Palaeotology C.Genetics D.Molecular Biology	75	SN	Model of questions	Marks	100
					1	Dissection	4	
					2	Evolution/Palaeontology :1	4	
					3	Spotting:4(specimens- 2+Bones-2)	4	
					4	Genetics : 1	4	
					5	Viva	5	
6					Collection/Recoed	4		
			T o t a l	25				
3 <sup>rd</sup> yr ( G )	SEM-V	Z-505	A.Toxicology B.Biochemistry c.Biotechnology D.Applied & Economic zoology	75	SN	Model of questions	Marks	
					1	Biochemistry:1exp	5	
					2	Applied & economic zoology: 2	5	
					3	Project	8	
					4	Collection/Record	3	
					5	Viva	4	
	SEM-VI	Z-606	A.Cell biology B.Developmental biology C.Maamalian physiology D.Immunology	75	S N	Model of questions	Marks	
					1	Cell biology: 1	4	
					2	Mammalian physiology:1	4	
					3	Developtmental biology: 1	2	
					4	Project	8	
					5	Collection/Record	3	
					6	Viva	4	
			T O T A L	25				

**S.K.M.UNIVERSITY, DUMKA**

**B.Sc. ZOOLOGY (subsidiary /General) SEMESTER SYSTEM**

**1<sup>ST</sup> YEAR (SUBDIDIARY/ GENERAL)**

**SEMESTER: I**

**THEORY**

**PAPER: 1<sup>ST</sup> (Z-101)**

**FULL MARKS: 75**

**A. Animal Diversity (Non chordates): I**

1. Principles of classification: Silient features and classification up to Orders.
2. Protozoa : Type study – Entamoeba histolytica
3. Porifera : Type study – Scypha
4. Coelenterata : Type study – Obelia
5. Helminthes : Type study – Faciola hepatica
6. Annelida : Type study – Earthworm

**B. Animal behavior**

1. Innate and learned bahaviour
2. Social behavior in insects

**PRACTICAL**

**FULL MRKS: 25**

**LIST OF PRACTICALS**

**1. DISSECTION : Earthworm**

**2. MOUNTING**

Earthworm: Setae, Spermatheca, Septal nephredia

**3. STUDY OF SLIDES**

- a. Protozoa : Amoeba ,Entamoeba, Paramecium
- b. Porifera : Spicules, Gemule , T.S & L.S. of Sycon
- c. Coelenterata : W.M., T.S & L.S. of Hydra

**4. STUDY OF SPECIMENS**

- a. Porifera : Sycon
- b. Coelenterata : Aurelia , Porpita , Physalia
- c. Helminthes : Fasciola hepatica, Liver fluke , Ascaris
- d. Annelida : Earthworm , Leech

**5. ANIMAL BEHAVIOUR : Study of specimens showing parental care in Fishes / Amphibia**



**SEMESTER: II**  
**THEORY**  
**PAPER: 2<sup>ND</sup> (Z-202)**

**Full Marks: 75**

**A. Animal diversity(Non chordate) – II**

1. Arthropoda : Type study – Prawn
2. Mollusca : Type study – Pila
3. Echinodermata : Type study – Asterias
  
4. Ecology
  - i. Ecosystem: Definition, structure & function of a typical ecosystem
  - ii. Biogeochemical cycles
  - iii. Concept of flow of energy

**PRACTICAL**  
**LIST OF PRACTICALS**

**FULL MARKS : 25**

**A. DISSECTION:**

- B. Prawn : Nervous system
- C. Pila : Nervous system

**D. Mounting :**

1. Pila : Osphradium , Radulla

**E. Study of Permanent slides :**

1. Helminthes : Ascaris – T.S. of Body wall ( Male & female)
2. Annelida : Earthworm : T.S. of body wall, pharynx, Gizzard

**F. Study of specimens**

1. Arthropoda : Limulus, Scorpion , Julius, Prawn, Praying mantis, Dragon fly
2. Mollusca : Unio , Pila , Chiton , Octopus, Sepia
3. Echinodermata : Starfish

**G. Ecology :**

Limnological studies of Pond : Temperature , pH , Dissolved oxygen , turbidity, Planktonic studies

## **2<sup>nd</sup> YEAR (SUBDIDIARY/ GENERAL)**

**SEMESTER: III**

**THEORY**

**PAPER: 3<sup>RD</sup> (Z-303)**

**FULL MARKS: 75**

### **A. Animal Diversity-Chordates**

Protochordata- Amphioxus-general organization

Type study-Bony Fish

Amphibia-classification up to order

Reptilia- classification up to order

Mammalia:Prototheria and metatheria

### **B. Endocrinology**

Anatomy, histology and nature and function of hormones secreted by Pitutary, Thyroid, Adrenal, Gonad and Islets of langerhans.

## **PRACTICAL**

**FULL MRKS: 25**

### **LIST OF PRACTICALS**

#### **1. DISSECTION:**

Dog fish: General anatomy, Afferent and efferent blood vessels,

#### **2. MOUNTING**

Placoid, Cycloid, Ctenoid scales of fishes

#### **3. STUDY OF SLIDE:** Placoid, Cycloid, Ctenoid scales of fishes

#### **4. STUDY OF SPECIMENS**

Fishes: - Torpedo, Hammer headed shark, Hippocampus, Exocoetus, Sucking fish,

Anabas testudeneus, Channa punctatus, Clarias

batrachus, Heteropneustes fossilis, Catla catla, Labeo rohita

Amphibia: - Ichthyophis, Hyla,

#### **5. OSTEOLOGY:** Study of vertebrae & Limb bones of Amphibia, Reptilia, Aves and Mammal

#### **6. ENDOCRINOLOGY:** Histological slide of endocrine glands

**SEMESTER: IV**

**THEORY**

**PAPER: 4<sup>TH</sup> (Z -404)**

**FULL MARKS: 75**

**A. Evolution:** Lamarckism, NeoLamarckism, Darwinism and Neo Darwinism.

**B. Palaeontology :** Fossils and methods of fossil formation.

**C. Genetics**

1. Concept of Mendelism and Mehdel's laws.
2. Linkage and Crossing over.

**D. Molecular Biology**

1. DNA-structure and types
2. RNA-its various types.
3. Protein synthesis.

**PRACTICAL**

**FULL MARKS: 25**

**LIST OF PRACTICALS**

**DISSECTION:** Dog fish: Cranial nerves (5<sup>th</sup>, 7<sup>th</sup>, 9<sup>th</sup>, 10<sup>th</sup>.)

**EVOLUTION**

1. Homology & analogy as shown by wings of bird, bat and butterfly

**PALAEONTOLOGY:** study & comment upon fossil or model of fossil provided

**STUDY OF SPECIMENS**

Reptilia: Draco, Python, Bungarus, Naja

Aves: Pigeon

Mammal: Bat

**GENETICS**

Calculation & interpretation of result of sample data showing : Mendelian Monohybrid cross & Dihybrid cross

**Osteology-**

a. Study of skull bones of Amphibia, Reptilia, Aves and Mammal

### **3<sup>rd</sup> YEAR (GENERAL)**

**SEMESTER: V**

**THEORY**

**PAPER: 5<sup>TH</sup> (Z -505)**

**FULL MARKS: 75**

**A. Toxicology:** Introduction, basic concepts of Toxicology

**B. Biochemistry**

1. Carbohydrates- structure, classification and significance
2. Protein -structure, classification and significance.
3. Lipids- structure, classification and significance

**C. Biotechnology:** Introduction and scope of biotechnology

**D. Applied and Economic Zoology**

1. Pisciculture
3. Sericulture
4. Lac culture
5. Apiculture

**PRACTICAL**

**FULL MARKS: 25**

#### **LIST OF PRACTICALS**

**Biochemistry**

1. Tests for carbohydrates- Benedict's test
2. Tests for proteins-Biuret test
3. Tests for lipids-solubility test

**Applied and Economic Zoology**

Comment upon the economic importance of specimens provided-

- (i) Life cycle of silk worm
- (ii) Honey bee
- (iii) Lac insects
- (iii) Fishes-*Labeo, Catla, Channa, Clarias*

**PROJECT: Will be decided & assigned by faculty members**

**SEMESTER: VI**  
**THEORY**  
**PAPER: 6<sup>TH</sup> (Z- 606)**

**FULL MARKS: 75**

**A. Cell Biology:**

Structure and functions of various cell organelles-Plasma membranes, Endoplasmic reticulum, Mitochondria, Golgi complex, Ribosomes, Lysosomes, Chromosome, Cell cycle

**B. Developmental Biology**

1. Development of chick upto three germ layers.
2. Development and functions of extra embryonic membranes in chick

**C. Mammalian Physiology**

1. Transport of Oxygen and Carbon dioxide.
2. Digestion and absorption of dietary constituents.
3. Physiology of urine formation and acid base balance

**D. Immunology**

1. Introduction and scope of Immunology.

**PRACTICAL**

**FULL MARKS: 25**

**LIST OF PRACTICALS**

**Cell Biology**

1. Demonstration of Mitochondria in human buccal epithelium-vital staining by Janus green.
2. Demonstration of secretory granules-salivary gland of Cockroach-by neutral red
- 3. Mitotic and Meiotic Metaphase cell plate preparation in onion root tip and grasshopper testis respectively**

**Mammalian Physiology**

1. Bleeding and clotting time.
2. Preparation and staining of blood film and interpretation of result after light microscopy

**Developmental Biology**

Study of Whole mounts of-chick embryo-24, 48, 96 hrs

**PROJECT: Will be decided & assigned by faculty members**

## **LIST OF RECOMMENDED BOOKS**

### **INVERTEBRATE**

1. Barnes, R.D. Invertebrate Zoology -(W.B. Saunders Co.)
2. Hyman, L.H. : The Invertebrates Vol. I & II (McGraw Hill)
3. Invertebrate structure and function : Barrington (Nelson)
4. Kotpal, Agarwal & Khetrapal : Modern Textbook of zoology: Invertebrate (Rastogi publication)
5. R.L. Kotpal : Invertebrate series – Protozoa to Minor phyla : (Rastogi publication)

### **CHORDATES & COMPARATIVE ANATOMY**

1. The Chordates - Alexander, R.M. (Cambridge University Press)
2. The Chordates - Monath, A. R. (Cambridge University Press)
3. Chordata - Structure and Function - Waterman, A. J. (Mac Millan Co.)
4. Young, J.Z. : Life of Vertebrates (Oxford University Press)
5. Hildebrand : Analysis of vertebrates Structure (Wiley)
6. Kingsley : Outline of Comparative anatomy (Central Book Depot)
7. George C. Kent & Larry Miller : Comparative Anatomy of the Vertebrates (W.C.B. Publisher)
8. Noble, G.K., The Biology of the Amphibia (New York)
9. Protochordata – O.P. Saxena (S. Chand & Co. Ltd.)

### **MOLECULAR BIOLOGY & CELL PHYSIOLOGY**

1. Cell and Molecular Biology - De Robertis and De Robertis (Sander's College)
2. Cell Physiology - A. Geese
3. Manual of Laboratory Exp. in Cell Biology (W.C. Brown publishers)
4. Molecular Biology of the Gene - Watson, J.D et al (Benjamin/ Cummings)
5. Molecular Biology - Glick College Zoology: Boolotian and Stiles (Mac Millan)
6. Molecular Cell Biology - J. Darnell et al, American Book. Inc. U.S.A.
7. Molecular Biology of the Cell - B. Alberts, et. al. Garland Publishing. Inc. New York.
8. Jha, A.P. Genes and Evolution, John Pub. N. Delhi.
9. Introduction to Practical Molecular Biology, P.O. Dabre, John Wiley & Sons Ltd.

N. York.

10. De Robertis and De Robertis : Cell and Molecular Biology (Sauders College)
11. Edward Gasque: Manual of Laboratory Exp. In cell biology (MacMillan)
12. Lodish et.al. : Molecular Cell Biology (Freeman)

### **ANIMAL PHYSIOLOGY**

1. Animal Physiology - Eckert, R. (W. H. Freeman)
2. Review of Medical physiology, Ganong (Lange)
3. Reproductive Physiology - (Nalbandov, A.V.)
4. General & Comparative Physiology - Hoar (Prentice Hall)
5. Animal Physiology - Neilsen (Cambridge)
6. Comparative Animal Physiology - Prosser (Satish Book Enterprise)

### **BIOCHEMISTRY**

1. Biochemistry : Stryer, L. (Freeman)
2. Outline of Biochemistry: Cornet (Wiley)
3. Biologist's Guide to Principles & Techniques of Practical Biochemistry, K. Willson & K.H. Goulding. ELBS Ed.
4. Rummel, L. Practical Biochemistry, Tata Mac Graw.

### **ENDOCRINOLOGY**

1. Endocrinology - Hadley.
2. General Endocrinology - Bagnara, and Turner (W.B. Saunders)
3. Endocrinology - Hadley' (Prentice Hall)
4. E.J.W. Barrington - General & Comparative Endocrinology, Oxford, Clarendon Press.
5. P.J. Bentley, Comparative Vertebrate Endocrinology, Cambridge University Press.
6. R.H. Williams - Text Book of Endocrinology. W.B. Saunders.
7. C.R. Martin - Endocrine Physiology, Oxford.
8. A. Gorbman et al. Comparative Endocrinology. John Wiley & Sons

## **EVOLUTION**

1. Introduction to Evolution - Moody (Indian Ed)
2. Evolution - Savege - (Holt, Reimhart, Winston)
3. Natural History & Evolution. Chapman & Hall. N. York
4. King M. - Species Evolution, The Role of Chromosomal change, The cam, Univ, Press.
5. Strik Berger, M.W. Evolution, Jones & Bartett. Publishers, Boston, London
6. Dobzhansky, Ayala, Stenbbsins & Valentine : Evolution (WH Freeman)
7. Dobzhansky : Genetics & Origin of Species (Columbia University Press)
8. Major : Population, Species & Evolution
9. White : Animal Cytology & Evolution
10. Berrill, N.J. : The Origin Of Vertebrates
11. Colbert, E.H.: Evolution of the vertebrates
12. Romer, A.S.: Vertebrate Palaeontology (University of Chicago Press)
13. An Introduction to Palaeontology –A.P. Tyagi (S.Chand & Com.LTD)

## **ECOLOGY**

1. Ecology - Odum (Amerind)
2. Fundamentals of Ecology - Odum - (Saunders)
3. Ecology - Ricklets (W.H. Freeman)
4. Krebs. C.J. Ecology - Harpar & Row, -N. York.
5. Krebs. C.J. Ecological methodology, Harpar & Row, N. York.

## **GENETICS**

1. .Genetics (Mac Millan) - Strikberger
2. Genetics - Farnsworth (Harper & Raw)
3. Principles of Genetics : E.J. Gardner, M.J. Simmons & D.P. Snustand (John Wiley & Sons, INC)



## **BIOTECHNOLOGY**

1. Principles of Gene Manipulation - An introduction to genetic engineering - R.W. Old, and S.B. Primrose.) (VCH, Publishers)
2. Molecular Biology & Biotechnology - R. A. Meyers (ed)
3. Glick : Molecular Biotechnology
4. Animal Cell Culture –A Practical Approach ,Ed.John R.W.Masters,IRL - Press

## **EMBRYOLOGY**

1. Introduction to Embryology - Balinsky (CBS College publishers)
2. Developmental Biology - Biology - Berril, N. J. (Tata- Mc Graw Hill)
3. An outlines of Animal Development, -Davenport (Addison - Werley)
4. Biology of Developmental system - Grant
5. Developmental Biology - Subramaniyan, T (Narosa publishing House)
6. Development Biology - A Modern Sythesis, Rao, K.V. (oxford, IBM, Publishers)
7. Schatten & Schatten - Molecular Biology of Fertilization.
8. F.T.Longo - Fertilization, Chapman & Hall
9. Developmental Biology - Gilbert (Sinour)
10. Gilbert : Developmental Biology
11. Chordate Embryology : Verma & Agarwal : S.Chand & Com.LTD)

## **GENERAL**

1. Biology - (Benzamin) Campbell Text book of Zoology,
2. Text Book of Applied Entomology - Srivastava (Kalyani Pulishers)
3. Invertebrate structure and Function - Barrington (Nelson)
4. College Zoology - Boolootin & Stiles ( Mac Millan)
5. A manual of Zoology - Part - I Invertebrate -Ekambernath I Year (5. Vishwanathan)
6. Integrated Principles of Zoology - Hickman, Robert and Hickman( Timer - Mirror Mosby)
7. A life of Invertebrates - Russel - Hunter (Mac Millan)
8. .Russei - Hunter, W.D. A Biology of Higher Invertebrates.
9. Read, C.P. Animal Parasitism Prentice Hall Inc. New – Jersey

10. Gruch' G.C.-Clinical haematology in Medical Practice. (Eds. D. Penigton, B. Rush and P. Castaldi) (1984)
11. Saidapur, S.K.: Reproductive Cycle (Allied Publishers)
12. Nalbanov, A.V., Reproductive Physiology
13. .13. Welch : Limnology (McGraw Hill)
14. Marshall and Williams : Text book of zoology
15. Wolfe : Biology the Foundations (Wadsworth)
16. Parker & Haswell : Text Book of Zoology Vol. I & II (McMillan)
17. Gee, E.P.: The Wild life of India (Collins, London)
18. Cell Biology, Genetics, Evolution & Ecology: P.S. Verma & V.K. Agarwal : S. Chand & Co. LTD)

### **BIO- DIVERSITY & TAXONOMY**

1. M. Kato - The Biology of Bio-diversity, Springer
2. E.O. Wilson - Biodiversity, Academic Press, Washington
3. G. G. Simpson - Principles of Animal Taxonomy. Oxford IBH, Publishing Co.
4. E. Mayer. Elements of Taxonomy.
5. E.O. Wilson, The Diversity of Life (The College Edition) W. W. Northern & co.
6. B.K. Tikador - Threatened Animals of India ZSI Publication, Calcutta,

### **BIOSTATISTICS**

1. Batschelet E. Introduction to Mathematics for life Scientist, Springer-Verlag Berlin.
2. Sokal, R.R. and F.J. Rohlf, Biometry (Freeman)
3. Sendecor, G.W. & W. G. Cochran. Statistical Methods, Affiliated East west Press, New Delhi. (Ind. ed)
4. Murray, J. D. Mathematical Biology, Springer - Verlag, Berlin

### **Applied & Economic Zoology**

1. Economic Zoology - Shukla & Upadhyaya (Rastogi Publishers)
2. Economic Zooiogy - VenKitaraman (Sudarsane Publishers)
3. Economic Zoology- Ahsan & Sinha (S.Chand & Company LTD)

### **ANIMAL BEHAVIOUR**

1. Animal Behaviour, An evolutionary approach, U.S. A.
2. Glutton - Brock, T.H., The evolution of Parental Care, Princeton University Press - U.S.A.
3. Krebs, J.R. and N.B. Davis, Behavioural Ecology, Blackwell, Oxford U.K.
4. Drickamer & Vessey :Animal Behaviour, concepts, Processes and Methods (wadsworth)
5. Grier : Biology of animal Behaviour (Mosby College)
6. Animal Behaviour: Reena Mathur ,(Rastogi Publication)

### **IMMUNOLOGY**

1. Kuby - Immunology W.H.Freeman, USA.
2. W.Paul - Fundamentals of Immunology.
3. I. M. Roitt - Essential Immunology ELBS edition. Molecular Biology:

**SIDO-KANHU MURMU UNIVERSITY,**  
DUMKA - 814101 (Jharkhand)



**SYLLABUS FOR PSYCHOLOGY**  
**B.A.(HONS.)**

### Semester I

Paper		Total Marks		Distribution of marks mid and end semester			
		FM	PM	Mid-Semester		End-Semester	
				FM	PM	FM	PM
Foundation of Psychology	C.C-1.T	75	40%	20% of total marks	40%	80% of total marks	40%
Statistical method for psychological research.	C.C-2.T	75	40%	20% of total marks	40%	80% of total marks	40%
Practical - I	C.C-1&2P	50	40%	20% of total marks	40%	80% of total marks	40%
*General Psychology	GE-1.T	75	40%	20% of total marks	40%	80% of total marks	40%
*Practical - II	GE-1P	25	40%	20% of total marks	40%	80% of total marks	40%
AECC	AECC-1	50	40%	20% of total marks	40%	80% of total marks	40%

**\* Not for Psychology Honors students.**

Psychology Honors student will choose G.E. of any one of the following subjects.

- (i) History.
- (ii) Geography.
- (iii) Political Science.
- (iv) Economics.
- (v) Anthropology.
- (vi) Sociology.

## **Foundations of Psychology.**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1: Introduction:**

- (a) What is psychology?
- (b) Methods of psychology
- (c) Subfields of psychology
- (d) Psychology in modern India.

### **Unit 2 : Perception:**

- (a) Perceptual processing.
- (b) Role of attention in perception
- (c) Perceptual organization
- (d) Perceptual sets
- (e) Perceptual constancies
- (f) Depth perception,
- (g) Distance and movement
- (h) Illusions.

### **Unit 3 : Learning and Motivation:**

- (a) Learning concept.
- (b) Theories of learning.
  - \* Thorndike.
  - \* Pavlov.
  - \* Tolman.

- (c) Motivation: Concept and types.
- (d) Role of motivation in learning.
- (f) Motivational conflicts.

#### **Unit 4: Memory**

- (a) Concept
- (b) Type of memory
- (c) Difference between LTM and STM
- (d) Forgetting: Nature and Causes.

#### **Readings List :**

Baron, R. and Misra, G. (2013). Psychology. New Delhi: Pearson.

Chadha, N.K. and Seth, S. (2014). The Psychological Realm: An Introduction. New Delhi. Pinnacle Learning,

Ciccarelli, S. K. and Meyer, G. E. (2010). Psychology- New Delhi Pearson Education.

Passer, M.W. and Smith, R.E. (2010). Psychology: The science of mind and behaviour New Delhi: Tata McGraw-Hill.

Md. Suleman (2012) : Adhunic samanya Manougyan. Patna: Motilal Banarsidas.

Sing, A. K (2012). Adhunic samanya monavigyan. Patna: Motilal Banaridas.

# **Statistical Methods for Psychological Research Statistics**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

## **Unit 1 : Introduction:**

- a. Meaning and nature of statistics.
- b. Importance and Utilities of statistics in psychology
- c. Types of statistics.
- d. Difference between Psychological and Physical measurement.

## **Unit 2: Graphic representation of frequency distributions**

- a. The Histogram.
- b. The Frequency Polygon.
- c. The Cumulative frequency Curve.

## **Unit 3: Central Tendency:**

- a. The Mean.
- b. The Median.
- c. The Mode.
- d. Calculation of mean, median, mode.

## **Unit 4: Measurement of Variability:**

- a. The range.



- b. Deviational measures.
- c. Properties of the Standard Deviation.
- f. Calculation of SD.

### **Readings List :**

Garrett, H.E. (2010). Statistics in Psychology and Education. New Delhi: Surjeet Publication.

Hussain, Shamshad (2010). Statistics in Psychology Patna: Motilal Banarsidas.

Suleiman, Md. (2012). Shikha and Manovigyan me shankhiki. Patna: Motilal Banarsidas.

Singh, A.K. (2012). Shiksha aum Manovigyan Me Shankhiki. Patna: Motilal Banarsidas.

## **Practical – I**

Time 4 Hours

Full Marks 35

(for end semester)

Marks distribution experiment – 25 vive-voci- 5N. B.-5

Four questions will be set out of which candidates be required to answer two questions

### **1. Sensory-Motor Learning:**

*Effect of practice on sensory-motor learning.*

- (a) Bi-lateral transfer. (Positive transfer)
- (b) Habit-interference (negative transfer)

### **2. Verbal Learning:**

Memorising non-sense syllable by the methods of:

- (a) Simple reproduction.
- (b) Serial reproduction.

## **Reading List**

Mohsin, S.M. (1982). Experiments in psychology.

Sulaiman, M. (1996). Manovigyanik prayog aur parikshan.

## **General Psychology**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1: Introduction:**

- (a) Definition
- (b) Goals of psychology.

### **Unit 2: Methods of Psychology:**

- (a) Experiment.
- (b) Interview.
- (c) Observation.

### **Unit 3: Audio-visual Processes:**

- (a) Structure.
- (b) Function.

### **Unit 4: Perceptual Processes:**

- (a) Processes involved.
- (b) Perceptual Organization.
- (c) Gestalt view.
- (d) Social and personal factors in perception.

### **Reading List:**

Wood, S.E. and Wood, E.G. (1996): The world of Psychology: New York: Allyn-Bacon.

Rahman, A. (1998): Samanya Manovigyan Vishay aur Viyakhya: Motilal Banarasi Das.

Sulaiman, Md (1996): Uchhtar Samanya Manovigyan: Patna: Motilal Banarsidas.

## **Practical – II**

Time 4 Hours

Full Marks 35

(for end semester)

Marks distribution experiment – 25 vive-voci- 5N. B.-5

Four questions will be set out of which candidates be required to answer two questions

### **1. Verbal learning:**

- (a) Prompting and anticipation.
- (b) Paired association.

### **2. Method of Learning.**

- (a) Massed vs Distributed.
- (b) Part vs Whole.

### **Reading List:**

Sinha R.R.P and Mishra, B.K. (1984). Manovigyan Mein Prayog ewam Sankhiyeki Patna: Bharati Bhawan.

Sulaiman, Md. (1996): Manovigyanik prayog aur Parikshan. Patna: Motilal Banarsidas.

Mohsin., S.M. (1982). Experimental Psychology Patna Motilal Banarasi Das.

## Semester II

Paper		Total Marks		Distribution of marks mid and end semester			
		FM	PM	Mid-semester		End-Semester	
				FM	PM	FM	PM
Bio Psychology	C.C-3.T	75	40%	20% of total marks	40%	80% of total marks	40%
Educational Psychology - I	C.C-4.T	75	40%	20% of total marks	40%	80% of total marks	40%
Practical - I	C.C-3&4P	50	40%	20% of total marks	40%	80% of total marks	40%
*Youth gender and identity	GE-2.T	75	40%	20% of total marks	40%	80% of total marks	40%
*Practical - II	GE-2P	25	40%	20% of total marks	40%	80% of total marks	40%
AECC-2	AECC-2	50	40%	20% of total marks	40%	80% of total marks	40%

**\* Not for Psychology Honors students.**

Psychology Honors students will choose G.E. of any one of the following subjects.

- (i) History.
- (ii) Geography.
- (iii) Political Science.
- (iv) Economics.
- (v) Anthropology.
- (vi) Sociology.

## **Biopsychology**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit I : Introduction to biopsychology**

- (a) Nature.
- (b) Scope.
- (c) Methods.
- (d) Ethics.

### **Unit 2: The functioning brain:**

- (a) Structure.
- (b) Functions of neurons.
- (c) Neural conduction.
- (d) Synaptic transmission.
- (e) Organization of nervous systems.

### **Unit 3. Behavioral regulations:**

- (a) Biological basis of learning and memory.
- (b) Functional abnormalities of neurotransmitter.
- (c) Dopamine and serotonin hypothesis.
- (d) Neuroendocrine system and development of brain behavior.

#### **Unit 4. Heredity:**

- (a) Meaning of Heredity.
- (b) Basic genetic Principles.
- (c) Law of Heredity.
- (d) Importance of Heredity.

#### **Reading List**

Breedlove, S. M., Rosenzweig, M. R. and Watson, N. V. (2007) Biological Psychology: An introduction to behavioral, cognitive, and clinical neuroscience, (5<sup>th</sup> Edition). Sunderland, Massachuset.

Carlson, N. R. (2009) Foundations of Physiology, (6<sup>th</sup> Edition). New Delhi: Pearson Education.

Pinel, J. P. (2011) Biopsychology (8<sup>th</sup> Edition). New Delhi. Pearson Education.

Singh, A.K. (2014). Neuro-psychology. Patna: Motilal Banarsidas.



## **Educational Psychology – I**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1: Educational Psychology.**

- (a) Concept.
- (b) Aims.
- (c) Scope.
- (d) Significance.

### **Unit 2: Education for special children.**

- (a) Concept.
- (b) Adjustment.
- (c) Education of mentally retarded children.

### **Unit 3: Educational technology and programmed learning.**

- (a) Meaning.
- (b) Important.
- (c) Nature of programmed learning.
- (d) Skinner view points of programmed learning.

### **Unit 4: Class room Management.**

- (a) Ecology of Classroom.
- (b) Social psychology of classroom.
- (c) Discipline.
- (d) Communication.

### **Reading List**

Divesta and Thompson (1985). Educational Psychology. New York: Appleton-Centry.

Fraudsem, AN (1961). Educational Psychology. New York Mc Graw Hill.

Lindgren, H. (1976). Educational Psychology in the Classroom. Hong Kong : John Willey.

Rao, S. Narayan (2002). Educational Psychology. New Delhi: New Age International (P) Limited Publishers.

S. S. Chauhan (1984). Advanced Educational Psychology. New Delhi: Vikas Publishing House Pvt. Ltd.

Skinner, CE (2002) Educational Psychology. New Delhi: Prentice Hall of India Ltd.

Suleman, M. and Sinha, R.K. (2005). Uchchatar Shiksha Manovigyan. Patna; Motilal Banarsidas. (In Hindi).

Singh, AK (2007). Shiksha Manovigyan. Patna: Bharti Bhawan. (In Hindi)

## **Practical**

Time 4 Hours

Full Marks 35

(for end semester)

Marks distribution experiment – 25 vive-voci- 5N. B.-5

Four questions will be set out of which candidates be required to answer two questions

### **Test of Intelligence**

1. Alexander's test Battery of intelligence (Pass Along, koh's Block Design, Cube Construction.)
2. Mohsin's General Intelligence Test.
3. Jalota's test of Intelligence.
4. Raven Progressive Matrices.

### **Reading List:**

Sinha, R.R.P (2001). Manovigyan me prayog, Parikchan aur Snakhiyeki.

Sulaiman, M (1999). Manovigyan Prayog aur parikcahn. Patna: Motilal Banarsidas.

Anastasi A. (1988). Psychological Testing .New York: McMillan.

## **Youth, Gender and Identity**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1:**

- (a) Defining concepts of youth.
- (b) Exploring youth, relationships and gender dynamics: peers, families and personal relationships

### **Unit 2:**

- (a) The impact of music and gendered ideology.
- (b) Young people, celebrities and identity formation.

### **Unit 3:**

- (a) Criminalization, young people and labeling ideologies.
- (b) The impact of globalization on youth identities.

### **Unit 4:**

- (a) Vulnerability and inequality and its impact on identity development.
- (b) The self worth of youth.

### **Reading List:**

Ahmed, L (1992). Women and gender in Islam. Yale university press.

Alexander, C.E. (2000) The Asian Gang: Ethnicity, identity, masculinity. Berg: Oxford International Publishers Ltd.

Aronowitz (1992) The Politics of Identity. Routledge.

Back, L. (1996) New Ethnicities and Urban Culture: Racism and Multicultural in Young lives. Routledge and Taylor Francis Group.

Castells, M (1997) The Power of Identity. Blackwell.

Craib, I (1998) Experiencing Identity. Sage Publications Ltd.

Frosh, S, Phoenix, A and Pattman, R. (2002) Young. Masculinity Palgrave. Macmillan.

Griffin, C, (1993) Representations of Youth. Polity Press.

Hamilton, M (2008) What's happening to our girls? Viking-Imprint of Penguin Books.

Horrocks, R. (1995) Male, Myths and Icons; Masculinity in popular culture. New York: Macmillan Press Ltd.

McDonald, R and Marsh, J (2005). Disconnected Youth? Growing up in Britain's Poor Neighbourhoods. Palgrave Macmillan.

McRobbie, A (1990) Feminism and Youth Culture. Macmilan Basingstoke.

Nayak, A. (2003) Race, Place and Globalisation: Youth Culture in a changing world. Berg Publishers Ltd.

Roche, J and Tucker, S, (1997) Youth in Society. Buckingham: Open University Press  
Websites. [www.infed.org.uk](http://www.infed.org.uk). [www.nya.oreg.uk](http://www.nya.oreg.uk)

## **Practical**

Time 4 Hours

Full Marks 35

(for end semester)

Marks distribution experiment – 25 vive-voci- 5N. B.-5

Four questions will be set out of which candidates be required to answer two questions

1. Moudsley Personality Inventory.
2. Mohsin's Bell Adjustment Inventory.
3. Word Association Test.
4. Sinha Comprehensive Anxiety Scale.

### **Reading List:**

Groth- Marnat, Garry (2005). The Handbook of Psychological Assessment ( 4 Ed). New York: John wiley and Sons.

Suleman, M. (2012) Manovigyan Mein Prayog aur Parikshan. Patna: Motilal Banarsidas.

Singh, A.K. (2012).Manovigyan Mein Prayog Qum Parikshan. Patna: Motilal Banarsidas.

### Semester III

Paper		Total Marks		Distribution of marks mid and end semester			
		FM	PM	Mid-semester		End-Semester	
				FM	PM	FM	PM
Research Methodology	C.C-5.T	75	40%	20% of total marks	40%	80% of total marks	40%
Health Psychology	C.C-6.T	75	40%	20% of total marks	40%	80% of total marks	40%
Applied Social Psychology	C.C-7.T	75	40%	20% of total marks	40%	80% of total marks	40%
Practical - I	C.C-5,6&7P	75	40%	20% of total marks	40%	80% of total marks	40%
*Psychology at Work	GE-3.T	75	40%	20% of total marks	40%	80% of total marks	40%
*Practical - II	GE-3 P	25	40%	20% of total marks	40%	80% of total marks	40%
Guidance	SEC-1	50	40%	20% of total marks	40%	80% of total marks	40%

**\* Not for Psychology Honors students.**

Psychology Honors student will choose G.E. of any one of the following subjects.

- (i) History.
- (ii) Geography.
- (iii) Political Science.
- (iv) Economics.
- (v) Anthropology.
- (vi) Sociology.

## **Research Methodology**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1: Psychological research.**

- (a) Definition.
- (b) Goal
- (c) Steps in Psychological research.
- (d) Ethics in psychological research.

### **Unit 2 Sampling:**

- (a) Definition.
- (b) Probability sampling methods.
- (c) Non- probability sampling methods.

### **UNIT 3: Non - experimental Methods (1):**

- (a) Case study.
- (b) Observation.
- (c) Survey.

### **UNIT 4: Non-experimental methods (II):**

- (a) Psychological testing
- (b) Standardization.
- (c) Reliability
- (d) Validity.
- (f) Norm.



### **Reading List:**

Chandha, N. K. (2009). Applied Psychometric. New Delhi: Sage Publication.

Dyer, C. (2001). Research in Psychology: A Practical Guide to Research Methodology and Statistics (2<sup>nd</sup> Ed.). Oxford: Blackwell Publishers.

Gregory, R.J. (2006). Psychological Testing: History, Principles, and Applications (4<sup>th</sup>Ed.). New Delhi: Pearson Education.

Murphy, K.R. and Davidshofer, C. O. (2004). Psychological Testing: Principles and Applications (6<sup>th</sup> Ed.). New Jersey: Prentice Hall.

Neuman, W.L. (2006). Social Research Methods: Qualitative and Quantitative Approaches (6<sup>th</sup> Ed. ). Boston : Pearson Education.

Willig, C. (2001). Introducing qualitative research in psychology: Adventures in theory and method. Philadelphia: Open University Press.

Singh , A.K. (2013). Research methods in behavioural sciences. Patna: Student's Friends Publication.

Md. Suleiman (2013). Manovigyam me shodh pranaly. Patna: Motilal Banarisidas

## **Health Psychology**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1: Introduction to Health Psychology:**

- (a) Components of health as social, emotional, cognitive and physical aspects.
- (b) Relationship between health and psychology.
- (c) Mind and body relationship.
- (d) Goals of health psychology

### **Unit 2: Well-Being:**

- (a) Components of well-being e.g.

### **Unit 3: Managing stress, illness and pain:**

- (a) Causes.
- (b) Consequences.
- (c) Interventions.

### **Unit 4: Health enhancing behaviors:**

- (a) Implications for well-being.
- (b) Psychological factors as resilience, hope, optimism, positive self.
- (C) Physical factors as exercise, safety, nutrition, etc.

### **Reading List:**

Carr, A. (2004). Positive Psychology: The science of happiness and human strength. UK: Routledge.

DiMatteo, M. R. and Martin, L.R. (2002). Health psychology. New Delhi: Pearson.

Misra, G. (1999). Stress and Health. New Delhi: Concept.

Sarafino, E.P. (2002). Health psychology: Bio psychosocial interactions (4<sup>th</sup> Ed.).NY: Wiley.

Snyder, C.R., and Lopex, S.J. (2007). Positive Psychology: The Scientific and Practical Explorations of Human Strengths. Thousand Oaks, CA: Sage.

Taylor, S.E. (2006). Health Psychology (6<sup>th</sup> Ed.). New Delhi: Tata McGraw Hill.

# **Applied Social Psychology**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

## **Unit : 1 Introduction:**

- a) Definition and Nature of Applied Social Psychology.
- b) Importance and Applications of Applied Social Psychology.
- c) Scope and Current status of Applied Social Psychology.

## **Unit : 2 Crime and Criminals:**

- a) Definition, Nature and Characteristics of Crime and Criminals
- b) Psychological, Biological and Socio-cultural explanation of Crime and Criminals
- c) Walter Reckless theory of Crime and Preventive measures of Crime

## **Unit : 3 Terrorism:**

- a) Definition Nature and Characteristics.
- b) Origin and Development in India.
- c) Consequences and Preventive Measures.
- d)

## **Unit : 4 Violence against Women:**

- a) Definition, Nature and Characteristics.
- b) Type, Causes and Consequences.
- c) Legal Act in for Prevention.

### **References:**

- Singh, AK. , Samsj Manovigyan ki Ruprekha, Patna, Motilal Banarsidas.
- Suleman, Md(2012). Manovigyan aur Samajik Samasyaye, Patna: Motilal Banarsidas.
- Prasad, Navratan(2009). Samajik Samasyaye, Patna, Motilal Banarsidas.
- Baron , R and Byrne(2010). Social Psychology: New Delhi: Pearson Education.
- K, Renu(2010). Apradhsashtra aur Samajik Samasyaye, New Delhi: Atlantic Publication.
- Pandey, G(2010). Samaj Manovigyan, New Delhi, Atlantic Publication.
- Bandura, A(1990). Aggression : A Social Learning Analysis.New Jersey, Prentice Hall
- Gelles & Cornell(2005). Intimate Violence in Families, Beverly Hills, Sage Publication.
- Marwah, Ved(2004). Pathology of Terrorism in India, Delhi
- Saxena, NS(2010). Terrorism: History And Facets in the World and India., New Delhi, Abhinav Publication.
- Ahuja, Ram (2010). Sociological Criminology, New Age International Publisher.
- Fitzgerald, Mike(2005). Crime And Society, New York Hammond worth.
- Becker, Howard(2004). Social Problem, : A Modern Approach, New York, John Willey.

## **Practical – I**

Time 4 Hours

Full Marks 35

(for end semester)

Marks distribution experiment – 25 vive-voci- 5N. B.-5

Four questions will be set out of which candidates be required to answer two questions

1. Colour Preference Test.
2. General Health Questionnaire by S.K. Verma.
3. Psychological Wellbeing by David Goldberg.
4. Emotional Maturity Scale by Mahesh Bhargave.

### **Reading List:**

Suleiman, Md (2012). Manovigyan Mein Prayog aur Parikshan. Patna: Motilal Banarasisidas.

Sinha, RRP (2001). Manovigyan me prayog, parikshan aur sankshiyiki.

Anastasi, A (1988). Psychological testing. New York: McMillan.

## **Psychology at work**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1: Work Psychology**

- (a) The origin of work psychology.
- (b) Work Psychology Today.
- (c) Work Psychology and Common sense.

### **Unit 2: Minority group at work.**

- (a) Women at work.
- (b) Ethnic minority at work.
- (c) Disabled works.

### **Unit 3: Attitude at work.**

- (a) What is an attitude?
- (b) How attitude measure?
- (c) Attitude and behaviour.

### **Unit 4: Stress at work.**

- (a) What is stress?
- (b) The cost of stress?
- (c) The source of stress at work.

(d) Relationship at work.

### **Reading List:**

John, Aronld, Ivan, T Robertson, Cary, L. Cooger (2012) Work Psychology; New Delhi: Mc Millan India.

Kemp, N.J., Well . T.D., Clegg, C.W and Cordey, J.L. Antonomons work groups in a greefield site: A comparative study. Journal of Occupational Psychology.

Potter, J. and Weherell, M. Discouses and Social Psychology: Beyond Attitudes and behavior ., London: Sage.

Reethlis berger., F.J and Dickson, W.J. Management and the worker. New York: John Wiley.

Trist. E.L. and Bangosh, R.W. Some social and psychological consequences of the long wall method of coal qetting. Human relation, 1-38.

Alderfer, C.A nd Thomas, D.A. The singnificance of race and ethnicity for understanding orgnisation behaviour. In C.L Cooper and I.T Robertson (Eds). International Review of I/O Psychology. John Wiley.

Brengel, I. Sex and race in the labor market. Feminist Review, 32 (summer), 49-68.

Davidson, M.J and Cooper, C.L The extra presence of women executive. Personal Management.

Davidson, M.J and Cooper. C.L Working women: An international quarterly. New York: John Wiley.

Fogarty. M.P., Rapaport . R. and Rapoport , R.N . Sex , career and family quarterly. Hills Calif: Sage.

Friedman, M. and Rosen man, R.H. Type A behavior and your heart. London: Wild Wood House.

Aizen. I. and Fishbein, M, Understanding Attitudes and Predicteny. Englewood cliffs, N.J: Prentice Hall.

Cacioppo, J. T and Petty, R.E. Effects of massage repletion and position one cognitive responses, recall and persuasion. Journal of Personality and Social Psychology.



Caldur, B. J. and Schure , P.H Attitudinal Processes in Organizational. In L. Cummings and B. Stand (Eds). Research in Organizational Behavior, Vol.3 Greenwich, Conn: JAI Press.

Cooper, C.L, Sloan, S. and Williams, S. Occupational Stress Indicator. Windsor: NFER/Nelson.

Eiser, J.R. Social Psychology: Attitudes, Cognitions and Social Behavior. Cambridge: Cambridge: University Press.

Jamis, I and Feshbach, S. Effects of fear arousing communications. Journal of abnormal and Social Psychology.

Kiesler, C.A. The Psychology of Commitment. London: Academic Press.

Bortner, R.W. A short rating scale as a potential measure of pattern. A behavior Journal of chronic Diseases.

Razaque et al. (2012). New Horizons in Stress Management. New Delhi: Ayushman Publication House.

Beck, V. (1972). Working under pressure. London Staples Press.

Cooper, C.L. Executive Stress: A ten country comparison. Human Resource Management.

Cooper, C.L and Smith, M.J. Job Stress and Blue Coller Work. Chic ester: John Wiley.

Cox. T. Repetitive Work. In C.L. Cooper and R. Payne (Eds), Current Concerns in Occupational Stress. Chictrister: John Wiley.

## **Practical – II**

Time 4 Hours

Full Marks 35

(for end semester)

Marks distribution experiment – 25 vive-voci- 5N. B.-5

Four questions will be set out of which candidates be required to answer two questions

### **Psychophysical Methods:**

Determination of D.L for lifted weight and visual length by methods.

- (a) Limits.
- (b) Constant stimuli.

### **Reaction Time:**

Sensorial and muscular reaction time, simple and complex.

### **Reading List**

Groth- Marnat, Garry (2005). The Handbook of Psychological Assessment ( 4 Ed). New York: John wiley and Sons.

Sulaiman, M. (2012) Manovigyan Mein Prayog aur Parikshan. Patna: Motilal Banarisidas.

Singh, A.K. (2012). Monovigyan Mein Prayog aum Parikshan. Patna: Motilal Banarsidas.

## **Guidance**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit :1**

1. Concept, assumptions, issues and problems of guidance.
2. Needs, scope and significance of guidance..

### **Unit 2:**

1. Types of guidance. - educational , vocational and personal, group guidance.
2. Role of the teacher in guidance.
3. Agencies of guidance.- National level or state level.

### **Unit 3:**

1. Educational guidance.
2. Principal of guidance.
3. Guidance and curriculum, guidance and classroom learning.

### **Unit 4:**

1. Vocational guidance.
2. Nature of work.
3. Various motives associated with work.
4. Approaches to career guidance.

Vacationalizaiton of secondary education and career development.

### Semester IV

Paper		Total Marks		Distribution of marks mid and end semester			
		FM	PM	Mid-semester		End-Semester	
				FM	PM	FM	PM
Emergence and growth of Psychology	C.C-8.T	75	40%	20% of total marks	40%	80% of total marks	40%
Statistics II	C.C-9.T	75	40%	20% of total marks	40%	80% of total marks	40%
Social Psychology	C.C-10.T	75	40%	20% of total marks	40%	80% of total marks	40%
Practical - I	C.C-8,9&10.P	75	40%	20% of total marks	40%	80% of total marks	40%
*Psychology and media	GE-4.T	75	40%	20% of total marks	40%	80% of total marks	40%
*Practical - II	GE-4 P	25	40%	20% of total marks	40%	80% of total marks	40%
Personality Testing	SEC-2	50	40%	20% of total marks	40%	80% of total marks	40%

**\* Not for Psychology Honors students.**

Psychology Honors student will choose G.E. of any one of the following subjects.

- (i) History.
- (ii) Geography.
- (iii) Political Science.
- (iv) Economics.
- (v) Anthropology.
- (vi) Sociology.

## **Emergence and growth of Psychology**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1: History of Psychology:**

Origin, development of psychology as an independent science.

### **Unit 2: Contributions in Psychology:**

Main contributions- Wilhelm Wundt, E.B. Titchener, William James.

### **Unit 3: Objectivity in Psychology:**

Development of Behaviorism- contributions of Watson.

### **Unit 4: Gestalt psychology:**

Foundation of gestalt psychology, experimental contributions of gestalt psychology, criticism of gestalt psychology, present states of gestalt psychology.

Works of Wertheimer, Kohler and Koffka.

### **Reading List:**

Boring. E.G. (1995). A History of Experimental Psychology. New York: Appleton Century Co.

Heidbreder, E. (1997). Seven Psychologies. New Delhi: Kalyani publishes.

Leaky, TH (1991). A History of Modern Psychology. New Jersey: Prentice Hall.

Murphy, G. (1960). Historical Introduction of Modern Psychology. London: Routledge and Kagan Private Ltd.

Raju, P. T. (1988). Structural Depths of Indian thought. New York: Albama State University.

Singh A.K. (2006). The Comprehensive History of Psychology Delhi: Motilal Banaridas Publication Private Limited.

Rahman, A. and Jawaid, A. (1994). Manovigyan ka Sanchhipt Itihas. Patna: Motilal Banarsidas.

Singh, A. K (2002). Manovigyan ka Sampradaya Evam Ithias Patna : Motilal Banarsidas.

## **Statistics II**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1:        Normal Probability Curve.**

- (a)    The nature of normal probability curve.
- (b)    Characteristics of normal probability curve.
- (d)    Use of normal probability curve.

### **Unit 2:**

- (a)    Historical perspectives.
- (b)    Coefficient of correlation.
- (c)    Calculation of Pearson coefficient of correlation.
- (d)    Spearman's rank order correlation coefficient.

### **Unit 3:        Null hypothesis.**

- (a)    Concept.
- (b)    Computation of chi - square.
- (c)    Testing of divergence of observed result from expected on the hypothesis of equal probability.
- (d)    2X2 contingency table.

### **Unit 4:        Hypothesis testing and making inferences:**

- (a)    Significance of mean difference.
- (b)    Computation of t - value - correlated and uncontrolled.
- (c)    Interpretation of t - value.
- (d)    Level of significance.

### **Reading List:**

Suleiman, Md. (2012). Shikah and Manovigyan the shankhiki. Patna: Motilal Banarsidas.

Singh, A.K. (2012). Shiksha aum Manovigyan Me Shankhikis. Patna: Motilal Banarsidas.



## **Social Psychology**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1:**

Psychological understanding of social system.

Indian family system.

Social stratification- caste, class, power, social identities- religious ethics.

### **Unit 2:**

Social inequity poverty and deprivation:

Social psychological analysis of deprivation;

Consequences of deprivation, poverty-cause and measures.

### **Unit 3:**

#### **Environmental issues:**

- (a) Environment culture and behaviour.
- (b) Crowding – explanation and consequences.

### **Unit 4:**

Anti-Social behavior:

- (a) Corruption and bribery.
- (b) Crime and delinquency causes, measures.

### **Reading List:**

Misra, G. (1990). Applied social psychology in India; New Delhi, Sage.

Forsea, M. (1998). Family and Marriage in India, Japan: Sachi.

Sinha, D., Tripathi R.C. and Misra, G. (1995). Deprivaiton: Its social roots and psychological consequences, New Delhi: Concept.

Tripathi, R.C. (1998). Applied Social Psychology. In J. pandey (ed.) Psychology in India, The state of the Art. Vol. II., New Delhi.

Singh, A.K (2002). Samaj Manovigyan ki Roop Rekha. Patna: Motilal Banarasi Das.

Alam, R and Razaque, (2006). Social Dimension of Human Behavior. New Delhi: Manak Publication.

## **Practical**

Time 4 Hours

Full Marks 35

(for end semester)

Marks distribution experiment – 25 vive-voci- 5N. B.-5

Four questions will be set out of which candidates be required to answer two questions

1. Noise and Sensitivity Scale by Mohar I.S. et al.
2. Bhatia Battery of Performa test of intelligence.
4. Life satisfaction Scale by Pramod kumar.

### **Reading List:**

Sinha R.R.P and Mishra, B.K. (1984). Manovigyan Mein Prayog ewam Sankhiyeki Patna: Bharati Bhawan.

Sulaiman, Md. (1996): Manovigyanik prayog aur Parikshan. Patna: Motilal Banarsidas.

Mohsin., S.M. (1982). Experimental Psychology Patna Motilal Banarasi Das.

## **Practical**

Time 4 Hours

Full Marks 35

(for end semester)

Marks distribution experiment – 25 vive-voci- 5N. B.-5

Four questions will be set out of which candidates be required to answer two questions

### **1. Attention:**

- (a) Distraction of Attention.
- (b) Span of Attention.

### **2. Forgetting**

- (a) Test of retroactive inhibition.
- (b) Test of proactive inhibition.

### **Reading List:**

Suleiman, Md. (2012). Manovigyan Mein Prayog aur Parikshan. Patna: Motilal Banarsidas.

Sinha, R.R.P and Mishra, B.K. (1984). Manovigyan Mein prayog ewam sankhiyeki. Patna: Bharati Bhawarn .

Mohsin, S.M. (1982). Experimental Psychology. Patna: Motilal Banarsidas.

## **Psychology and Media**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

**Unit 1: Introductions and Defining Media Psychology:**

**Unit 2: Public Opinion About Media: Framing and Mental Models.**

**Unit 3: Measuring Media and the Experience of Technology.**

**Unit 4: Media Literacy and Digital Citizenship.**

### **Reading List:**

Baym, Nancy K. (2010). Personal Connections in the Digital Age, Chapter 1.

Giles, D.C. (2010). Psychology of the Media. London: Palgrave Macmillan. Chapters 1, 2, 11 and 12.

Bandura, A. (2001). Social cognitive theory of mass communication. Media Psychology, 3(3). 265-299.

Reeves, B., and Anderson, D.R. (1991). Media studies and psychology.

Rutledge, P. (2012). Is There a need for a distinct field of media psychology in K. Dill (Ed).

Baym, Nancy K. (2010). Personal connections in the Digital Age, Chapter 2.

Giles, D.C. (2010). Psychology of the media. London: Palgrave Macmillan Chapter 9-10.

Gee, J. P. (2007). What video games have to teach us about learning and literacy (Revised and updated) (2<sup>nd</sup> Ed.). New York: Palgrave Macmillan. Chapters 1, 2, and 6.

Johnson-Laird, P.N., And Byrne, R. (2000). Mental models: A Gentle introduction from [http://www.tcd.ie/Psychology/other/ruth\\_Byrne/mental\\_models/index\\_html](http://www.tcd.ie/Psychology/other/ruth_Byrne/mental_models/index_html).

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- Chi, M.T.H. (2008). Three types of conceptual change: Belief revision mental model transformation, and categorical shift. In S. Vosniadou (Ed). *Handbook of Research on conceptual change* (pp. 61-82). Hillsdale, NJ: Erlbaum,
- Lyengar, J. (2005). Speaking of values: The framing of American Politics. *The Forum*, 3(3), 1-9.
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- Sheufole, D. (1999). Framing as a theory of media effects *journal of communication*, winter, 103-122.
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- Giles, D.C. (2010). *Psychology of the Media*. London: Palgrave Macmillan, chapters 3-8.
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- Anderson, C. A., Berkowitz, L., Donnerstein, E., Huesmann, L. R., Johnson, J.D., Linz, D., et al. (2003). The influence of media violence on youth. *Psychological Science in the Public Interest*.
- Ferguson, C. J. (2009). Media violence effects: Confirmed truth or just another X-File. *Journal of forensic psychology practice*, 9 (2), 103-126.
- Ferguson, C.J. (2009). Violent video game: Dogma, fear, and pseudoscience. *Skeptical Inquirer*, September/October.
- Kutner, L., and Olson, C.K. (2008). *Grand theft childhood: the surprising truth about violent video game and what parents Can Do*. New York: Simon and Schuster.
- Sternheimer, K. (2009) *Connecting social problems in popular culture*. Westview press.
- Giles, D.C. (2003). *Media Psychology*. Mahwah, New Jersey: Lawrence Erlbaum Associates., Chapter 3.
- Prensky, M. (2001). Digital Natives, Digital Immigrants. *On the Horizon*, 9(5). Part 1.

Prensky, M. (2001). Digital Natives, Digital Immigrants: Do they really think differently. *On the Horizon*, 9(6). Part 2.

Strudley, G. (2008). The media literacy of primary school children: Literature Review, from [http://gdstrudley3. Webs.com](http://gdstrudley3.Webs.com).

Jenkins, H. (2008). *Convergence culture: Where old and New Media collide* (Revised ed.). New York: University Press., Chapters 5 and 6.

Longford, G. (2007). Pedagogies of digital citizenship and the politics of code. *Techne: Research in philosophy and technology*, 9 (1).

Jenkins, H., Purushotma, R., Clinton, K., Weigel, M., and Robinson, A, J. (2006). *Confronting the challenges of participatory culture: Media Education for the 21<sup>st</sup> Century*. Retrieved September, 12, 2009.

## **Personality Testing**

1. Vocational Interest Record- S.P Kulshrestha.
2. Test of Democratic Values- Dr. Alok Gardia.
3. Creative Behavior Questionnaire. Prof. AP Singh and AK Singh.
4. Mental Health Questionnaire – Srivatav and Bhatia.



### Semester V

Paper		Total Marks		Distribution of Marks Mid and End Semester			
		FM	PM	Mid-Semester		End-Semester	
				FM	PM	FM	PM
Organizational Psychology	C-11.T	75	40%	20% of total marks	40%	80% of total mark	40%
Abnormal Psychology	C-12.T	75	40%	20% of total marks	40%	80% of total mark	40%
Practical I	C-11&12P	50	40%	20% of total marks	40%	80% of total mark	40%
Educational Psychology - II	DSE-1.T	75	40%	20% of total marks	40%	80% of total mark	40%
Emotional intelligence	DSE-2.T	75	40%	20% of total marks	40%	80% of total mark	40%
Practical II	DSE-1&2.p	50	40%	20% of total marks	40%	80% of total mark	40%

## **Organization Psychology**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1 : Introduction and issues in Organizational Psychology**

- (a) Brief History of Organization Psychology. Industry and Organization;
- (b) Current status of Organizational psychology.
- (c) Psychology in the Indian context: Organizational structure.
- (d) Organizational climate and culture.

### **Unit 2: Introduction of work related attitudes and work motivation**

Job satisfaction, Job involvement, Organization commitment, Organizational Citizenship Behavior; Psychological Contract, work engagement .

### **Unit 3: Leadership**

Contemporary perspectives on leadership

Cross-cultural leadership issues

Indian on leadership

Diversity issues in leadership.

### **Unit 4: Positive Organizational Behavior**

- (a) Optimism
- (b) Emotional Intelligence
- (c) Self-Efficacy
- (d) Work life balance.

### **Reading list:**

Arnoldt, M.G. (2001) Industrial Organizational Psychology. Indiana: Cengage Learning.

Greenberg, J. and Baron, R.A. (2007). Behaviour in Organizations (9<sup>th</sup> Ed.). Indiana: Dorling Kindersley.

Luthans, F. (2009). Organizational behaviour. New Delhi: McGraw Hill.

Muchinsky, P. (2006). Psychology applied to work: An introduction to industrial and organizational psychology. NC: Hypergraphic Press.

Pareek, U. (2010). Understanding Organizational Behaviour. Oxford: Oxford University Press.

Prakash, A. (2011). Organizational behaviour in India: An indigenous perspective. In G. Misra (Ed.), Handbook of Psychology. New Delhi: Oxford University Press.

Singh, K. (2010). Organizational behaviour: Texts and Cases. Indiana: Dorling Kindersley.

## **Abnormal Psychology**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1: Definition of abnormality,**

- (a) Criteria
- (b) Classification
- (c) Clinical assessment.

### **Unit 2: Clinical States**

- (a) Clinical Picture of GAD, OCD, and Phobias.
- (b) Dynamics of anxiety disorders.
- (c) Clinical picture of conversion disorder and its dynamics.
- (d) Clinical picture of dissociative identity disorder and its dynamics.

### **Unit 3: Developmental Disorders. Mental Retardation,**

- (a) Autism,
- (b) ADHD
- (c) Learning Disabilities.

### **Unit4: Diathesis-Stress Model**

- (a) The Impact of stress on Physiological Parameters (Coronary Heart Diseases and Essential Hypertension)
- (b) Substance-related disorder.

### **Reading List:**

Ahuja N. (2011). A short Textbook of psychiatry (7<sup>th</sup> Ed.) New Delhi: Jaypee.

Barlow D.H. and Durand V.M. (2005). Abnormal Psychology: An Integrated Approach (4<sup>th</sup> Ed.) Wassworth: New York.

Carson R.C., Butcher J.N., Mineka, A., and Hooley J.M (2007). Abnormal Psychology (13<sup>th</sup> Ed.). ND: Pearson Education.

Kring, A. M., Johnson, S. L., Davison G.C. and Neale J.M. (2010). Abnormal Psychology (11<sup>th</sup> Ed. ). NY: John Wiley.

## **Practical**

Time 4 Hours

Full Marks 35

(for end semester)

Marks distribution experiment – 25 vive-voci- 5N. B.-5

Four questions will be set out of which candidates be required to answer two questions

1. Recall and Recognition.
2. Aesthesiometric Index.  
Method of limits
3. Fatigue through Ergograph.
4. Role of mental set in thinking.

### **Reading List:**

Sinha R.R.P and Mishra, B.K. (1984). Manovigyan Mein Prayog ewam Sankhiyeki  
Patna: Bharati Bhawan.

Sulaiman, Md. (1996): Manovigyanik prayog aur Parikshan. Patna: Motilal  
Banarsidas.

Mohsin., S.M. (1982). Experimental Psychology Patna Motilal Banarasi Das.

## **Practical II**

Time 4 Hours

Full Marks 35

(for end semester)

Marks distribution experiment – 25 vive-voci- 5N. B.-5

Four questions will be set out of which candidates be required to answer two questions

1. R.T.
2. Cattell 16 PF
3. Chatterji's non-verbal test of intelligence.
4. PGI Social Support

### **Reading List:**

Sulaiman, M. Manovigyan Mein Prayog aur Parikshan. Patna: Motilal Banaridas.

Singh, A.K. Manovigyan Mein prayog aur Parikshan. Patna: Motilal Banaridas.

## **Educational Psychology - II**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1: Educational Psychology:**

- (a) Concept.
- (b) Scope of educational psychology.
- (c) Contribution of psychology in education.

### **Unit 2: Human Development:**

- (a) Concept, principles and sequential stages of development.
- (b) Factors influencing development and their relative roles.
- (c) General characteristics and problem for each stage.

### **Unit 3: Learning:**

- (a) Concept, Types of learning.
- (b) Various view points of learning.

### **Unit 4: Individual difference: Concept of individual difference.**

- (a) Creativity - nature, process, identification, fostering and guiding, creative children.
- (b) Adjustment of teaching- learning process to suit individual difference, learning style and teaching strategies.



### **Reading List:**

Kakar (2015). Educational Psychology. New Delhi: Prentice Hall.

Skinner,(2010). Educational Psychology. New York: Academic.

Singh, A.K. (2015). Shiksha Manovigyan. Patna: Motilal Banarsidas.

Suleman, Md. (2015) Ucchtar Shiksha Manovigyan. Patna: Motilal Banarsidas.

## **Emotional intelligent**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

**Unit 1: Understanding Emotional Intelligence.**

Personality and emotional intelligence.

**Unit 2: The Ability Model of Emotional Intelligence.**

The Trait model of emotional intelligence.

The Mixed model of emotional intelligence.

**Unit 3: The Bar-On Model of Emotional, Social Intelligence and the Genos Model.**

Criticism of the theoretical foundation and measures of assessment of emotional intelligence.

Emotional Intelligence, personality disorders, and Individuals on the autism spectrum .

**Unit 4: Emotional Intelligence and Personal Relationships.**

Emotional Intelligence at the Workplace.

Improving your emotional intelligence.

### Semester VI

Paper		Total Marks		Distribution of marks mid and end semester			
		FM	PM	Mid-semester		End-semester	
				FM	PM	FM	PM
Clinical Psychology	C-13.T	75	40%	20% of total marks	40%	80% of total marks	40%
Counseling Psychology	C-14.T	75	40%	20% of total marks	40%	80% of total marks	40%
Practical - I	C-13&14P	50	40%	20% of total marks	40%	80% of total marks	40%
Human Resource Management	DSE-3.T	75	40%	20% of total marks	40%	80% of total marks	40%
Community Psychology	DSE-4.T	75	40%	20% of total marks	40%	80% of total marks	40%
Practical - II	DSE-3&4.p	50	40%	20% of total marks	40%	80% of total marks	40%

## **Clinical Psychology**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1: Schizophrenia:**

- (a) Type, cause, etiology, treatment.

### **Unit 2: Mood Disorders:**

- (a) Type, cause, etiology, treatment.

### **Unit 3: Personality Disorders :**

- (a) Antisocial- Personality.
- (b) Borderline personality disorders.
- (c) Sexual disorders (Clinical Picture):
  - \* Paraphilias
  - \* Gender Identity Disorder
  - \* Sexual Dysfunction

### **Unit 4: Intervention and Management**

- (a) Biological.
- (b) Psychoanalytic.
- (c) Cognitive.
- (d) Behavioral.

### **Reading List**

- Ahuja, N. (2011). A Short Textbook of Psychiatry (7<sup>th</sup> Ed.) New Delhi: Jaypee.
- Barlow D.H. and Durand V.M. (2005). Abnormal Psychology: An Intergrated Approach (4<sup>th</sup> Ed.). New Delhi: Pearson Education.
- Carson R.C., Butcher, J.N., Mineka, S, and Hooley J.M. (2007). Abnormal Psychology (13<sup>th</sup> Ed.). New Delhi: Pearson Education.
- Kring, A.M., Johnson, L.L., Davison, G.C. and Neale, J.M. (2010). Abnormal Psychology (11<sup>th</sup> Ed. ). New York: John Wiley.

## **Counseling Psychology**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1: Introduction.**

- (a) Definition and nature.
- (b) Counseling as a profession-training, activities and professional ethics.
- (c) The effective counselor- Personality characteristics, skills, self of counselor.

### **Unit 2: Counseling Process.**

- (a) Stages of counseling.
- (b) Assessment for counseling.

### **Unit 3: Counseling Theory and Techniques.**

- (a) Individual counseling theory and techniques-Psychoanalytic, Humanistic, Behavioral, Cognitive.
- (b) Group techniques.

### **Unit 4: Counseling Application.**

- (a) Family and couples counseling.
- (b) School and Career counseling.
- (c) Workplace counseling.

- (d) Counseling for wellness.

**Reading List:**

Feltham, C and Horton, I. (2000). Handbook of Counseling and Psychotherapy. London: Sage.

Gibson, R.L. and Mitchell, M.H. (2003). Introduction to Counseling and Guidance (6<sup>th</sup> Ed.). New Delhi: Pearson India.

Gliadding, S.T. (2009). Counseling: A comprehensive profession (6<sup>th</sup> Ed.) New Delhi: Pearson India.

Misra, G. (Ed.) (2010). Psychology in India, (Volume 3). Clinical and Health Psychology. New Delhi: Pearson India.

Rao, S. (2002). Counseling and Guidance (2<sup>nd</sup> Ed.) New Delhi: Mc Graw Hill.

## **Practical - I**

Time 4 Hours

Full Marks 35

(for end semester)

Marks distribution experiment – 25 vive-voci- 5N. B.-5

Four questions will be set out of which candidates be required to answer two questions

1. Verbal General Intelligence Test of Joshi.
2. Verbal General intelligence test of Ram Naresh.
3. Emotional Maturity Scale by R.R. Tripathi.
4. Differential Personality Scale of Arun Kumar Singh

### **Reading List:**

Sulaiman, M (2012). Manovigyan Mein Prayog aur Parikshan. Patna: Motilal Banarisidas.

Singh, A.K(2013). Manovigyan Mein Prayog aur Parikshan. Patna: Motilal Banarisidas.



## **Human Resource Management**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

### **Unit 1: Introduction to Human Resource Management (HRM)**

HRM and HRD, Context and issues in HRM

### **Unit 2: Human Resource Practices**

Job analysis, recruitment and selection, training, performance, evaluation

### **Unit 3: International human resource management (HRM)**

The context of globalization, Forms of IHRM/Types of cross-national organizations (Domestic, International, Multinational, Global, Transnational), Role of culture in IHRM, Dimensions of cultural difference.

### **Unit 4: International Human Resource Management (IHRM)**

Policies and practices in the multinational enterprise. Selection for international assignees, expatriate failure, training: development of a global mind set, Cross-cultural training, well-being of the global work force.

## **Reading List**

Bhatnagar, J. and Budhwar, J. (2009). The Changing Face of People Management in India. London: Routledge.

Briscoe, D. R., Schuler, R. S. and Claus, L. (2009). International Human Resource Management: Policies and Practices for Multinational Enterprises (3<sup>rd</sup> Ed). New York: Routledge.

DeCenzo, D. A nd Robbins, S.P. (20006). Fundamentals of Human Recourse Management (8<sup>th</sup> Ed). New York: Wiley.

Harzing, A.W.K. and Pennignton, A. (2011). International Human Resource Management. New Delhi: Sage publications.

Khandelwal, K.A. (2009). In search of Indianess: Cultures of Multinationals. New Delhi: Knnishka Publishers.

## **Community Psychology**

Time 3 Hours

Full Marks 60

(for end semester)

Eight questions of equal value (i.e. 15 marks each) will be set, out of which four questions are to be answered. Question number one will be compulsory comprising 15 objective type questions covering the entire syllabus.

- Unit 1:** Historical and Social contexts of Community Psychology: Concept, evolution and nature of community mental health.
- Unit 2:** Models of mental health services: mental, social, organizational and ecological.
- Unit 3:** Community mental health, intervention and community based rehabilitation. Issues, principles and programmers, evaluation of CBR, training the Para - professional and non-professionals.
- Unit4:** Community mental health in India: Issues and challenges.

### **Reading List:**

Bloom, B. (1973). Community Mental Health – A critical analysis. New Jersey. General Learning Press.

Koch, C.H (1986) (ed.). Community Clinical Psychology. London: Croom Helm.

Mann, P.A. (1978). Community Psychology: Concepts and Application. New York:

The Free Press. Rappaport, J. (1977). Community psychology: Values Research and Action. New York: Holt, Reinehart and Wingston.

## **Practical – II**

Time 4 Hours

Full Marks 35  
(for end semester)

Marks distribution experiment – 25 vive-voci- 5N. B.-5

Four questions will be set out of which candidates be required to answer two questions

1. Eysenck Personality Questionnaire.
2. All port Vernon Lindsley Scale of Value.
3. Edward Personal Preference Schedule.
4. Tripathi Personal Preference Scale.

### **Reading List:**

Sulaiman, M. Manovigyan Mein Prayog aur Parikshan. Patna: Motilal Banarisidas.

Singh, A.K. Manovigyan Mein Prayog aur Parikshan. Patna: Motilal Banarisidas.

# Syllabus and Scheme of Examination

For

**B.Sc. (Honors) Chemistry & B.Sc. Miner Chem.  
(Generic Elective)**

**SIDO-KANHU MURMU UNIVERSITY,**  
DUMKA - 814101 (Jharkhand)



Under  
**Choice Based Credit System**  
2017

## **Course Structure (Chemistry-Major)**

### **Details of courses under B.Sc. (Honours)**

<b>Course</b>	<b>*Credits</b>
<b>Theory+ Practical</b>	
<hr/>	
<b>I. Core Course</b>	<b>14×4= 56</b>
<b>(14 Papers)</b>	
<b>Core Course Practical</b>	<b>04×4+02×06= 28</b>
<b>(07 Papers)</b>	
<b>II. Elective Course</b>	
<b>(8 Papers)</b>	
A.1. Discipline Specific Elective	4×4=16
<b>(4 Papers)</b>	
A.2. Discipline Specific Elective	2×4=8
Practical/Tutorial*	
<b>(4 Papers)</b>	
B.1. Generic Elective/ Interdisciplinary	4×4=16
<b>(4 Papers)</b>	
B.2. Generic Elective	
Practical/ Tutorial*	4×2=8
<b>(4 Papers)</b>	

- **Optional Dissertation or project work in place of one Discipline Specific Elective paper (6 credits) in 6th Semester**

### **III. Ability Enhancement Courses**

#### **1. Ability Enhancement Compulsory**

**(2 Papers of 2 credit each)**

2×2=4

Environmental Science

English Communication

#### **2. Ability Enhancement Elective (Skill Based)**

2×2=4

(Minimum 2)

**(2 Papers of 2 credit each)**

**Total credit**

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**140**

## PROPOSED SCHEME FOR CHOICE BASED CREDIT SYSTEM IN

### B. Sc. Honours (Chemistry)

<b>Semester</b>	<b>Core Course (14)</b>	<b>Ability enhancement compulsory course (AECC) (2)</b>	<b>Ability enhancement effective course (AEEC) (2) (Skill Based)</b>	<b>Elective : Discipline specific DSE (4)</b>	<b>Elective: General (GE) (4)</b>
I	Inorganic I: Atomic structure and Chemical Bonding-I (4)	English communication			GE 1
	Physical I: States of matter and ionic Equilibrium (4) Practical-1(4) (4)				
II	Organic I: Basic and hydrocarbons (4)	Environmental Science			<b>GE-2</b>
	Physical II: Chemical thermodynamics and its applications (4) Practical-II (4)				
III	Inorganic II: s and p block elements (4)		SEC-1		GE-3
	Organic II: Oxygen containing functional groups (4)				



	Physical III: Phase equilibria and Chemical Kinetics (4) Practical-III (6)				
IV	Inorganic III: Coordination Chemistry		SEC-2		GE-4
	Organic III: Heterocyclic Chemistry (4)				
	Physical IV: Electrochemistry (4) Practical-IV (6)				
V	Organic IV: Biomolecules (4)			DSE- 1	
	Physical V: Quantum Chemistry and Spectroscopy (4) Practical-V (4)			DSE- 2	
VI	Inorganic IV: Organometallic Chemistry (4)			DSE-3	
	Organic Chemistry V: Spectroscopy (4) Practical VI (4)			DSE-4	

Semester	Course Opted	Course name	Credits
I	Ability Enhancement Compulsory course- I	English Communications	2
	Core Course-I	Inorganic Chemistry-I	4
	Core Course-II	Physical Chemistry-I	4
	Core Course- Practical-I		4
	Generic Elective -1	GE-1	4
	Generic Elective -1 Practical		2
II	Ability Enhancement Compulsory Course-II	Environmental Science	2
	Core Course-III	Organic Chemistry-I	4
	Core Course-IV	Physical Chemistry-II	4
	Core Course Practical-II		4
	Generic Elective -2	GE-2	4
	Generic Elective -2 Practical		2
III	Core Course-V	Inorganic Chemistry-II	4
	Core Course-VI	Organic Chemistry-II	4
	Core Course –VII	Physical Chemistry-III	4
	Core Course Practical-III		6
	Skill Enhancement Course -1	SEC-1	2
	Generic Elective -3	GE-3	4
	Generic Elective -3 Practical		2

IV	Core Course-VIII	Inorganic Chemistry-III	4
	Core Course-IX	Organic Chemistry-III	4
	Core Course-X	Physical Chemistry-IV	6
	Core Practical-IV		4
	Skill Enhancement Course -2	SEC -2	4
	Generic Elective -4	GE-4	2
	Generic Elective -4 Practical		4
V	Core Course-XI	Organic Chemistry-IV	4
	Core Course-XII	Physical Chemistry-V	4
	Core Course Practical-V		4
	Discipline Specific Elective -1	DSE-1	4
	Discipline Specific Elective -2	DSE-2	4
	Discipline Specific Elective Practical-I		4
VI	Core Course-XIII	Inorganic Chemistry-IV	4
	Core Course-XIV	Organic Chemistry-V	4
	Core Course Practical-VI		4
	Discipline Specific Elective -3	DSE-3	4
	Discipline Specific Elective-4	DSE-4	4
	Discipline Specific Elective 4 Practical-II		4
Total Credits			140

**Core Papers (C): (Credit: 04 each)** (1 period/week for tutorials or 4 periods/week for practical)

1. Inorganic Chemistry I: Atomic Structure & Chemical Bonding (4 )
2. Physical Chemistry I: States of Matter & Ionic Equilibrium (4 )
3. Practical -I (4)
4. Organic Chemistry I: Basics and Hydrocarbons (4 )
5. Physical Chemistry II: Chemical Thermodynamics and its Applications (4)
6. Practical-II (4)
7. Inorganic Chemistry II: s- and p-Block Elements (4)
8. Organic Chemistry II: Oxygen Containing Functional Groups (4)
9. Physical Chemistry III: Phase Equilibria and Chemical Kinetics (4)
10. Practical-III (6)
11. Inorganic Chemistry III: Coordination Chemistry (4)
12. Organic Chemistry III: Heterocyclic Chemistry (4)
13. Physical Chemistry IV: Electrochemistry (4)
14. Practical-IV (6)
15. Organic Chemistry IV: Biomolecules (4)
16. Physical Chemistry V: Quantum Chemistry & Spectroscopy (4)
17. Practical-V (4)
18. Inorganic Chemistry IV: Organometallic Chemistry (4)
19. Organic Chemistry V: Spectroscopy (4)
20. Practical-VI (4)

Discipline Specific Elective Papers: (4 papers) - DSE 1-4

1. Applications of Computers in Chemistry (4) + Lab (4)
2. Analytical Methods in Chemistry (4) + Lab (4)
3. Green Chemistry (4) + Lab (4)
4. Industrial Chemicals & Environment (4) + Lab (4)

Other Discipline (Four papers of any one discipline) - GE 1 to GE 4

1. Mathematics (5) + Tut (1)
2. Physics (4) + Lab (2)
3. Economics (5) + Tut (1)
4. Computer Science (4) + Lab (2)
5. Zoology (4) + Lab (2)
6. Botany (4) + (2)
7. Geology (4) + (2)
8. Anthropology (4) + (2)

Skill Enhancement Courses (02 papers) (Credit: 02 each) - SEC1 to SEC-2

1. Business Skills for Chemists
2. Intellectual Property Rights

## CORE COURSE (HONOURS IN CHEMISTRY)

### Semester I

#### CHEMISTRY-C I:

##### INORGANIC CHEMISTRY-I

(Credits: Theory-04)

Theory: 60

##### Lectures

##### Atomic Structure:

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of  $\psi$  and  $\psi^2$ . Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, aufbau's principle and its limitations, Variation of orbital energy with atomic number.

(14  
Lectures)

##### Periodicity of Elements:

*s*, *p*, *d*, *f* block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to *s* & *p*-block.

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. 9

(b) Atomic radii (van der Waals)

(c) Ionic and crystal radii.

(d) Covalent radii (octahedral and tetrahedral)

(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.

(f) Electron gain enthalpy, trends of electron gain enthalpy.

(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

**(16 Lectures)**

### **Chemical Bonding:**

- (i) *Ionic bond*: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.
- (ii) *Covalent bond*: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules  $N_2$ ,  $O_2$ ,  $C_2$ ,  $B_2$ ,  $F_2$ ,  $CO$ ,  $NO$ , and their ions;  $HCl$ ,  $BeF_2$ ,  $CO_2$ , (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and  $\sigma$  bond and  $\pi$  bond electrons, and bond multiple bonding (bond lengths). Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.
- (iii) *Weak Chemical Forces*: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding,

valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process. Principles involved in volumetric analysis to be carried out in class.

**(30 Lectures)**

**Reference Books:**

Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.  
Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

**Reference Books:**

Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press □ (2006).  
Ball, D. W. Physical Chemistry Thomson Press, India (2007).  
Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).  
Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

## CHEMISTRY -C II: PHYSICAL CHEMISTRY II

(Credits: Theory-04)

Theory: 60 Lectures

### **Gaseous state:**

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity,  $\sigma$  from  $\eta$ ; variation calculation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor,  $Z$ , and its variation with pressure for different gases. Causes of deviation from ideal behaviour. Van der Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); virial equation of state; van der Waals equation expressed in virial form and calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

(25 Lectures)

### **Ionic equilibria:**

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di- and triprotic acids (exact treatment). Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations. Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

(35 Lectures)



**Reference Books:**

- Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press (2006).
- Ball, D. W. Physical Chemistry Thomson Press, India (2007).
- Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
- Mortimer, R. G. Physical Chemistry 3<sup>rd</sup> Ed. Elsevier: NOIDA, UP (2009).

## CHEMISTRY PRACTICAL-I (4)

60 Lectures

### Group-A

**(A) Titrimetric Analysis** (i) Calibration and use of apparatus (ii) Preparation of solutions of different Molarity/Normality of titrants

### **(B) Acid-Base Titrations**

- (i) Estimation of carbonate and hydroxide present together in mixture.
- (ii) Estimation of carbonate and bicarbonate present together in a mixture.
- (iii) Estimation of free alkali present in different soaps/detergents

### **(C) Oxidation-Reduction Titrimetry**

- (i) Estimation of Fe(II) and oxalic acid using standardized  $\text{KMnO}_4$  solution.
- (ii) Estimation of oxalic acid and sodium oxalate in a given mixture.
- (iii) Estimation of Fe(II) with  $\text{K}_2\text{Cr}_2\text{O}_7$  using internal (diphenylamine, anthranilic acid) and external indicator.

### Group-B

#### 1. Surface tension measurements.

- a. Determine the surface tension by
  - (i) drop number (ii) drop weight method.
- b. Study the variation of surface tension of detergent solutions with concentration.

#### 2. Viscosity measurement using Ostwald's viscometer.

- a. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature.
- b. Study the variation of viscosity of sucrose solution with the concentration of solute.

### Reference text:

1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.
2. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, S. Chand & Co.: New Delhi (2011).
3. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8 th Ed.; McGraw-Hill: New York (2003).
4. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3<sup>rd</sup> Ed.; W.H. Freeman & Co.: New York (2003).

## Semester II

### CHEMISTRY-C III: ORGANIC CHEMISTRY I (Credits: Theory-04)

Theory: 60 Lectures

#### Basics of Organic Chemistry

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes. Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

(6 Lectures)

#### Stereochemistry:

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis-trans and, syn-anti isomerism E/Z notations with C.I.P rules. Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

(18 Lectures)

#### Chemistry of Aliphatic Hydrocarbons

##### A. Carbon-Carbon sigma bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

**B. Carbon-Carbon pi bonds:** Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

**Reactions of alkenes:** Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction;

Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.

**Reactions of alkynes:** Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

**(24 Lectures)**

### **Aromatic Hydrocarbons**

**Aromaticity:** Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

**(12 Lectures)**

### **Reference Books:**

Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.

Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005.

## CHEMISTRY -C IV:

### PHYSICAL CHEMISTRY II

(Credits: Theory-04) Theory:

60 Lectures

**Chemical Thermodynamics:** Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

**First law:** Concept of heat,  $q$ , work,  $w$ , internal energy,  $U$ , and statement of first law; enthalpy,  $H$ , relation between heat capacities, calculations of  $q$ ,  $w$ ,  $U$  and  $H$  for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

**Thermochemistry:** Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

**Second Law:** Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes. *Third Law:* Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

**Free Energy Functions:** Gibbs and Helmholtz energy; variation of  $S$ ,  $G$ ,  $A$  with  $T$ ,  $V$ ,  $P$ ; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

(40 Lectures)

**Chemical Equilibrium:** Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of

fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants  $K_p$ ,  $K_c$  and  $K_x$ . Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

**(10 Lectures)**

**Solutions and Colligative Properties:** Dilute solutions;

(i) Lowering of vapour pressure, Raoult's and Henry's Laws and their applications.

(ii) Elevation of boiling point,

(iii) Depression of freezing point,

(iv) Osmotic pressure applications in calculating molar masses of normal, dissociated and associated solutes in solution.

**(10 Lectures)**

### **Reference Books**

Peter, A. & Paula, J. de. *Physical Chemistry 9th Ed.*, Oxford University Press (2011).

Castellan, G. W. *Physical Chemistry 4th Ed.*, Narosa (2004).

Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.*, Prentice-Hall (2012).

McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd.: New Delhi (2004). Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics*. CRC Press: NY (2011). Levine, I. N. *Physical Chemistry* 6th Ed., Tata Mc Graw Hill (2010). Metz, C.R. *2000 solved problems in chemistry*, Schaum Series (2006)

## CHEMISTRY- C PRACTICAL II

### 60 Lectures

1. Checking the calibration of the thermometer
2. Purification of organic compounds by crystallization using the following solvents: a. Water b. Alcohol c. Alcohol-Water
3. Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)
4. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)
5. **Thermochemistry**
  - (a) Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).
  - (b) Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
  - (c) Calculation of the enthalpy of ionization of ethanoic acid.
  - (d) Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.
  - (e) Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
  - (f) Determination of enthalpy of hydration of copper sulphate.
  - (g) Study of the solubility  $\Delta$  of benzoic acid in water and determination of  $H$ .  
*Any other experiment carried out in the class.*

### Reference Books

1. Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
2. Athawale, V. D. & Mathur, P. *Experimental Physical Chemistry* New Age International: New Delhi (2001).
3. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
4. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012)
5. Hashmat Ali: Reaction mechanism in organic Chemistry, S. Chand

## Semester III

### CHEMISTRY-C V: INORGANIC CHEMISTRY-II

(Credits: Theory-04) Theory:

60 Lectures

**Acids and Bases** Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids.

(12 Lectures)

#### Chemistry of *s* and *p* Block Elements:

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of *s* and *p* block elements. Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate. Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

(36 Lectures)

#### Noble Gases:

Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF<sub>2</sub>, XeF<sub>4</sub> and XeF<sub>6</sub>; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF<sub>2</sub>). Molecular shapes of noble gas compounds (VSEPR theory).

(12 Lectures)

#### Reference Books:

1. Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
2. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models of Inorganic Chemistry 3rd Ed.*, John Wiley Sons, N.Y. 1994.
3. Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth-Heinemann. 1997.
4. Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.
5. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry 4th Ed.*, Pearson, 2010. □ □ Shriver & Atkins, *Inorganic Chemistry 5th Ed.*



**CHEMISTRY-C VI:**  
**ORGANIC CHEMISTRY-II**

**(Credits: Theory-04)**

**Theory:**

**60 Lectures**

**Chemistry of Halogenated Hydrocarbons:**

*Alkyl halides:* Methods of preparation, nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination. *Aryl halides:* Preparation, including preparation from diazonium salts. nucleophilic aromatic substitution; SNAr, Benzyne mechanism. Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions. Organometallic compounds of Mg and Li – Use in synthesis of organic compounds.

**(16 Lectures)**

**Alcohols, Phenols and Epoxides:** *Alcohols:* preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement; *Phenols:* Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe’s–Schmidt Reactions, Fries and Claisen rearrangements with mechanism;

**(16 Lectures)**

**Carbonyl Compounds:** Structure, reactivity and preparation; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisan-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements,  $\alpha$  haloform reaction and Baeyer Villiger oxidation, - substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, LiAlH<sub>4</sub>, NaBH<sub>4</sub>, MPV, PDC and PGC); Addition reactions of unsaturated carbonyl compounds: Michael addition. Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

**(14 Lectures)**

**Carboxylic Acids and their Derivatives:** Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids; Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group -Mechanism of acidic and alkaline hydrolysis of

esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement.

**(14 Lectures)**

**Reference Books:**

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry (Volume I)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
4. Reaction mechanism in organic chemistry, Hashmat Ali, S. Chand

## CHEMISTRY-C VII:

### PHYSICAL CHEMISTRY-III

(Credits: Theory-04)

#### Theory:

60 Lectures

**Phase Equilibria:** Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent 19 and incongruent melting points, solid solutions. Nernst distribution law: its derivation and applications.

(28 Lectures)

**Chemical Kinetics** Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws . Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

(18 Lectures)

**Catalysis:** Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

(8 Lectures)

**Surface chemistry:** Physical adsorption, chemisorption, adsorption isotherms. nature of adsorbed state.

(6 Lectures)

#### Reference Books:

1. Peter Atkins & Julio De Paula, *Physical Chemistry 9th Ed.*, Oxford University Press (2010).
2. Castellan, G. W. *Physical Chemistry*, 4th Ed., Narosa (2004).
3. McQuarrie, D. A. & Simon, J. D., *Molecular Thermodynamics*, Viva Books Pvt. Ltd.: New Delhi (2004).
4. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.*, Prentice-Hall (2012).
5. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S.

6. *Commonly Asked Questions in Thermodynamics*. CRC Press: NY (2011).
7. Zundhal, S.S. *Chemistry concepts and applications* Cengage India (2011).
8. Ball, D. W. *Physical Chemistry* Cengage India (2012).
9. Mortimer, R. G. *Physical Chemistry 3rd Ed.*, Elsevier: NOIDA, UP (2009).
10. Levine, I. N. *Physical Chemistry 6th Ed.*, Tata McGraw-Hill (2011).
11. Metz, C. R. *Physical Chemistry 2nd Ed.*, Tata McGraw-Hill (2009).

## CHEMISTRY - C III

### PRACTICAL (06)

75 Lectures

#### (Group-A)

##### (A) Iodo / Iodimetric Titrations

(i) Estimation of Cu(II) and  $K_2Cr_2O_7$  using sodium thiosulphate solution (Iodimetrically). (ii) Estimation of available chlorine in bleaching powder iodometrically.

##### (B) Inorganic preparations

(i) Cuprous Chloride,  $Cu_2Cl_2$  (ii) Preparation of Aluminium potassium sulphate  $KAl(SO_4)_2 \cdot 12H_2O$  (Potash alum) or Chrome alum.

#### (Group – B)

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.

2. Organic preparations:

i. Acetylation of one of the following compounds: amines (aniline, *o*-, *m*-, *p*-toluidines and *o*-, *m*-, *p*-anisidine) and phenols ( - naphthol, vanillin, salicylic acid) by any one method: a. Using conventional method. b. Using green approach

ii. Benzoylation of one of the following amines (aniline, *o*-, *m*-, *p*-toluidines and *o*-, *m*-, *p*-anisidine) and one of the following phenols ( - naphthol, resorcinol, *p*-cresol) by Schotten-Baumann reaction.

iii. Oxidation of ethanol/ isopropanol (Iodoform reaction).

iv. Bromination of any one of the following:

a. Acetanilide by conventional methods b. Acetanilide using green approach (Bromate-bromide method)

v. Nitration of any one of the following:

a. Acetanilide/nitrobenzene by conventional method b. Salicylic acid by green approach (using ceric ammonium nitrate).

vi. Selective reduction of *meta* dinitrobenzene to *m*-nitroaniline.

vii. Reduction of *p*-nitrobenzaldehyde by sodium borohydride.

viii. Hydrolysis of amides and esters. The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC.

### Group-C

- I. Distribution of acetic/ benzoic acid between water and cyclohexane.
- II. Study the equilibrium of at least one of the following reactions by the distribution method:
  - (i)  $I_2(aq) + I^- \rightarrow I_3^-(aq)$
  - (ii)  $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n^{2+}$
  - (iii) Study the kinetics of the following reactions. 1. Integrated rate method:
    - a. Acid hydrolysis of methyl acetate with hydrochloric acid.
    - b. Saponification of ethyl acetate.

### Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.*; W.H. Freeman & Co.: New York (2003).
4. *Chemistry: Preparation and Quantitative Analysis*, University Press (2000).
5. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis*, University Press (2000).
6. Vogel, A.I. *A Textbook of Quantitative Inorganic Analysis*, ELBS. 1978
7. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
8. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012)
9. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic*

## Semester IV

### CHEMISTRY-VIII: INORGANIC CHEMISTRY-III

(Credits: Theory-04)

**Theory:**

**60 Lectures**

**Coordination Chemistry:** Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of  $\Delta_o$  in weak (and strong fields, pairing, etc). energies, factors affecting the magnitude of  $\Delta_o$  (Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory. IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.

**(30 Lectures)**

**Transition Elements:** General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Difference between the first, second and third transition series. Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy)

**(22 Lectures)**

**Lanthanoids and Actinoids:** Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

**(8 Lectures)**

#### Reference Books:

1. Purcell, K.F & Kotz, J.C. Inorganic Chemistry W.B. Saunders Co, 1977.
2. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
3. Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.
4. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. Wiley-VCH, 1999
5. Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967.
6. Greenwood, N.N. & Earnshaw A., Chemistry of the Elements, Butterworth- Heinemann, 1997.

**CHEMISTRY-C IX:**  
**ORGANIC CHEMISTRY-III**

**(Credits: Theory-04)**

**Theory:**

**60 Lectures**

**Nitrogen Containing Functional Groups** Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium Salts: Preparation and their synthetic applications.

**(22 Lectures)**

**Polynuclear Hydrocarbons** Reactions of naphthalene phenanthrene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons.

**(12 Lectures)**

**Heterocyclic Compounds** Classification and nomenclature, Structure, aromaticity in 5-numbered and 6- membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction Derivatives of furan: Furfural and furoic acid.

**(26 Lectures)**

**Reference Books:**

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Acheson, R.M. *Introduction to the Chemistry of Heterocyclic compounds*, John Welly & Sons (1976).



5. Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
6. Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
7. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry*, Oxford University Press.
8. Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Prajati Parakashan (2010).

## CHEMISTRY-C X:

### PHYSICAL CHEMISTRY-IV (Credits: Theory-04)

#### Theory:

60 Lectures

**Conductance** Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. 24 Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

(25 Lectures)

**Electrochemistry** Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, 2 quinone-hydroquinone, Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

(35 Lectures)

#### Reference Books:

1. Atkins, P.W & Paula, J.D. *Physical Chemistry*, 9th Ed., Oxford University Press (2011).
2. Castellan, G. W. *Physical Chemistry 4th Ed.*, Narosa (2004).
3. Mortimer, R. G. *Physical Chemistry 3rd Ed.*, Elsevier: NOIDA, UP (2009).
4. Barrow, G. M., *Physical Chemistry 5th Ed.*, Tata McGraw Hill: New Delhi (2006).

5. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.*, Prentice-Hall (2012).
6. Rogers, D. W. *Concise Physical Chemistry* Wiley (2010). □ □ Silbey, R. J.; Alberty, R. A. & Bawendi, M. G. *Physical Chemistry 4th Ed.*, John Wiley & Sons, Inc. (2005).

**CHEMISTRY PRACTICAL-C IV**  
**(Credit- 06)**

**75 Lectures**

**(Group-A)**

1. Detection of extra elements.
2. Functional group test for nitro, amine and amide groups.
3. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds)

**Reference Books**

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012)
3. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*, University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis*, University Press (2000).

**(Group-B)**

**Gravimetric Analysis:**

- i. Estimation of nickel using Dimethylglyoxime (DMG).
- ii. Estimation of copper as CuSCN

**Inorganic Preparations:**

- i. Tetraamminecopper (II) sulphate,  $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot \text{H}_2\text{O}$
- ii. *Cis* and *trans*  $\text{K}[\text{Cr}(\text{C}_2\text{O}_4)_2 \cdot (\text{H}_2\text{O})_2]$  Potassium dioxalatodiaquachromate (III)
- iii. Tetraamminecarbonatocobalt (III) ion
- iv. Potassium tris (oxalate) ferrate(III)

**Reference Book:**

1. Vogel, A.I. A text book of Quantitative Analysis, ELBS 1986.

**Group-C**

**Conductometry**

- 1) Perform the following conductometric titrations:
  - i. Strong acid vs. strong base

- ii. Weak acid vs. strong base
- iii. Mixture of strong acid and weak acid vs. strong base
- iv. Strong acid vs. weak base

### **Potentiometry**

2) Perform the following potentiometric titrations:

- i. Strong acid vs. strong base
- ii. Weak acid vs. strong base
- iii. Dibasic acid vs. strong base
- v. Potassium dichromate vs. Mohr's salt

### **Reference Books:**

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.*; W.H. Freeman & Co.: New York (2003).

## Semester V

### CHEMISTRY-C XI: ORGANIC CHEMISTRY-IV (Credits: Theory-04)

#### Theory:

**60 Lectures**

**Nucleic Acids** Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides.

**(15 Lectures)**

#### **Amino Acids, Peptides and Proteins**

Amino acids, Peptides and their classification.

$\alpha$ -Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pKa values, isoelectric point and electrophoresis;

Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups -Solid-phase synthesis

**(20 Lectures)**

#### **Enzymes**

Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition).

**(10 Lectures)**

#### **Pharmaceutical Compounds: Structure and Importance**

Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).

**(15 Lectures)**

**Reference Books:**

1. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry. VIth Edition. W.H. Freeman and Co.
2. Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) Principles of Biochemistry. IV Edition. W.H. Freeman and Co.
3. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition. Lange Medical Books/ McGraw-Hill.

## CHEMISTRY-C XII:

### PHYSICAL CHEMISTRY V (Credits: Theory-04)

**Theory:**

**60 Lectures**

**Quantum Chemistry** Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and “particle-in-a-box” (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.

**(15 Lectures)**

#### **Molecular Spectroscopy:**

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model.

**(30 Lectures)**

#### **Photochemistry**

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of



photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.

**(15 Lectures)**

**Reference Books:**

1. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).
2. Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001).
3. House, J. E. Fundamentals of Quantum Chemistry 2nd Ed. Elsevier: USA (2004).
4. Lowe, J. P. & Peterson, K. Quantum Chemistry, Academic Press (2005).
5. Kakkar, R. Atomic & Molecular Spectroscopy, Cambridge University Press (2015).

## CHEMISTRY PRACTICAL- C V (Credit- 04)

60 Lectures

### (Group-A)

1. Estimation of glycine by Sorenson's formalin method.
2. Study of the titration curve of glycine.
3. Saponification value of an oil or a fat.
4. Determination of Iodine number of an oil/ fat.

### (Group-B)

#### Colourimetry

- I. Verify Lambert-Beer's law and determine the concentration of  $\text{CuSO}_4/\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$  in a solution of unknown concentration
- II. Determine the concentrations of  $\text{KMnO}_4$  and  $\text{K}_2\text{Cr}_2\text{O}_7$  in a mixture.
- III. Determine the amount of iron present in a sample using 1,10-phenanthroline.

#### Reference Books

1. Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.*; W.H. Freeman & Co.: New York (2003).
4. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
5. Arthur, I. V. *Quantitative Organic Analysis*, Pearson.

## Semester VI

### CHEMISTRY-C XIII: INORGANIC CHEMISTRY-IV (Credits: Theory-04)

Theory:

60 Lectures

#### Theoretical Principles in Qualitative Analysis (H<sub>2</sub> S Scheme)

Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.

(20 Lectures)

#### Inorganic Polymers:

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

(10 Lectures)

#### Bioinorganic Chemistry:

Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine.

(15 Lectures)

#### Catalysis by Organometallic Compounds

Study of the following industrial processes and their mechanism:

1. Alkene hydrogenation (Wilkinsons Catalyst)
2. Hydroformylation (Co salts)
3. Wacker Process
4. Synthetic gasoline (Fischer Tropsch reaction)
5. Synthesis gas by metal carbonyl complexes

(15 Lectures)

#### Reference Books:

##### Recommended Texts:

1. Vogel, A.I. *Qualitative Inorganic Analysis*, Longman, 1972
2. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, 7th Edition, Prentice Hall, 1996-03-07.

3. Cotton, F.A. G.; Wilkinson & Gaus, P.L. *Basic Inorganic Chemistry 3rd Ed.*; Wiley India,
4. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed.*, Harper Collins 1993, Pearson, 2006.
5. Sharpe, A.G. *Inorganic Chemistry*, 4th Indian Reprint (Pearson Education) 2005
6. Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry 3rd Ed.*, John Wiley and Sons, NY, 1994.
7. Greenwood, N.N. & Earnshaw, A. *Chemistry of the Elements, Elsevier 2nd Ed*, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
8. Lee, J.D. *Concise Inorganic Chemistry 5th Ed.*, John Wiley and sons 2008.
9. Powell, P. *Principles of Organometallic Chemistry*, Chapman and Hall, 1988.
10. Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.*, Oxford University Press, 1994.
11. Basolo, F. & Person, R. *Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed.*, John Wiley & Sons Inc; NY.
12. Purcell, K.F. & Kotz, J.C., *Inorganic Chemistry*, W.B. Saunders Co. 1977
13. Miessler, G. L. & Donald, A. Tarr, *Inorganic Chemistry 4th Ed.*, Pearson, 2010.
14. Collman, James P. et al. *Principles and Applications of Organotransition Metal Chemistry*. Mill Valley, CA: University Science Books, 1987.
15. Crabtree, Robert H. *The Organometallic Chemistry of the Transition Metals*.j
16. New York, NY: John Wiley, 2000.
17. Spessard, Gary O., & Gary L. Miessler. *Organometallic Chemistry*. Upper Saddle River, NJ: Prentice-Hall, 1996.

**CHEMISTRY-C XIV: ORGANIC CHEMISTRY-IV (Credits: Theory-04 )**

**Theory:**

**60 Lectures**

**Organic Spectroscopy**

General principles Introduction to absorption and emission spectroscopy. *UV Spectroscopy*: Types of  $\lambda$  electronic transitions, max, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules  $\lambda_{\text{max}}$  for calculation for  $\alpha, \beta$  the unsaturated following aldehydes, systems: ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

*IR Spectroscopy*: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.

**(24 Lectures)**

**Carbohydrates**

Occurrence, classification and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; Disaccharides – Structure elucidation of maltose, lactose and sucrose. Polysaccharides – Elementary treatment of starch, cellulose and glycogen.

**(16 Lectures)**

**Dyes**

Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes - Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes – structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.

**(8 Lectures)**

**Alkaloids** Natural occurrence, General structural features, Isolation and their physiological action Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

**(6 Lectures)**

### **Terpenes**

Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral, Neral and  $\alpha$ -terpineol.

**(6 Lectures)**

### **Reference Books:**

1. Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
2. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Billmeyer, F. W. *Textbook of Polymer Science*, John Wiley & Sons, Inc.
4. Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. *Polymer Science*, New Age International (P) Ltd. Pub.
5. Finar, I. L. *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
7. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry*, Oxford University Press.
8. Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Prajati Prakashan (2010).
9. Kemp, W. *Organic Spectroscopy*, Palgrave

## CHEMISTRY PRACTICAL - C VI

### (Group-A)

Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:

$\text{CO}_3^{2-}$ ,  $\text{NO}_2^-$ ,  $\text{S}^{2-}$ ,  $\text{SO}_3^{2-}$ ,  $\text{S}_2\text{O}_3^{2-}$ ,  $\text{CH}_3\text{COO}^-$ ,  $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{NO}_3^-$ ,  $\text{BO}_3^{3-}$ ,  $\text{C}_2\text{O}_4^{2-}$ ,  $\text{PO}_4^{3-}$ ,  $\text{NH}_4^+$ ,  $\text{K}^+$ ,  $\text{Pb}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Bi}^{3+}$ ,  $\text{Sn}^{2+}$ ,  $\text{Sb}^{3+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$ ,  $\text{Cr}^{3+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$

Mixtures should preferably contain one interfering anion, **or** insoluble component ( $\text{BaSO}_4$ ,  $\text{SrSO}_4$ ,  $\text{PbSO}_4$ ,  $\text{CaF}_2$  or  $\text{Al}_2\text{O}_3$ ) **or** combination of anions e.g.  $\text{CO}_3^{2-}$  and  $\text{SO}_3^{2-}$ ,  $\text{NO}_2^-$  and  $\text{NO}_3^-$ ,  $\text{Cl}^-$  and  $\text{Br}^-$ ,  $\text{Cl}^-$  and  $\text{I}^-$ ,  $\text{Br}^-$  and  $\text{I}^-$ ,  $\text{NO}_3^-$  and  $\text{Br}^-$ ,  $\text{NO}_3^-$  and  $\text{I}^-$ .

Spot tests should be done whenever possible.

- Measurement of 10 Dq by spectrophotometric method
- Verification of spectrochemical series.
- Controlled synthesis of two copper oxalate hydrate complexes: kinetic vs thermodynamic factors.
- Preparation of acetylacetonato complexes of  $\text{Cu}^{2+}/\text{Fe}^{3+}$ . Find  $\lambda_{\text{max}}$  of the complex.
- Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g. bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

### (Group-B)

- Extraction of caffeine from tea leaves.
- Preparation of sodium poly acrylate.
- Preparation of urea formaldehyde.
- Analysis of Carbohydrate: aldoses and ketoses, reducing and non-reducing sugars.
- Qualitative analysis of unknown organic compounds containing mono functional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bi functional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols etc.
- Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided).
- Preparation of methyl orange.

**Reference Books:**

1. Vogel, A.I. *Quantitative Organic Analysis*, Part 3, Pearson (2012).
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012)
4. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*, University Press (2000).
5. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis*, University Press (2000).
6. Vogel's *Qualitative Inorganic Analysis*, Revised by G. Svehla.
7. Marr & Rockett *Inorganic Preparations*.



# CHEMISTRY-DSE I-IV (ELECTIVES)

## CHEMISTRY-DSE-I : APPLICATIONS OF COMPUTERS IN CHEMISTRY

(Credits: Theory-04)

Theory:

60 Lectures

### Basics:

Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics. Compiled versus interpreted languages. Debugging. Simple programs using these concepts. Matrix addition and multiplication. Statistical analysis.

(25 Lectures)

### Numerical methods:

*Roots of equations:* Numerical methods for roots of equations: Quadratic formula, iterative method, Newton-Raphson method, Binary bisection and Regula-Falsi.

*Differential calculus:* Numerical differentiation.

*Integral calculus:* Numerical integration (Trapezoidal and Simpson's rule), probability distributions and mean values.

*Simultaneous equations:* Matrix manipulation: addition, multiplication. Gauss-Siedal method.

(35 Lectures)

### Reference Books:

1. Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007) Chapters 3-5.
2. Levie, R. de, *How to use Excel in analytical chemistry and in general scientific data analysis*, Cambridge Univ. Press (2001) 487 pages.
3. Noggle, J. H. *Physical chemistry on a Microcomputer*. Little Brown & Co. (1985).
4. Venit, S.M. *Programming in BASIC: Problem solving with structure and style*. Jaico
5. Publishing House: Delhi (1996).

## PRACTICAL-DSE LAB- I:

### APPLICATIONS OF COMPUTERS IN CHEMISTRY

60 Lectures

Computer programs based on numerical methods for

1. Roots of equations: (e.g. volume of van der Waals gas and comparison with ideal gas, pH of a weak acid).
2. Numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, potentiometric titrations).
3. Numerical integration (e.g. entropy/ enthalpy change from heat capacity data), probability distributions (gas kinetic theory) and mean values.

#### Reference Books:

1. McQuarrie, D. A. *Mathematics for Physical Chemistry* University Science Books (2008).
2. Mortimer, R. *Mathematics for Physical Chemistry*. 3rd Ed. Elsevier (2005).
3. Steiner, E. *The Chemical Maths Book* Oxford University Press (1996).
4. Yates, P. *Chemical Calculations*. 2nd Ed. CRC Press (2007).
5. Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007) Chapters 3-5.
6. Levie, R. de, *How to use Excel in analytical chemistry and in general scientific data analysis*, Cambridge Univ. Press (2001) 487 pages.
7. Noggle, J. H. *Physical Chemistry on a Microcomputer*. Little Brown & Co. (1985).
8. Venit, S.M. *Programming in BASIC: Problem solving with structure and style*. Jaico Publishing House: Delhi (1996).

## CHEMISTRY-DSE- II :

### ANALYTICAL METHODS IN CHEMISTRY

(Credits: Theory-04)

#### Theory: 60 Lectures

##### **Optical methods of analysis:**

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

*UV-Visible Spectrometry:* Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument;

*Infrared Spectrometry:* Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques.

Structural illustration through interpretation of data, Effect and importance of isotope substitution.

*Flame Atomic Absorption and Emission Spectrometry:* Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

(25 Lectures)

##### **Thermal methods of analysis:**

Theory of thermogravimetry (TG), basic principle of instrumentation.

Techniques for quantitative estimation of Ca and Mg from their mixture.

(10 Lectures)

##### **Electroanalytical methods:**

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pK<sub>a</sub> values.

(10 Lectures)

##### **Separation techniques:**

Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and

nonaqueous media. Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods.

**(15 Lectures)**

**Reference Books:**

1. Vogel, Arthur I: A Text book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman .
2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, 36 International Pu blisher, 2009.
6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.
7. Mikes, O. & Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.
8. Ditts, R.V. Analytical Chemistry – Methods of separation.

## **PRACTICALS- DSE LAB-II (2):**

### **ANALYTICAL METHODS IN CHEMISTRY**

**60 Lectures**

#### **I. Separation Techniques**

1. Chromatography: Separation of mixtures

(i) Paper chromatographic separation of  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$ , and  $\text{Cr}^{3+}$ .

(ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the  $R_f$  values.

#### **2. Solvent Extractions:**

To separate a mixture of  $\text{Ni}^{2+}$  &  $\text{Fe}^{2+}$  by complexation with DMG and extracting the  $\text{Ni}^{2+}$  DMG complex in chloroform, and determine its concentration by spectrophotometry. Solvent extraction of zirconium with amberlite LA-1, separation from a mixture of irons and gallium.

3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

4. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.

5. Analysis of soil: Determination of pH of soil.

#### **Reference Books:**

1. Vogel, Arthur I: A Text book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman .
2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.

6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.
7. Mikes, O. & Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.
8. Ditts, R.V. Analytical Chemistry – Methods of separation.

## **CHEMISTRY-DSE - III: GREEN CHEMISTRY**

**(Credits: Theory-04)**

**Theory: 60**

### **Lectures Introduction to Green Chemistry**

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry.

**(4 Lectures)**

### **Principles of Green Chemistry and Designing a Chemical synthesis**

Twelve principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products (Atom Economy); prevention/ minimization of hazardous/ toxic products; designing safer chemicals – different basic approaches to do so; selection of appropriate auxiliary substances (solvents, separation agents), green solvents, solventless processes, immobilized solvents and ionic liquids; energy requirements for reactions - use of microwaves, ultrasonic energy; selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups; use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; designing of biodegradable products; prevention of chemical accidents; strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.

**(36 Lectures)**

### **Examples of Green Synthesis/ Reactions**

Green Synthesis of the following compounds: adipic acid, catechol, BHT, methyl methacrylate, urethane, aromatic amines (4-aminodiphenylamine), benzyl bromide, acetaldehyde, disodium iminodiacetate (alternative to Strecker synthesis), citral, i buprofen, paracetamol, furfural.

**(10 Lectures)**

## **Future Trends in Green Chemistry**

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; oncovalent derivatization; Green chemistry in sustainable development.

**(10 Lectures)**

### **Reference Books:**

1. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005).
2. P.T. Anastas & J.K. Warner: Oxford Green Chemistry- Theory and Practical, University Press (1998).
3. A.S. Matlack: Introduction to Green Chemistry, Marcel Dekker (2001).
4. M.C. Cann & M.E. Connely: Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).
5. M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical Society, Washington (2002).



## CHEMISTRY PRACTICAL – DSE- III (2) LAB: GREEN CHEMISTRY

60 Lectures

**1. Using renewable resources** Preparation of biodiesel from vegetable oil.

**2. Avoiding waste**

Principle of atom economy.

Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry. Preparation of propene by any one method can be studied (I) Triethylamine ion + OH<sup>-</sup> → propene + trimethylpropene + water H<sub>2</sub>SO<sub>4</sub>/ (II) 1-propanol propene + water

**3. Diels Alder reaction in water**

Reaction between furan and maleic acid in water and at room temperature rather than in benzene and reflux.

4. Extraction of D-limonene from orange peel using liquid CO<sub>2</sub> prepared form dry ice.

**Reference Books:**

1. Anastas, P.T & Warner, J.C. *Green Chemistry: Theory and Practice*, Oxford University Press (1998).
2. Kirchoff, M. & Ryan, M.A. *Greener approaches to undergraduate chemistry experiment*. American Chemical Society, Washington DC (2002).
3. Ryan, M.A. *Introduction to Green Chemistry*, Tinnesand; (Ed), American Chemical Society, Washington DC (2002).
4. Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. *Green Chemistry Experiment: A monograph International Publishing House Pvt Ltd. New Delhi*. Bangalore CISBN 978-93-81141-55-7 (2013).
5. Cann, M.C. & Connelly, M. E. *Real world cases in Green Chemistry*, American Chemical Society (2008).
6. Cann, M. C. & Thomas, P. *Real world cases in Green Chemistry*, American Chemical Society (2008).
7. Pavia, D. L. Lamponan, G. H. & Kriz, G.S. *W B Introduction to organic laboratory*

## CHEMISTRY-DSE - IV:

### INDUSTRIAL CHEMICALS AND ENVIRONMENT

(Credits: Theory-04)

Theory:

60 Lectures

#### Industrial Gases and Inorganic Chemicals

*Industrial Gases:* Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

*Inorganic Chemicals:* Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

(14 Lectures)

#### Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur. Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution.

Pollution by  $\text{SO}_2$ ,  $\text{CO}_2$ ,  $\text{CO}$ ,  $\text{NO}_x$ ,  $\text{H}_2\text{S}$  and other foul smelling gases. Methods of estimation of  $\text{CO}$ ,  $\text{NO}_x$ ,  $\text{SO}_x$  and control procedures.

Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.

*Water Pollution:* Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.

Water purification methods.

Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal.

(30 Lectures)

**Energy & Environment**

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc. Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

**(10 Lectures)**

**Biocatalysis**

Introduction to biocatalysis: Importance in “Green Chemistry” and Chemical Industry.

**(6 Lectures)**

**Reference Books:**

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
4. S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
5. K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
6. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.
7. S.E. Manahan, *Environmental Chemistry*, CRC Press (2005).
8. G.T. Miller, *Environmental Science* 11th edition. Brooks/ Cole (2006).
9. A. Mishra, *Environmental Studies*. Selective and Scientific Books, New Delhi (2005).

**CHEMISTRY PRACTICAL - DSE LAB- IV(2) :  
INDUSTRIAL CHEMICALS & ENVIRONMENT**

**60 Lectures**

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Percentage of available chlorine in bleaching powder.
4. Measurement of chloride, sulphate and salinity of water samples by simple titration method ( $\text{AgNO}_3$  and potassium chromate).
5. Estimation of total alkalinity of water samples ( $\text{CO}_3^{2-}$ ,  $\text{HCO}_3^-$ ) using double titration method.

**Reference Books:**

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. J. A. Kent: *Riegel's Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
4. S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
5. K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
6. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.

**Skill Enhancement Course (any two) (Credit: 02 each)- SEC1 to SEC4**

**BUSINESS SKILLS FOR CHEMISTS**

**(Credits: 02) Theory:**

**30 Lectures**

**Business Basics**

Key business concepts: Business plans, market need, project management and routes to market.

**Chemistry in Industry**

Current challenges and opportunities for the chemistry-using industries, role of chemistry in India and global economies.

**Making money**

Financial aspects of business with case studies

**Intellectual property** Concept of intellectual property, patents.

**Reference**

[www.rsc.org](http://www.rsc.org)

## INTELLECTUAL PROPERTY RIGHTS (IPR)

(Credits: 02)

### Theory:

30 Lectures

*In this era of liberalization and globalization, the perception about science and its practices has undergone dramatic change. The importance of protecting the scientific discoveries, with commercial potential or the intellectual property rights is being discussed at all levels – statutory, administrative, and judicial. With India ratifying the WTO agreement, it has become obligatory on its part to follow a minimum acceptable standard for protection and enforcement of intellectual property rights. The purpose of this course is to apprise the students about the multifaceted dimensions of this issue.*

### Introduction to Intellectual Property:

Historical Perspective, Different Types of IP, Importance of protecting IP.

### Copyrights

Introduction, How to obtain, Differences from Patents.

### Trade Marks

Introduction, How to obtain, Different types of marks – Collective marks, certification marks, service marks, Trade names, etc. Differences from Designs.

### Patents

Historical Perspective, Basic and associated right, WIPO, PCT system, Traditional Knowledge, Patents and Healthcare – balancing promoting innovation with public health, Software patents and their importance for India.

### Different International agreements

#### (a) World Trade Organization (WTO):

- (i) General Agreement on Tariffs & Trade (GATT), Trade Related Intellectual Property Rights (TRIPS) agreement
- (ii) General Agreement on Trade related Services (GATS)
- (iii) Madrid Protocol
- (iv) Berne Convention
- (v) Budapest Treaty

#### (b) Paris Convention

**WIPO and TRIPS, IPR and Plant Breeders Rights, IPR and Biodiversity**

**IP Infringement issue and enforcement** – Role of Judiciary, Role of law enforcement agencies – Police, Customs etc. Economic Value of Intellectual Property – Intangible assets and their valuation, Intellectual Property in the Indian Context – Various laws in India Licensing and technology transfer.

**Reference Books:**

1. N.K. Acharya: *Textbook on intellectual property rights*, Asia Law House (2001).
2. Manjula Guru & M.B. Rao, *Understanding Trips: Managing Knowledge in Developing Countries*, Sage Publications (2003).
3. P. Ganguli, *Intellectual Property Rights: Unleashing the Knowledge Economy*, Tata McGraw-Hill (2001).
4. Arthur Raphael Miller, Micheal H.Davis; *Intellectual Property: Patents, Trademarks and Copyright in a Nutshell*, West Group Publishers (2000).
5. Jayashree Watal, *Intellectual property rights in the WTO and developing countries*,
6. Oxford University Press, Oxford.

**Generic Elective Papers (GE) (Minor-Chemistry) (any four) for other Departments/Disciplines: (Credit: 06 each)**

**GE: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS (Credits: Theory-04)**

**Theory:**

**60 Lectures**

***Section A: Inorganic Chemistry-1 (30 Periods)***

**Atomic Structure:** *Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. Significance of quantum numbers, orbital angular momentum and quantum numbers  $ml$  and  $ms$ . Shapes of  $s$ ,  $p$  and  $d$  atomic orbitals, nodal planes. Discovery of spin, spin quantum number ( $s$ ) and magnetic spin quantum number ( $ms$ ). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.*

**(14 Lectures)**

**Chemical Bonding and Molecular Structure**

***Ionic Bonding:*** General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

***Covalent bonding:*** VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

**(16 Lectures)**



## **Section B: Organic Chemistry-1 (30 Periods)**

### **Fundamentals of Organic Chemistry**

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. 45 Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

**(8 Lectures)**

### **Stereochemistry**

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis* - *trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

**(10 Lectures)**

### **Aliphatic Hydrocarbons**

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

**Alkanes:** (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

**Alkenes:** (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); *cis* alkenes (Partial catalytic hydrogenation) and *trans* alkenes (Birch reduction). *Reactions:* *cis*-addition (alk. KMnO<sub>4</sub>) and *trans* -addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation.

**Alkynes:** (Upto 5 Carbons) *Preparation:* Acetylene from CaC<sub>2</sub> and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline KMnO<sub>4</sub>, ozonolysis and oxidation with hot alk. KMnO<sub>4</sub>.

**(12 Lectures)**

**Reference Books:**

1. J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.
2. F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
3. Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*, John Wiley.
4. James E. Huheey, Ellen Keiter and Richard Keiter: *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
5. T. W. Graham Solomon: *Organic Chemistry*, John Wiley and Sons.
6. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
7. E. L. Eliel: *Stereochemistry o f Carbon Compounds*, Tata McGraw Hill.
8. I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
9. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
10. Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand

# GE LAB - I: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

## 60 Lectures

### *Section A: Inorganic Chemistry - Volumetric Analysis*

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with  $\text{KMnO}_4$ .
3. Estimation of water of crystallization in Mohr's salt by titrating with  $\text{KMnO}_4$ .
4. Estimation of Fe (II) ions by titrating it with  $\text{K}_2\text{Cr}_2\text{O}_7$  using internal indicator.
5. Estimation of Cu (II) ions iodometrically using  $\text{Na}_2\text{S}_2\text{O}_3$ .

### *Section B:*

### *Organic Chemistry*

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)

### **Reference Books:**

1. Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
2. Vogel's Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.
3. Textbook of Practical Organic Chemistry, A.I. Vogel, Prentice Hall, 5th edition.
4. Practical Organic Chemistry, F. G. Mann. & B. C. Saunders, Orient Longman, 1960.

**GE- II :CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY-I**  
(Credits: Theory-04)

**Theory:**

**60 Lectures**

***Section A: Physical Chemistry-1***

**(30 Lectures)**

**Chemical Energetics**

Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

**(10 Lectures)**

**Chemical Equilibrium:**

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between  $G$  and  $G^\circ$ , Le Chatelier's principle. Relationships between  $K_p$ ,  $K_c$  and  $K_x$  for reactions involving ideal gases.

**(8 Lectures)**

**Ionic Equilibria:**

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

**(12 Lectures)**

***Section B: Organic Chemistry-2 (30 Lectures)***

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

**Aromatic hydrocarbons**

*Preparation* (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

*Reactions:* (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

**(10 Lectures)**

**Alkyl and Aryl Halides** Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions.

*Preparation:* from alkenes and alcohols.

*Reactions:* hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

**Aryl Halides** *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

*Reactions (Chlorobenzene):* Aromatic nucleophilic substitution (replacement by -OH group) and effect of nitro substituent. Benzyne Mechanism:  $\text{KNH}_2/\text{NH}_3$  (or  $\text{NaNH}_2/\text{NH}_3$ ).

**(10 Lectures)**

**Alcohols and Phenols** Upto 5 Carbons) **Alcohols:** *Preparation:* Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

*Reactions:* With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk.  $\text{KMnO}_4$ , acidic dichromate, conc.  $\text{HNO}_3$ ). Oppeneauer oxidation *Diols:* (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

**Phenols:** (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben-Hoesch Condensation, Schotten-Baumann Reaction.

**(10 Lectures)**

#### **Reference Books:**

1. T. W. Graham Solomons: *Organic Chemistry*, John Wiley and Sons.
2. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
3. I.L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
4. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
5. Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand.
6. G. M. Barrow: *Physical Chemistry* Tata McGraw-Hill (2007).
7. G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).

8. J. C. Kotz, P. M. Treichel & J. R. Townsend: *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
9. B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
10. R. H. Petrucci: *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

## GE LAB- II: CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY-I

60 Lectures

### *Section A: Physical Chemistry*

#### **Thermochemistry**

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

#### **Ionic equilibria pH measurements**

- a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
- b) Preparation of buffer solutions:
  - (i) Sodium acetate-acetic acid
  - (ii) Ammonium chloride-ammonium hydroxide Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

### *Section B: Organic Chemistry*

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
  - (a) Bromination of Phenol/Aniline
  - (b) Benzoylation of amines/phenols
  - (c) Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone

#### **Reference Books**

1. A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
2. F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960).
3. B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

**GE-III : SOLUTIONS, PHASE EQUILIBRIUM,  
CONDUCTANCE, ELECTROCHEMISTRY &  
FUNCTIONAL GROUP ORGANIC CHEMISTRY-II**  
(Credits: Theory-04) Theory:

60 Lectures

***Section A: Physical Chemistry-2***

**(30 Lectures)**

**Solutions** Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

**Phase Equilibrium**

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur)

**Conductance**

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions. Conductometric titrations (only acid-base).

**Electrochemistry**

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties:  $G$ ,  $H$  and  $S$  from EMF data.

***Section B: Organic Chemistry-3 (30 Lectures)***

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

**Carboxylic acids and their derivatives**

Carboxylic acids (aliphatic and aromatic) *Preparation*: Acidic and Alkaline hydrolysis of esters. *Reactions*: Hell – Vohlard - Zelinsky Reaction.

**Carboxylic acid derivatives (aliphatic):** (Upto 5 carbons)



*Preparation:* Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. *Reactions:* Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

**(6 Lectures)**

### **Amines and Diazonium Salts**

Amines (Aliphatic and Aromatic): (Upto 5 carbons) *Preparation:* from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. *Reactions:* Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with  $\text{HNO}_2$ , Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

**Diazonium salts:** *Preparation:* from aromatic amines. *Reactions:* conversion to benzene, phenol, dyes.

**(6 Lectures)**

### **Amino Acids, Peptides and Proteins:**

*Preparation of Amino Acids:* Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis. *Reactions of Amino acids:* ester of  $-\text{COOH}$  group, acetylation of  $-\text{NH}_2$  group, complexation with  $\text{Cu}_2^+$  ions, ninhydrin test. Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.

**(10 Lectures)**

### **Carbohydrates:**

Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disaccharides (sucrose, cellobiose, maltose, lactose).

**(8 Lectures)**

### **Reference Books:**

1. G. M. Barrow: *Physical Chemistry* Tata McGraw-Hill (2007).
2. G. W. Castellan: *Physical Chemistry* 4th Ed. Narosa (2004).
3. J. C. Kotz, P. M. Treichel, J. R. Townsend, *General Chemistry*, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
4. B. H. Mahan: *University Chemistry*, 3rd Edn. Narosa (1998).
5. R. H. Petrucci, *General Chemistry*, 5th Edn., Macmillan Publishing Co.: New York (1985).

6. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
7. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
8. Finar, I. L. *Organic Chemistry (Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.*, W. H. Freeman.
10. Berg, J. M., Tymoczko, J. L. & Stryer, L. *Biochemistry 7th Ed.*, W. H. Freeman

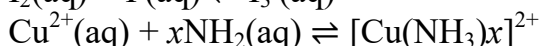
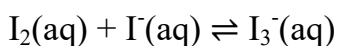
# GE LAB- III: SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL ORGANIC CHEMISTR-II

60 Lectures

## *Section A: Physical Chemistry*

### **Distribution**

Study of the equilibrium of one of the following reactions by the distribution method:



### **Conductance**

- i. Determination of cell constant
- ii. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
- iii. Perform the following conductometric titrations:
- iv. Strong acid vs. strong base
- v. Weak acid vs. strong base
- vi. Weak acid vs. strong base

## *Section B: Organic Chemistry*

Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

### **Reference Books:**

1. A.I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn.
2. F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman, 1960.
3. B.D. Khosla: Senior Practical Physical Chemistry, R. Chand & Co.
4. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Press.

## **GE- IV:CHEMISTRY OF S- AND P-BLOCK ELEMENTS, STATES OF MATTER & CHEMICAL KINETICS**

**(Credits: Theory-04)**

**Theory:**

**60 Lectures**

### **General Principles of Metallurgy**

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent.

**(4 Lectures)**

### ***s*- and *p*-Block Elements**

Periodicity in *s*- and *p*-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling, Mulliken, and Alfred- Rochow scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

### **Compounds of *s*- and *p*-Block Elements**

Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of *p*- block elements. Concept of multicentre bonding (diborane). Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry. Hydrides of nitrogen (NH<sub>3</sub>, N<sub>2</sub>H<sub>4</sub>, N<sub>3</sub>H, NH<sub>2</sub>OH)

**(26 Lectures)**

### ***Section B: Physical Chemistry-3 (30 Lectures)***

#### **Kinetic Theory of Gases**

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO<sub>2</sub>.

#### **Solids**

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X-Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl

and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

### **Chemical Kinetics**

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

### **Reference Books:**

1. G. M. Barrow: *Physical Chemistry* Tata McGraw-Hill (2007).
2. G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).
3. J. C. Kotz, P. M. Treichel & J. R. Townsend: *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
5. R. H. Petrucci: *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
6. J. D. Lee: *A New Concise Inorganic Chemistry*, E.L.B.S.\
7. F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
8. D. F. Shriver and P. W. Atkins: *Inorganic Chemistry*, Oxford University Press. Gary Wulfsberg: *Inorganic Chemistry*, Viva Books Pvt. Ltd.

## GE LAB- IV:CHEMISTRY OF S- AND P-BLOCK ELEMENTS, STATES OF MATTER & CHEMICAL KINETICS

60 Lectures

### *Section A: Inorganic Chemistry*

Semi-micro qualitative analysis using H<sub>2</sub>S of mixtures- not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH<sup>4+</sup>, Pb<sup>2+</sup>, Ag<sup>+</sup>, Bi<sup>3+</sup>, Cu<sup>2+</sup>, Cd<sup>2+</sup>, Sn<sup>2+</sup>, Fe<sup>3+</sup>, Al<sup>3+</sup>, Co<sup>2+</sup>, Cr<sup>3+</sup>, Ni<sup>2+</sup>, Mn<sup>2+</sup>, Zn<sup>2+</sup>, Ba<sup>2+</sup>, Sr<sup>2+</sup>, Ca<sup>2+</sup>, K<sup>+</sup> Anions : CO<sub>3</sub><sup>2-</sup>, S<sup>2-</sup>, SO<sub>3</sub><sup>2-</sup>, S<sub>2</sub>O<sub>3</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, PO<sub>4</sub><sup>3-</sup>, BO<sub>3</sub><sup>3-</sup>, C<sub>2</sub>O<sub>4</sub><sup>2-</sup>, F<sup>-</sup>

*(Spot tests should be carried out wherever feasible)*

### *Section B: Physical Chemistry*

(I) Surface tension measurement (use of organic solvents excluded).

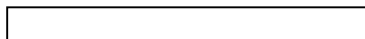
- Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
- Study of the variation of surface tension of a detergent solution with concentration.

(II) Viscosity measurement (use of organic solvents excluded).

- Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
- Study of the variation of viscosity of an aqueous solution with concentration of solute.

### Reference Books:

1. A.I. Vogel, Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
2. A.I. Vogel, Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
3. B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.



**Sido-Kanhu Murmu University, Dumka**  
**B. Sc. HONOURS IN PHYSICS (under CBCS) w.e.f. 2015-2018**  
**Course Structure**

Course Name		Full Marks
<b>SEM I</b>		
PHY-CC-1.T	MATHEMATICAL PHYSICS-I (04 Credits, 60 Lectures)	75
PHY-CC-2.T	MECHANICS (04 Credits, 60 Lectures)	75
PHY-CC-1&2.P	(PRACTICAL) (04 Credits)	50
GE -1.T/(1.T+1.P)	from other disciplines (06 Credits/(04 + 02 Credits))	100/(75+25)
PHY-AECC1	LANGUAGE (ENGLISH/HINDI)	50
<b>SEM II</b>		
PHY-CC-3.T	ELECTRICITY AND MAGNETISM (04 Credits, 60 Lectures)	75
PHY-CC-4.T	OPTICS (04 Credits, 60 Lectures)	75
PHY-CC-3&4.P	(PRACTICAL) (04 Credits)	50
GE -2.T/(2.T+2.P)	from other disciplines (06 Credits/(04 + 02 Credits))	100/(75+25)
PHY-AECC2	ENVIRONMENTAL STUDIES	50
<b>SEM III</b>		
PHY-CC-5.T	MATHEMATICAL PHYSICS -II AND THERMAL PHYSICS (04Credits, 60 Lectures)	75
PHY-CC-6.T	PHYSICS OF THERMODYNAMICS (04 Credits, 60 Lectures)	75
PHY-CC-7.T	ANALOG SYSTEMS AND APPLICATIONS (04 Credits, 60 Lectures)	75
PHY-CC-5,6&7P	(PRACTICAL) (06 Credits)	50
GE -3.T/(3.T+3.P)	from other disciplines (06 Credits/(04 + 02 Credits))	100/(75+25)
PHY-SEC-1	ELECTRICAL CIRCUIT & NETWORK SKILLS (Credits: 02; Theory: 30 Lectures)	50
<b>SEM IV</b>		
PHY-CC-8.T	MATHEMATICAL PHYSICS-III (04 Credits, 60 Lectures)	75
PHY-CC-9.T	QUANTUM MECHANICS (04 Credits, 60 Lectures)	75
PHY-CC-10.T	DIGITAL SYSTEMS AND APPLICATIONS (04 Credits, 60 Lectures)	75
PHY-CC-8,9&10P	(PRACTICAL) (06 Credits)	50
GE -4.T/(4.T+4.P)	from other disciplines (06 Credits/(04 + 02 Credits))	100/(75+25)
PHY-SEC-2	APPLIED OPTICS (Credits: 02) THEORY: 30 Lectures	50

<b>SEM V</b>		
PHY-CC-11.T	ATOMIC, MOLECULAR, LASER AND NUCLEAR PHYSICS (04 Credits, 60 Lectures)	75
PHY-CC-12.T	SOLID STATE PHYSICS (04 Credits, 60 Lectures)	75
PHY-CC-11&12P	(PRACTICAL) (04 Credits)	50
PHY-DSE-1.T	PHYSICS OF DEVICE & INSTRUMENT (04 Credits, 60 Lectures)	75
PHY-DSE-2.T	ADVANCE MATHEMATICAL PHYSICS (04 Credits, 60 Lectures)	75
PHY-DSE-1&2P	(PRACTICAL) (04 Credits)	50
<b>SEM VI</b>		
PHY-CC-13.T	ELECTROMAGNETIC THEORY (04 Credits, 60 Lectures)	75
PHY-CC-14.T	STATISTICAL MECHANICS (04 Credits, 60 Lectures)	75
PHY-CC-13&14P	(PRACTICAL) (04 Credits)	50
PHY-DSE-3.T	CLASSICAL DYNAMICS (Credits: Theory-04, Tutorial-02) Theory: 75 Lectures	75+25
PHY-DSE-4.T	NUCLEAR & PARTICLE PHYSICS (Credits: Theory-04, Tutorial-02) Theory: 75 Lectures	75+25
Extra-Curricular Based Activities ( <i>list-under UG regulation: page 17</i> )		50
<b>OR</b>		
PHY-CC-13.T	ELECTROMAGNETIC THEORY (04 Credits, 60 Lectures)	75
PHY-CC-14.T	STATISTICAL MECHANICS (04 Credits, 60 Lectures)	75
PHY-CC-13&14P	(PRACTICAL) (04 Credits)	50
PHY-DSE-3.T	CLASSICAL DYNAMICS (Credits: Theory-04, Tutorial-02) Theory: 75 Lectures	75+25
PHY-DSE-4	DISSERTATION	100
Extra-Curricular Based Activities ( <i>list-under UG regulation: page 17</i> )		50



## **GENERIC ELECTIVES FOR PHYSICS HONOURS STUDENTS**

Any one discipline out of the following (annexure-2 of UG regulation)

1. MATHEMATICS
2. CHEMISTRY
3. GEOLOGY
4. STATISTICS

**Important Instructions for faculty members and question setters**  
***(see Table-09 of UG regulation).***

**Para I:**

A paper having 06 credits carry 100 marks; 80 marks for end semester exam and 20 marks for internal exam (mid term), which further divided as 15 (internal exam-theory/practical) + 05 (attendance and other activities).

A candidate has to answer Five Questions out of Nine Questions of which Question no. 1 is compulsory and will be of short answer type to be answered in about 100 words (4 Questions to be answered out of 8). Out of the remaining 08 (eight) Questions, 04 (four) are to be answered. Each question carries 16 marks.

**Para II:**

A paper having 04 credits carry 75 marks; 60 marks for end semester exam and 15 marks for internal exam (mid term), which further divided as 10 (internal exam-theory/practical) + 05 (attendance and other activities).

A candidate has to answer Five Questions out of Nine Questions of which Question no. 1 is compulsory and will be of short answer type to be answered in about 100 words (3 Questions to be answered out of 6). Out of the remaining 08 (eight) Questions, 04 (four) are to be answered. Each question carries 12 marks.

**Para III:**

A paper having 02 credits carry 50 marks; 40 marks for end semester exam and 10 marks for internal exam (mid term), which further divided as 05 (internal exam-theory/practical) + 05 (attendance and other activities).

A candidate has to answer Three Questions out of Five Questions of which Question no. 1 is compulsory and will be of short answer type to be answered in about 100 words (2 Questions to be answered out of 4) and carry 05 marks each. Out of the remaining 04 (four) Questions, 02 (two) are to be answered and carries 15 marks.

## SYLLABUS

### CORE COURSES (HONOURS IN PHYSICS)

#### SEMESTER-I

##### **PHY-CC-1.T: MATHEMATICAL PHYSICS-I**

**(04 Credits, 60 Lectures)**

**Calculus:** Binomial series (statements only). First Order Differential Equations and Integrating Factor. Second Order Differential equations: Homogeneous Equations with constant coefficients.

**(14 Lectures)**

**Vector Calculus:** 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 and their physical interpretation. **(14 Lectures)**

Line, surface and volume integrals. Gauss' divergence theorem, Green's and Stoke's Theorems and their applications. **(18 Lectures)**

**Orthogonal Curvilinear Coordinates:**

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. **(14 Lectures)**

**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.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
7. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
8. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press.
9. Vector Analysis by Spigel..

##### **PHY-CC-2.T: MECHANICS (04 Credits, 60 Lectures)**

**Elasticity:** Relation between Elastic constants. Twisting torque on a Cylinder or Wire, Bending moment, Cantiliver, beam supported at the end and loaded at middle and its application to determine Young's modulus, Searle's experiments, Flat spiral spring. Effect of temperature and pressure on elasticity. **(10 Lectures)**

**Fluid Motion:** Kinematics of Moving Fluids: Viscous fluid, Poiseuille's Equation for Flow of a Liquid through a Capillary Tube with correction, Flow of compressible fluid through a capillary tube, Rankine's methods for measurement of viscosity of gas. Effect of temperature and pressure on viscosity. **(5 Lectures)**

**Surface Tension:** Surface tension and surface energy, angle of contact, expression for excess pressure, principal of virtual work, Ripples and Gravity waves. Effect of temperature and pressure

on surface tension. **(4 Lectures)**

**Central Force Motion:**

Two bodies problem, Motion under central force field. Conservation of angular momentum, Kepler's Laws. **(6 Lectures)**

**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. **(13 Lectures)**

**Frame of references:** Inertial and Non-inertial frames. Centrifugal force and Coriolis force and their simple applications, eastward deflection. **(6 Lectures)**

**Special Theory of Relativity:** Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Lorentz contraction. Time dilation. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. **(16 Lectures)**

**Reference Books:**

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

**Additional Books for Reference**

1. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
2. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
3. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
4. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

## **PHY-CC-1&2P (PRACTICAL)**

### **(04 Credits)**

1. Determination of  $Y$  by bending of beam method.
2. To determine  $g$  and velocity for a freely falling body using Digital Timing Technique
3. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
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/static method.
6. To determine the elastic Constants of a wire by Searle's method.
7. To determine the value of  $g$  using Bar Pendulum.
8. To determine the value of  $g$  using Kater's Pendulum.

### **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<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11<sup>th</sup> Edn, 2011, Kitab Mahal

## SEMESTER-II

### **PHY-CC-3.T: ELECTRICITY AND MAGNETISM**

**(04 Credits, 60 Lectures)**

#### **Electric Field and Electric Potential**

Conservative nature of Electrostatic Field. Electric field and Potential due to electric dipole and quadrupole. Boundary conditions and refraction of lines of force. Laplace's and Poisson equations. The Uniqueness Theorem. Gauss' law in integral and differential form and its applications.

**(10 Lectures)**

**Dielectric Properties of Matter:** Electric Field in matter. Polarization, Polarizability and susceptibility of dielectrics, Displacement vector **D**. Relations between **E**, **P** and **D**. Clausius-Mossotti equation, Gauss' Law in dielectrics. **(15 Lectures)**

**Magnetic Properties of Matter:** Magnetization vector (**M**). Magnetic Intensity(**H**). Magnetic Susceptibility and permeability. Relation between **B**, **H**, **M**. B-H curve and hysteresis. Properties of magnetic materials- Dia, Para and Ferromagnetism, Langevin's theory, Measurement of susceptibility by Quincke's Method. **(15 Lectures)**

**Electrical Circuits:** AC 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. Anderson's bridge, De-Sauty bridge and Cary Foster bridge. Equivalent circuit and vector diagram. Transformer, Losses in transformer. **(12 Lectures)**

**Ballistic Galvanometer:** Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. **(8 Lectures)**

#### **Reference Books:**

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
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 University Press.
6. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.
7. Electricity and Magnetism by R. K. Tewary.

### **PHY-CC-4.T: OPTICS**

## **(04 Credits, 60 Lectures)**

**Geometrical Optics:** Fermat's Principle; Lens and Mirror formula, Laws of reflection and refraction, Cardinal points, thick lens formula. **(7 Lectures)**

**Interference:** Division of amplitude and wavefront. Interference in Thin Films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. **(15 Lectures)**

**Interferometer:** Michelson Interferometer, Michelson-Morley experiment and its failure-(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. **(10 Lectures)**

**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. **(10 Lectures)**

**Fraunhofer diffraction:** Single slit. Double slit, Circular aperture and disc, Resolving Power of a telescope and Rayleigh criterion, Plane transmission grating. Concave grating, Resolving power of grating. **(10 Lectures)**

**Polarization:** Polarization by reflection, Brewster's law, Double refraction, Nicol prism, retardation plate:  $\lambda/2$  and  $\lambda/4$  plates. Babinet compensator, Production and detection of plane, circular and elliptically polarized light. Optical activity. **(08 Lectures)**

### **Reference Books**

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
  2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
  3. Principles of Optics, Max Born and Emil Wolf, 7<sup>th</sup> Edn., 1999, Pergamon Press.
  4. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
  5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
  6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
  7. Optics by B. K. Mathur.
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### **PHY-CC-3&4P (PRACTICAL) (04 Credits)**

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using Carey Foster's Bridge.
4. To compare capacitances using De'Sauty's bridge.
5. To verify the Thevenin and Norton theorems.
6. To verify the Superposition, and Maximum power transfer theorems.
7. To determine self inductance of a coil by Anderson's bridge.
8. 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) Band width.
9. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
10. To determine refractive index of the Material of a prism using sodium source.
11. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
12. To determine the wavelength of sodium source using Michelson's interferometer.
13. To determine wavelength of sodium light using Fresnel Biprism.
14. To determine wavelength of sodium light using Newton's Rings.
15. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
16. To determine dispersive power and resolving power of a plane diffraction grating.

### **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, 11<sup>th</sup> Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.
5. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
6. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11<sup>th</sup> Ed., 2011, Kitab Mahal
7. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers
8. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.



### SEMESTER-III

#### **PHY-CC-5.T: MATHEMATICAL PHYSICS-II AND THERMAL PHYSICS (04 Credits, 60 Lectures)**

**Fourier Series:** Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Analysis of saw tooth, triangular and square wave form. **(20 Lectures)**

**Kinetic Theory of Gases Distribution of Velocities:** Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy, Specific heats of Gases. **(10 Lectures)**

**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. **(8 Lectures)**

**Real Gases:** Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO<sub>2</sub> Gas. Critical Constants. Continuity of Liquid and Gaseous State. Boyle Temperature. Vander-Waal's Equation of State for Real Gases by virial method. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule- Thomson Effect for Real and Vander-Waal Gases. Temperature of Inversion. Joule- Thomson Cooling. **(15 Lectures)**

**Thermal conductivity:** Rectilinear flow of heat in metal rod, Conductivity by periodic flow method, Weidemann and Frantz law. **(07 Lectures)**

#### **Reference Books:**

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
  2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
  3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
  4. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
  5. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
  6. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books
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## PHY-CC-6.T: PHYSICS OF THERMODYNAMICS

(04 Credits, 60 Lectures)

**Introduction to Thermodynamics 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  $C_p$  and  $C_v$ , Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient. (12 Lectures)

**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, 2<sup>nd</sup> 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. (14 Lectures)

**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. Temperature-Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero. (11 Lectures)

**Thermodynamic Potentials:** Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations. (11 Lectures)

**Maxwell's Thermodynamic Relations:** Derivations and applications of Maxwell's Relations, Maxwell's Relations: (1) Clausius-Clapeyron equation, (2) Values of  $C_p$ - $C_v$ , (3) T-ds Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process. (12 Lectures)

### Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
  2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1958, Indian Press
  3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2<sup>nd</sup> Edition, 1993, Tata McGraw-Hill
  4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
  5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
  6. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2<sup>nd</sup> Ed., 2012, Oxford University Press
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## **PHY-CC-7.T: ANALOG SYSTEMS AND APPLICATIONS**

### **(04 Credits, 60 Lectures)**

**Semiconductor Diodes:** P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. Static and Dynamic Resistance. Current equation Mechanism in Forward and Reverse Biased Diode. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. **(08 Lectures)**

**Two-terminal Devices and their Applications:** (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, (2) Zener Diode and Voltage Regulation. **(8 Lectures)**

**Bipolar Junction transistors:** n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains  $\alpha$  and  $\beta$  and Relations between these. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow.Active, Cutoff and Saturation Regions. **(10 Lectures)**

**Amplifiers:** Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network, h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. **(12 Lectures)**

**Coupled Amplifier:** RC-coupled amplifier and its frequency response.**(5 Lectures)**

**Feedback in Amplifiers:** Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. **(5 Lectures)**

**Sinusoidal Oscillators:** Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators. **(07 Lectures)**

**Network theorems:** Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Maximum Power Transfer theorem. **(05 Lectures)**

**Modulations:** Amplitude modulation, solid state amplitude modulator.

#### **Reference Books:**

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning
4. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
5. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
6. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
7. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India
8. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India
9. Hand book of electronics by Gupta and Kumar.

### **PHY-CC-5,6 & 7P (PRACTICAL)(06 Credits)**

1. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
2. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
3. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
4. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
5. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.
6. To test a Diode and Transistor using a Multimeter.
7. To design a switch (NOT gate) using a transistor.
8. To verify and design AND, OR, NOT and XOR gates using NAND gates.
9. To design a combinational logic system for a specified Truth Table.
10. To convert a Boolean expression into logic circuit and design it using logic gate ICs.
11. To minimize a given logic circuit.
12. Half Adder, Full Adder and 4-bit binary Adder.
13. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
14. To design an astablemultivibrator of given specifications using 555 Timer.
15. To design a monostablemultivibrator of given specifications using 555 Timer.
16. Write the following programs using 8085 Microprocessor
  - i. Addition and subtraction of numbers using direct addressing mode
  - ii. Addition and subtraction of numbers using indirect addressing mode
  - iii. Multiplication by repeated addition.
  - iv. Division by repeated subtraction.

### **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, 11<sup>th</sup> Ed., 2011, Kitab Mahal
  3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers
  4. A Laboratory Manual of Physics for undergraduate classes,D.P.Khandelwal,1985, Vani Pub.
  5. Modern Digital Electronics, R.P. Jain, 4<sup>th</sup> Edition, 2010, Tata McGraw Hill.
  6. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, McGraw Hill.
  7. Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall.
  8. Microprocessor 8085:Architecture, Programming and interfacing, A. Wadhwa,2010, PHI Learning.
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## **PHY-SEC-1 ELECTRICAL CIRCUIT & NETWORK SKILLS**

### **(02 Credits, 30 Lectures)**

**Understanding Electrical Circuits:** Main electric circuit elements and their combination. Active and passive components, Kirchoff's laws, 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. **(6 Lectures)**

**Generators and Transformers:** DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers. **(3 Lectures)**

**Solid-State Devices:** Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources **(3 Lectures)**

**Electrical Protection:** Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device) **(6 Lectures)**

**Electrical Wiring:** Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board. **(7 Lectures)**

#### **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.
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## SEMESTER-IV

### **PHY-CC-8.T: MATHEMATICAL PHYSICS-III**

**(04 Credits, 60 Lectures)**

**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. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Taylor's theorem (statement only). **(40 Lectures)**

**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. **(10 Lectures)**

**Laplace Transforms:** Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. Dirac Delta function, Periodic Functions. Convolution Theorem. **(10 Lectures)**

#### **Reference Books:**

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

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### **PHY-CC-9.T: QUANTUM MECHANICS (04 Credits, 60 Lectures)**

Inadequacy of classical mechanics, Planck's theory of blackbody radiation, 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. **(10 Lectures)**

Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Energy-time uncertainty principle. Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. **(15 Lectures)**

Schrodinger wave equation and its physical meaning. Its applications to one dimensional problems: Free particle in a box with rigid wall, finite potential step, one dimensional square well, Linear Harmonic oscillator, Rigid rotator and Hydrogen atom (s-state). **(15 Lectures)**

**Operator formulation:** operators eigenvalues and eigenfunctions, linear operator, commuting and non-commuting operator, hermitian operator, Position, momentum and Energy operators; commutator of position and momentum operators, Expectation values of position and momentum.

**Angular momentum and spin:** Commutation relation, Pauli's spin matrices, symmetric and anti-symmetric wavefunction and Pauli's exclusion principle. **(20 Lectures)**

**Reference Books:**

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan
6. A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2<sup>nd</sup> Ed., 2010, McGraw Hill
7. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2<sup>nd</sup> Edn., 2002, Wiley.
8. Quantum Mechanics, Leonard I. Schiff, 3<sup>rd</sup> Edn. 2010, Tata McGraw Hill.
9. Quantum Mechanics, G. Aruldas, 2<sup>nd</sup> Edn. 2002, PHI Learning of India.

**Additional Books for Reference**

6. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
7. Theory and Problems of Modern Physics, Schaum's outline, R. Gautreau and W. Savin, 2<sup>nd</sup> Edn, Tata McGraw-Hill Publishing Co. Ltd.
8. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.

**PHY-CC-10.T: DIGITAL SYSTEMS AND APPLICATIONS**

**(04 Credits, 60 Lectures)**

**Introduction to CRO:** Block Diagram of CRO. Electron Gun, Deflection System and Time Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. **(10 Lectures)**

**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. **(14 Lectures)**

**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.

**(16 Lectures)**

**Arithmetic Circuits:** Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor. **(10 Lectures)**

**Timers:** IC 555: block diagram and applications: Astablemultivibrator and Monostablemultivibrator. **(10 Lectures)**

**Reference Books:**

1. Digital Principles and Applications, A.P. Malvino, D.P. Leach and Saha, 7<sup>th</sup> Ed., 2011, Tata McGraw
  2. Fundamentals of Digital Circuits, Anand Kumar, 2<sup>nd</sup> Edn, 2009, PHI Learning Pvt. Ltd.
  3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
  4. Digital Systems: Principles & Applications, R.J. Tocci, N.S. Widmer, 2001, PHI Learning
  5. Logic circuit design, Shimon P. Vingron, 2012, Springer.
  6. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
  7. Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.
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**PHY-CC-8, 9 &10P (PRACTICAL)****(06 Credits)**

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 laser source using diffraction of single slit.
6. To determine the wavelength of laser source using diffraction of double slits.
7. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating
8. To study V-I characteristics of PN junction diode, and Light emitting diode.
9. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
10. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
11. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
12. To study the various biasing configurations of BJT for normal class A operation.
13. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
14. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
15. To design a digital to analog converter (DAC) of given specifications.
16. To study the analog to digital converter (ADC) IC.
17. To design inverting amplifier using Op-amp (741,351) and study its frequency response
18. To design non-inverting amplifier using Op-amp (741,351) & study its frequency response
19. To investigate the use of an op-amp as an Integrator.
20. To investigate the use of an op-amp as a Differentiator.

**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<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11<sup>th</sup> Edn, 2011, Kitab Mahal
4. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994,



Mc-Graw Hill.

5. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4<sup>th</sup> edition, 2000, Prentice Hall.
6. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
7. Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson

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## PHY-SEC-2 APPLIED OPTICS (Credits: 02) THEORY: 30 Lectures

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

<b>(i) Sources and Detectors (9 Periods)</b> Lasers, Spontaneous and stimulated emissions, Temporal coherence and spatial coherence, Theory of laser action, Einstein's coefficients, Light amplification, Characterization of laser beam, He-Ne laser, Semiconductor lasers.
<b>Experiments on Lasers:</b> a. Determination of the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser. b. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser. c. To find the polarization angle of laser light using polarizer and analyzer d. Thermal expansion of quartz using laser
<b>Experiments on Semiconductor Sources and Detectors:</b> a. V-I characteristics of LED b. Study the characteristics of solid state laser c. Study the characteristics of LDR d. Photovoltaic Cell e. Characteristics of IR sensor
<b>(ii) Fourier Optics (6 Periods)</b> Concept of Spatial frequency filtering, Fourier transforming property of a thin lens
<b>Experiments on Fourier Optics:</b> <b>a. Fourier optic and image processing</b> 1. Optical image addition/subtraction 2. Optical image differentiation 3. Fourier optical filtering 4. Construction of an optical 4f system <b>b. Fourier Transform Spectroscopy</b> Fourier Transform Spectroscopy (FTS) is a powerful method for measuring emission and absorption spectra, with wide application in atmospheric remote sensing, NMR spectrometry and forensic science. <b>Experiment:</b> To study the interference pattern from a Michelson interferometer as a function of mirror separation in the interferometer. The resulting interferogram is the Fourier transform of the power spectrum of the source. Analysis of experimental interferograms allows one to determine the transmission characteristics of several interference filters. Computer simulation can also be done.
<b>(iii) Holography (6 Periods)</b> Basic principle and theory: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition
<b>Experiments on Holography and interferometry:</b>

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

**(iv) Photonics: Fibre Optics (9 Periods)**

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

**Experiments on Photonics: Fibre Optics**

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

**Reference Books:**

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

## SEMESTER-V

### **PHY-CC-11.T: ATOMIC, MOLECULAR, LASER AND NUCLEAR PHYSICS (04 Credits, 60 Lectures)**

**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. **(10 Lectures)**

**Many electron atoms:** Pauli's Exclusion Principle. Symmetric & Antisymmetric Wave Functions. 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's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.). **(15 Lectures)**

**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 excited states.

**(10 Lectures)**

**Nuclear Models:** Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Nuclear shell model, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force. **(10 Lectures)**

**Radioactivity:** Stability of the nucleus; Law of radioactive decay; Mean life and half-life, successive disintegration; Elementary idea of Alpha decay; Beta decay. Fission and fusion- mass defect, relativity and generation of energy; Fission - nature of fragments and emission of neutrons.

**(7 Lectures)**

**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. **(8 Lectures)**

#### **Reference Books:**

#### **Additional Books for Reference**

1. Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
  2. Introduction to Quantum Mechanics, D.J. Griffith, 2<sup>nd</sup> Ed. 2005, Pearson Education
  3. Quantum Mechanics, Walter Greiner, 4<sup>th</sup> Edn., 2001, Springer
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## **PHY-CC-12.T: SOLID STATE PHYSICS**

**(04 Credits, 60 Lectures)**

**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. **(14 Lectures)**

**Elementary Lattice Dynamics:** Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids.  $T^3$  law. **(16 Lectures)**

**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. **(12 Lectures)**

**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 Sellmeier relations. Langevin-Debye equation. **(8 Lectures)**

**Elementary band theory:** Bloch's theorem, Kronig-Penney 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. **(10 Lectures)**

### **Reference Books:**

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
  2. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India
  3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
  4. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
  5. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
  6. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
  7. Solid State Physics, M.A. Wahab, 2011, Narosa Publications
  8. Solid State Physics, M.K. Mahan and P. Mahto, 2008, Bharti Bhawan
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## **PHY-CC-11, &12 P (PRACTICAL)(04 Credits)**

1. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
2. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
3. To show the tunneling effect in tunnel diode using I-V characteristics.
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 Fe using Solenoid & determine energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150°C) and to determine its band gap.
10. 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, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

### **PHY-DSE-1.T.      PHYSICS OF DEVICES & INSTRUMENT**

#### **(04 Credits, 60 Lectures)**

Devices: Characteristic and small signal equivalent circuits of UJT and JFET. Metal- semiconductor Junction. Metal oxide semiconductor (MOS) device. Ideal MOS and Flat Band voltage. SiO<sub>2</sub>-Si based MOS. MOSFET– their frequency limits. Enhancement and Depletion Mode MOSFETS, CMOS. Charge coupled devices. Tunnel diode.      **(18 Lectures)**

Power supply and Filters: Block Diagram of a Power Supply, Qualitative idea of C and L Filters. IC Regulators, Line and load regulation, Short circuit protection      **(6 Lectures)**

Active and Passive Filters, Low Pass, High Pass, Band Pass and band Reject Filters. **(6 Lectures)**

Multivibrators: Astable and Monostable Multivibrators using transistors.      **(5 Lectures)**

#### **Digital Data Communication Standards:**

Introduction to communication systems: Block diagram of electronic communication system, Need for modulation. Amplitude modulation. Modulation Index. Analysis of Amplitude Modulated wave. Sideband frequencies in AM wave. CE Amplitude Modulator. Demodulation of AM wave using Diode Detector. basic idea of Frequency, Phase, Pulse and Digital Modulation including ASK, PSK, FSK. **(25 lectures)**

#### **Reference Books:**

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

**PHY-DSE-2.T.      ADVANCE MATHEMATICAL PHYSICS (04 Credits, 60 Lectures)**

**Linear Algebra:** Vector Spaces: Vector Spaces over Fields of Real and Complex numbers. Examples. Vector space of functions. Linear independence of vectors. Basis and dimension of a vector space. Change of basis. Subspace. Isomorphisms. Inner product and Norm. Inner product of functions: the weight function. Triangle and Cauchy Schwartz Inequalities. **(14 Lectures)**

**Linear Transformations:** Introduction. Identity and inverse. Singular and non-singular transformations. Representation of linear transformations by matrices. Similarity transformation. Linear operators. Adjoint of a linear operator. Hermitian operators and their matrix representation. Examples. Eigenvalues and eigenvectors of linear operators. Properties of eigenvalues and eigenvectors of Hermitian and unitary operators. Functions of Hermitian operators/ matrices **(22 Lectures)**

**Tensors:** Symmetric and antisymmetric tensors. Change of basis: relation between coordinate basis vectors. Change of tensor components under change of coordinate system. Example: Inertial coordinates & bases in Minkowski space, Lorentz transformations as coordinate transformations, Electromagnetic tensor and change in its components under Lorentz transformations. **(12 Lectures)**

**Calculus of Variations**

Variational Principle: Euler's Equation. Hamilton's Principle and the Euler-Lagrange equations of motion. Applications: motion of a simple pendulum, particle constrained to move on a hoop. **(12 Lectures)**

**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. Introduction to Matrices and Linear Transformations, D.T. Finkbeiner, 1978, Dover Pub.
  4. Linear Algebra, W. Cheney, E.W. Cheney & D.R. Kincaid, 2012, Jones & Bartlett Learning
  5. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole
  6. Mathematical Methods for Physics & Engineers, K.F. Riley, M.P. Hobson, S.J. Bence, 3rd Ed., 2006, Cambridge University Press
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**PHY-DSE-1&2P (PRACTICAL)(04 Credits)**

1. To design a power supply using bridge rectifier and study effect of C-filter.
2. To design the active Low pass and High pass filters of given specification.
3. To design the active filter (wide band pass and band reject) of given specification.
4. To study the output and transfer characteristics of a JFET.
5. To design a common source JFET Amplifier and study its frequency response.
6. To study the output characteristics of a MOSFET.
7. To study the characteristics of a UJT and design a simple Relaxation Oscillator.
8. To design an Amplitude Modulator using Transistor.
9. To design PWM, PPM, PAM and Pulse code modulation using ICs.
10. To design an Astablemultivibrator of given specifications using transistor.
11. To study envelope detector for demodulation of AM signal.
12. Study of ASK and FSK modulator.

**Reference Books:**

1. Basic Electronics:A text lab manual, P.B. Zbar, A.P. Malvino, M.A.Miller,1994, Mc-Graw Hill
  2. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
  3. Electronics : Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
  4. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4<sup>th</sup> edn., 2000, Prentice Hall.
  5. Introduction to PSPICE using ORCAD for circuits & Electronics, M.H. Rashid, 2003, PHI Learning.
  6. PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, Prentice-Hall of India
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## SEMESTER-VI

### **PHY-CC-13.T: ELECTROMAGNETIC THEORY**

**(04 Credits, 60 Lectures)**

**Maxwell Equations:** Derivation of Maxwell's equations. Displacement Current. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. **(12 Lectures)**

**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.

**(12 Lectures)**

**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. **(12 Lectures)**

**Polarization of Electromagnetic Waves:** Description of Linear, Circular and Elliptical Polarization. Uniaxial and Biaxial Crystals. 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. **(16 Lectures)**

**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. **(8 Lectures)**

#### **Reference Books:**

1. Introduction to Electrodynamics, D.J. Griffiths, 3<sup>rd</sup> Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
4. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
5. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
6. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

#### **Additional Books for Reference**

7. Electromagnetic Fields & Waves, P. Lorrain & D. Corson, 1970, W.H. Freeman & Co.
  8. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
  9. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004, Cambridge University Press
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## PHY-CC-14.T: STATISTICAL MECHANICS

**(04 Credits, 60 Lectures)**

**Classical Statistics:** Macrostate & Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, 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. **(20 Lectures)**

**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. **(8 Lectures)**

**Bose-Einstein Statistics:** B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Bose derivation of Planck's law. **(15 Lectures)**

**Fermi-Dirac Statistics:** Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals. **(17 Lectures)**

### Reference Books:

1. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2<sup>nd</sup> Ed., 1996, Oxford University Press.
  2. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
  3. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
  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 Univ. Press
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### PHY-CC-13&14 P (PRACTICAL)(04 Credits)

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 ultrasonic grating.
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's constant.
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 1985, Heinemann Educational Publishers
  3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
  4. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
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### PHY-DSE-3.T CLASSICAL DYNAMICS

#### (Credits: Theory-04, Tutorial-02) Theory: 75 Lectures

**Classical Mechanics of Point Particles:** Generalised coordinates and velocities. Hamilton's Principle, Lagrangian and Euler-Lagrange equations. Applications to simple systems such as coupled oscillators. Canonical momenta & Hamiltonian. Hamilton's equations of motion. Applications: Hamiltonian for a harmonic oscillator, particle in a central force field. Poisson brackets. Canonical transformations. **(25 Lectures)**

**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 & twin paradox. Four-vectors: space-like, time-like & light-like. Four-velocity and acceleration. Four-momentum and energy-momentum relation. The Electromagnetic field tensor and its transformation under Lorentz transformations: relation to known transformation properties of **E** and **B**. Electric and magnetic fields due to a uniformly moving charge. Equation of motion of charged particle & Maxwell's equations in tensor form. Motion of charged particles in external electric and magnetic fields. **(35 Lectures)**

**Electromagnetic radiation:** Review of retarded potentials. Potentials due to a moving charge: LienardWiechert potentials. Electric & Magnetic fields due to a moving charge: Power radiated, Larmor's formula and its relativistic generalisation. **(15 Lectures)**

**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: An introduction, Dieter Strauch, 2009, Springer.
  7. Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press
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**PHY-DSE-4.T NUCLEAR & PARTICLE PHYSICS**

**(Credits: Theory-04, Tutorial-02) Theory: 75 Lectures**

**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.

**(12 Lectures)**

**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. **(14 Lectures)**

**Radioactivity decay:**(a) Alpha decay: basics of  $\alpha$ -decay processes, theory of  $\alpha$ - emission, Gamow factor, Geiger Nuttall law,  $\alpha$ -decay spectroscopy. (b)  $\beta$ -decay: energy kinematics for  $\beta$ -decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion. **(14 Lectures)**

**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). **(10 Lectures)**

**Detector for Nuclear Radiations:** Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter **(5 Lectures)**

**Particle Accelerators:** Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons.**(5 Lectures)**

**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, color quantum number and gluons. **(15 Lectures)**

**Reference Books:**

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
  2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
  3. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
  4. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
  5. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
  6. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
  7. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP- Institute of Physics Publishing, 2004).
  8. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
  9. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).
  10. Theoretical Nuclear Physics, J.M. Blatt & V.F. Weisskopf (Dover Pub.Inc., 1991)
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### 1.3.2 Average percentage of courses that include experiential learning through project work/field

Program name	Name of the Course that include experiential learning through project work/field work/internship	Year of offering	Name of the student studied course on experiential learning through project work/field work/internship
B.A.	GEOGRAPHY HONS	2020-21	GOUR ROY
B.A.	GEOGRAPHY HONS	2020-21	MANOJ MAL
B.A.	GEOGRAPHY HONS	2020-21	CHAITALI MONDAL
B.A.	GEOGRAPHY HONS	2020-21	KRISHNA RAJAK
B.A.	GEOGRAPHY HONS	2020-21	APU BHANDARI
B.A.	GEOGRAPHY HONS	2020-21	JAGATJYOTI SINGHA
B.A.	GEOGRAPHY HONS	2020-21	CHANDANA RAY
B.A.	GEOGRAPHY HONS	2020-21	SUMI KUMARI
B.A.	GEOGRAPHY HONS	2020-21	NASHRIN KHATUN
B.A.	GEOGRAPHY HONS	2020-21	SAHID ANSARI
B.A.	GEOGRAPHY HONS	2020-21	MOUSUMI DAS
B.A.	GEOGRAPHY HONS	2020-21	RUPA MAL
B.A.	GEOGRAPHY HONS	2020-21	KANHA BASKEY
B.A.	GEOGRAPHY HONS	2020-21	SUMAN MONDAL
B.A.	GEOGRAPHY HONS	2020-21	RIYA MANDAL
B.A.	GEOGRAPHY HONS	2020-21	BABY KUMARI SHAW
B.A.	GEOGRAPHY HONS	2020-21	MD ALAM ANSARI
B.A.	GEOGRAPHY HONS	2020-21	DEBILAL MARDI
B.A.	GEOGRAPHY HONS	2020-21	SHIV HEMBRAM
B.A.	GEOGRAPHY HONS	2020-21	JOYDEV DHIBAR
B.A.	GEOGRAPHY HONS	2020-21	BHAGAN MARANDI
B.A.	GEOGRAPHY HONS	2020-21	JUHI KHATUN
B.A.	GEOGRAPHY HONS	2020-21	SUSMITA RAY
B.A.	GEOGRAPHY HONS	2020-21	AFROZA KHATUN
B.A.	GEOGRAPHY HONS	2020-21	HEMA KISKU
B.A.	GEOGRAPHY HONS	2020-21	DEBASIS MONDAL
B.A.	GEOGRAPHY HONS	2020-21	MD SATAR HUSSAIN
B.A.	GEOGRAPHY HONS	2020-21	NILMUNI MURMU
B.A.	GEOGRAPHY HONS	2020-21	GEETA HEMBROM
B.A.	GEOGRAPHY HONS	2020-21	RAHUL SHAIKH
B.A.	GEOGRAPHY HONS	2020-21	POONAM KUMARI
B.A.	GEOGRAPHY HONS	2020-21	RUMKI GHOSH
B.A.	GEOGRAPHY HONS	2020-21	ANIMESH MONDAL
B.A.	GEOGRAPHY HONS	2020-21	GOLAM NABIUN
B.A.	GEOGRAPHY HONS	2020-21	SUBHAJIT RAJAK
B.A.	GEOGRAPHY HONS	2020-21	ABDUL KARIM
B.A.	GEOGRAPHY HONS	2020-21	ATAUR RAHAMAN
B.A.	GEOGRAPHY HONS	2020-21	ASHOK MURMU
B.A.	GEOGRAPHY HONS	2020-21	RUMA KHATUN
B.A.	GEOGRAPHY HONS	2020-21	SK SAHIDUL ISLAM

B.A.	GEOGRAPHY HONS	2020-21	AMIT BHANDARI
B.A.	GEOGRAPHY HONS	2020-21	NILA BHANDARI
B.A.	GEOGRAPHY HONS	2020-21	GULSHAN KHATUN
B.A.	GEOGRAPHY HONS	2020-21	KALPANA KORA
B.A.	GEOGRAPHY HONS	2020-21	SERAFAT ALI
B.A.	GEOGRAPHY HONS	2020-21	MEENA KHATUN
B.A.	GEOGRAPHY HONS	2020-21	BIKRAM MONDAL
B.A.	GEOGRAPHY HONS	2020-21	UMA SHILL
B.A.	GEOGRAPHY HONS	2020-21	SHEELA MURMU
B.A.	GEOGRAPHY HONS	2020-21	SK MONIRUL
B.A.	GEOGRAPHY HONS	2020-21	DEBASHIS DAS
B.A.	GEOGRAPHY HONS	2020-21	SALMA PARWEEN
B.A.	GEOGRAPHY HONS	2020-21	BITTINI SOREN
B.A.	GEOGRAPHY HONS	2020-21	UJJWAL DHIBAR
B.A.	GEOGRAPHY HONS	2020-21	RINKU MAL
B.A.	GEOGRAPHY HONS	2020-21	PINKI KHATUN
B.A.	GEOGRAPHY HONS	2020-21	RIYA GHOSH
B.A.	GEOGRAPHY HONS	2020-21	SANJIDA KHATUN
B.A.	GEOGRAPHY HONS	2020-21	ANISUR RAHAMAN
B.A.	GEOGRAPHY HONS	2020-21	MIRJU MURMU
B.A.	GEOGRAPHY HONS	2020-21	BARUN KUMAR DEHRI
B.A.	GEOGRAPHY HONS	2020-21	AMINA PERWEEN
B.A.	GEOGRAPHY HONS	2020-21	SONALI BAGTI
B.A.	GEOGRAPHY HONS	2020-21	ASHISH KUMAR MANDAL
B.A.	GEOGRAPHY HONS	2020-21	BABULAL TUDU
B.A.	GEOGRAPHY HONS	2020-21	RAJESH KONAI
B.A.	GEOGRAPHY HONS	2020-21	SANJOY HANSDA
B.A.	GEOGRAPHY HONS	2020-21	UDAI MANDAL
B.A.	GEOGRAPHY HONS	2020-21	NUR ALAM
B.A.	GEOGRAPHY HONS	2020-21	RAKESH YADAV
B.A.	GEOGRAPHY HONS	2020-21	AREFIN MONDAL
B.A.	GEOGRAPHY HONS	2020-21	SAMIR MONDAL
B.A.	GEOGRAPHY HONS	2020-21	AYAN BOSE
B.A.	GEOGRAPHY HONS	2020-21	STENSHILA MURMU
B.A.	GEOGRAPHY HONS	2020-21	ANANT KUMAR
B.A.	GEOGRAPHY HONS	2020-21	RIJU DAS
B.A.	GEOGRAPHY HONS	2020-21	LAKHI MOHALI
B.A.	GEOGRAPHY HONS	2020-21	SHIBU BASKEY
B.A.	GEOGRAPHY HONS	2020-21	BIPLAB MONDAL
B.A.	GEOGRAPHY HONS	2020-21	SULEKHA PAL
B.A.	GEOGRAPHY HONS	2020-21	MADHAB KARMAKAR
B.A.	GEOGRAPHY HONS	2020-21	PARSOMA KHATUN
B.A.	GEOGRAPHY HONS	2020-21	KAJAL KUMARI
B.A.	GEOGRAPHY HONS	2020-21	PINKI MAJI
B.A.	GEOGRAPHY HONS	2020-21	SAGAR ADHYA
B.A.	GEOGRAPHY HONS	2020-21	MD ABDUR RAQEEB
B.A.	GEOGRAPHY HONS	2020-21	RIHANA KHATUN
B.A.	GEOGRAPHY HONS	2020-21	BHAIRAB NATH DAS

B.A.	GEOGRAPHY HONS	2020-21	SK INTAJ ALI
B.A.	GEOGRAPHY HONS	2020-21	SUFIYA KHATUN
B.A.	GEOGRAPHY HONS	2020-21	DULARI KUMARI
B.A.	GEOGRAPHY HONS	2020-21	SIMALUDDIN SEIKH
B.A.	GEOGRAPHY HONS	2020-21	KUSUM SINGHA
B.A.	GEOGRAPHY HONS	2020-21	NEHA PARWEEN
B.A.	GEOGRAPHY HONS	2020-21	JAHANARA BEGAM
B.A.	GEOGRAPHY HONS	2020-21	KIRAN GORAIN
B.A.	GEOGRAPHY HONS	2020-21	SAHARABANU KHATUN
B.A.	GEOGRAPHY HONS	2020-21	PAYAL ADHYA
B.A.	GEOGRAPHY HONS	2020-21	BABUSOL HANSDA
B.A.	GEOGRAPHY HONS	2020-21	BANESHWAR MAJI
B.A.	GEOGRAPHY HONS	2020-21	BHOLA
B.A.	GEOGRAPHY HONS	2020-21	HEMBROM
B.A.	GEOGRAPHY HONS	2020-21	SK HAMIDUR RAHAMAN
B.A.	GEOGRAPHY HONS	2020-21	SHILPA GHOSH
B.A.	GEOGRAPHY HONS	2020-21	BISHAL BHAKAT
B.A.	GEOGRAPHY HONS	2020-21	KAMLESH MARANDI
B.A.	GEOGRAPHY HONS	2020-21	STENSHILA HEMBROM
B.A.	GEOGRAPHY HONS	2020-21	AMIR KHAN
B.A.	GEOGRAPHY HONS	2020-21	RIYA ROY
B.A.	GEOGRAPHY HONS	2020-21	MUNNI KUMARI
B.A.	GEOGRAPHY HONS	2020-21	BADAL THAKUR
B.A.	GEOGRAPHY HONS	2020-21	SADH AKKAS
B.A.	GEOGRAPHY HONS	2020-21	SHRUTI SAHA
B.A.	GEOGRAPHY HONS	2020-21	ABDUR ROUF SAMIM
B.A.	GEOGRAPHY HONS	2020-21	AKESH CHANDRA MONDAL
B.A.	GEOGRAPHY HONS	2020-21	RAJESH MAHATO
B.A.	GEOGRAPHY HONS	2020-21	EITIKA MONDAL
B.A.	GEOGRAPHY HONS	2020-21	SUILY RANI GHOSH
B.A.	GEOGRAPHY HONS	2020-21	KRISHNA DHIBAR
B.A.	GEOGRAPHY HONS	2020-21	SALMA KHATUN
B.A.	GEOGRAPHY HONS	2020-21	MAHA PRASAD MANDAL
B.A.	GEOGRAPHY HONS	2020-21	MARTHA MURMU
B.A.	GEOGRAPHY HONS	2020-21	UTTAM HEMBROM
B.A.	GEOGRAPHY HONS	2020-21	PANI MARANDI
B.A.	GEOGRAPHY HONS	2020-21	MD AL AMIN
B.A.	GEOGRAPHY HONS	2020-21	NAZMAL ALAM
B.A.	GEOGRAPHY HONS	2020-21	KANCHAN PAUL
B.A.	GEOGRAPHY HONS	2020-21	ISHOKA KUMARI DHIBAR
B.A.	GEOGRAPHY HONS	2020-21	NAWAJ SHARIF MONDAL
B.A.	GEOGRAPHY HONS	2020-21	AMARTYA DEY
B.A.	GEOGRAPHY HONS	2020-21	SHOYLEN HEMBROM
B.A.	GEOGRAPHY HONS	2020-21	KHUTEB ANSARI
B.A.	GEOGRAPHY HONS	2020-21	DEEPAK KUMAR SINGH
B.A.	GEOGRAPHY HONS	2020-21	PINTU DAS
B.A.	GEOGRAPHY HONS	2020-21	MONIKA HANSDA
B.A.	GEOGRAPHY HONS	2020-21	BABU DHIBAR

B.A.	GEOGRAPHY HONS	2020-21	SOMNATH MANDAL
B.A.	GEOGRAPHY HONS	2020-21	MD MIRAJ UDDIN SEKH
B.A.	GEOGRAPHY HONS	2020-21	MONIKA KUMARI
B.A.	GEOGRAPHY HONS	2020-21	RAFIYA KHATUN
B.A.	GEOGRAPHY HONS	2020-21	ROJI KHATUN
B.A.	GEOGRAPHY HONS	2020-21	MUKESH MAHATO
B.A.	GEOGRAPHY HONS	2020-21	PAMPA MANDAL
B.A.	GEOGRAPHY HONS	2020-21	MOUMITA DAS
B.A.	GEOGRAPHY HONS	2020-21	TERESA TUDU
B.A.	GEOGRAPHY HONS	2020-21	MD SHOAIB RIZVI
B.A.	GEOGRAPHY HONS	2020-21	SUMONA MANDAL
B.A.	GEOGRAPHY HONS	2020-21	ASHIM AKRAM REZA
B.A.	GEOGRAPHY HONS	2020-21	PUSHPA SOREN
B.A.	GEOGRAPHY HONS	2020-21	IMDADUL HAQUE
B.A.	GEOGRAPHY HONS	2020-21	NAZMUL SEIKH
B.A.	GEOGRAPHY HONS	2020-21	MANOBI MONDAL
B.A.	GEOGRAPHY HONS	2020-21	AFSANA KHATUN
B.A.	GEOGRAPHY HONS	2020-21	KRIPASINDHU BAGDI
B.A.	GEOGRAPHY HONS	2020-21	KANDIN TUDU
B.A.	GEOGRAPHY HONS	2020-21	SANAM KHATUN
B.A.	GEOGRAPHY HONS	2020-21	JAYANTI CHOWDHURY
B.A.	GEOGRAPHY HONS	2020-21	MD KABIRUL ISLAM
B.A.	GEOGRAPHY HONS	2020-21	BIKASH MARANDI
B.A.	GEOGRAPHY HONS	2020-21	ARIF MAHAMAD
B.A.	GEOGRAPHY HONS	2020-21	PUJA ADHYA
B.A.	GEOGRAPHY HONS	2020-21	JAYTUN KHATUN
B.A.	GEOGRAPHY HONS	2020-21	MUKESH MURMU
B.A.	GEOGRAPHY HONS	2020-21	CHANDAN GORAIN
B.A.	GEOGRAPHY HONS	2020-21	SAFIK SEKH
B.A.	GEOGRAPHY HONS	2020-21	MD IZAZUL ISLAM
B.A.	GEOGRAPHY HONS	2020-21	MUKTAR ANSARI
B.A.	GEOGRAPHY HONS	2020-21	RICK DUTTA
B.A.	GEOGRAPHY HONS	2020-21	ALINA HEMBROM
B.A.	GEOGRAPHY HONS	2020-21	PARVIN AKTARY
B.A.	GEOGRAPHY HONS	2020-21	ARNAB MITRA
B.A.	GEOGRAPHY HONS	2020-21	AFRIN KHATUN
B.A.	GEOGRAPHY HONS	2020-21	JSIFUR RAHAMAN MALLICK
B.A.	GEOGRAPHY HONS	2020-21	TANUSHRI ROOJ
B.A.	GEOGRAPHY HONS	2020-21	SAIKAT DUTTA
B.A.	GEOGRAPHY HONS	2020-21	JAYENDRA RAY
B.A.	GEOGRAPHY HONS	2020-21	JIAUL ISLAM
B.A.	GEOGRAPHY HONS	2020-21	ABU HASAN
B.A.	GEOGRAPHY HONS	2020-21	BIKASH MAL
B.A.	GEOGRAPHY HONS	2020-21	JNNA PRASAD CHOUDHARI
B.A.	GEOGRAPHY HONS	2020-21	AMINA KHATUN
B.A.	GEOGRAPHY HONS	2020-21	RAFIKA KHATUN
B.A.	GEOGRAPHY HONS	2020-21	PRIYANKA TUDU
B.A.	GEOGRAPHY HONS	2020-21	NUR ALAM MOLLAH



B.A.	GEOGRAPHY HONS	2020-21	ABHISHEK MONDAL
B.A.	GEOGRAPHY HONS	2020-21	MIR SHARTAZ AZIZ
B.A.	GEOGRAPHY HONS	2020-21	ARTI KUMARI
B.A.	GEOGRAPHY HONS	2020-21	RAGHUBIR YADAB
B.A.	GEOGRAPHY HONS	2020-21	SAHADAT HOSSAIN
B.A.	GEOGRAPHY HONS	2020-21	SUMAN SAHA MONDAL
B.A.	GEOGRAPHY HONS	2020-21	ASHWNI KUMAR SAHA
B.A.	GEOGRAPHY HONS	2020-21	RAHIKA SOREN
B.A.	GEOGRAPHY HONS	2020-21	BIDISHA MONDAL
B.A.	GEOGRAPHY HONS	2020-21	OSIUR RAHAMAN MALLICK
B.A.	GEOGRAPHY HONS	2020-21	PANI TUDU
B.A.	GEOGRAPHY HONS	2020-21	KSHAMA CHOWDHURY
B.A.	GEOGRAPHY HONS	2020-21	SAFIUDDIN MALLICK
B.A.	GEOGRAPHY HONS	2020-21	RATHIN KSHIRAHARI
B.A.	GEOGRAPHY HONS	2020-21	SHIV MURMU
B.A.	GEOGRAPHY HONS	2020-21	MOUMITA MANDAL
B.A.	GEOGRAPHY HONS	2020-21	SONIA KHATUN
B.A.	GEOGRAPHY HONS	2020-21	SARFARAJ ANSARI
B.A.	GEOGRAPHY HONS	2020-21	SUBAN MURMU
B.A.	GEOGRAPHY HONS	2020-21	BASUDEB BAGTI
B.A.	GEOGRAPHY HONS	2020-21	NITYANAND PAL
B.A.	GEOGRAPHY HONS	2020-21	PRADEEP MISTRI
B.A.	GEOGRAPHY HONS	2020-21	JABED ANSARI
B.Sc.	Zoology Hons	2020-21	NISHA YADAV
B.Sc.	Zoology Hons	2020-21	SUKANTA PAUL
B.Sc.	Zoology Hons	2020-21	BABLI MANDAL
B.Sc.	Zoology Hons	2020-21	STEPHEN SOREN
B.Sc.	Zoology Hons	2020-21	FALGUNI SAHA
B.Sc.	Zoology Hons	2020-21	MAMONI KUMARI
B.Sc.	Zoology Hons	2020-21	SUVASISH MONDAL
B.Sc.	Zoology Hons	2020-21	RAHUL MANDAL
B.Sc.	Zoology Hons	2020-21	HIRAK BHANDARI
B.Sc.	Zoology Hons	2020-21	FARUK ANSARI
B.Sc.	Zoology Hons	2020-21	SONIA PANDEY
B.Sc.	Zoology Hons	2020-21	LIPIKA DAS
B.Sc.	Zoology Hons	2020-21	ANINDITA
B.Sc.	Zoology Hons	2020-21	BABLU MURMU
B.Sc.	Zoology Hons	2020-21	ROHIT CHAKRABORTY
B.Sc.	Zoology Hons	2020-21	BEAUTY GORAIN
B.Sc.	Zoology Hons	2020-21	HEMBROM
B.Sc.	Zoology Hons	2020-21	EJAJUL ANSARI
B.Sc.	Zoology Hons	2020-21	MD SK YASIN
B.Sc.	Zoology Hons	2020-21	MEGHA PAUL
B.Sc.	Zoology Hons	2020-21	SILPI PARIRA
B.Sc.	Zoology Hons	2020-21	SALLIKA LAHA
B.Sc.	Zoology Hons	2020-21	ARJUN ROUT
B.Sc.	Zoology Hons	2020-21	BISHWAJIT GHOSH
B.Sc.	Zoology Hons	2020-21	NISHA PANDIT

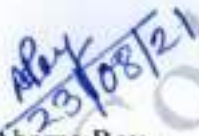
B.Sc.	Zoology Hons	2020-21	SAMAPTI GHOSH
B.Sc.	Zoology Hons	2020-21	BASANTI MURMU
B.Sc.	Zoology Hons	2020-21	FILUNI TUDU
B.Sc.	Zoology Hons	2020-21	RIMPA KARMAKAR
B.Sc.	Zoology Hons	2020-21	AAKRITI SALONI
B.Sc.	Zoology Hons	2020-21	AKBAR ALI
B.Sc.	Zoology Hons	2020-21	ANIMESH SAHA
B.Sc.	Zoology Hons	2020-21	DATTA SADHU
B.Sc.	Zoology Hons	2020-21	SUJAN KUMAR GHOSH
B.Sc.	Zoology Hons	2020-21	STENSHILA SOREN
B.Sc.	Zoology Hons	2020-21	SUDIP KUMAR DAS
B.Sc.	Zoology Hons	2020-21	MD NURUL HASSAN
B.Sc.	Zoology Hons	2020-21	ADYANATH DAS
B.Sc.	Zoology Hons	2020-21	SUBRATA GORAIN
B.Sc.	Zoology Hons	2020-21	SUJAY DAS
B.Sc.	Zoology Hons	2020-21	BIBEK BHAKAT
B.Sc.	Zoology Hons	2020-21	ARBAZ KHAN
B.Sc.	Zoology Hons	2020-21	NOOR NISHA
B.Sc.	Zoology Hons	2020-21	SOUVIK MONDAL
B.Sc.	Zoology Hons	2020-21	LUKHI SOREN
B.Sc.	Zoology Hons	2020-21	SUDHANGSHU PRASAD
B.Sc.	Zoology Hons	2020-21	RIMA PAUL
B.Sc.	Zoology Hons	2020-21	AKASH DUTTA
B.Sc.	Zoology Hons	2020-21	NICE AFROJA
B.Sc.	Zoology Hons	2020-21	SOUVIK ROOJ
B.Sc.	Zoology Hons	2020-21	PAKEEZA NAAZ
B.Sc.	Botany Hons	2020-21	JAYANTI MARANDI
B.Sc.	Botany Hons	2020-21	SUPRIYO GHOSH
B.Sc.	Botany Hons	2020-21	SHEELA HEMBROM
B.Sc.	Botany Hons	2020-21	ANANTA SADHU
B.Sc.	Botany Hons	2020-21	MAMATA MALLICK
B.Sc.	Botany Hons	2020-21	PURNIMA MANDAL
B.Sc.	Botany Hons	2020-21	PRIYANKA PAL
B.Sc.	Botany Hons	2020-21	SOFIUR RAHMAN
B.Sc.	Botany Hons	2020-21	SHASHI PRIYA
B.Sc.	Botany Hons	2020-21	RIJAUL ANSARI
B.Sc.	Botany Hons	2020-21	SOUMYAJIT SARKAR
B.Sc.	Botany Hons	2020-21	MARSHILA MARANDI
B.Sc.	Botany Hons	2020-21	NURSING SOREN
B.Sc.	Botany Hons	2020-21	ANIMESH DALUI
B.Sc.	Botany Hons	2020-21	NEPALI SOREN
B.Sc.	Botany Hons	2020-21	GOSTOGOPAL
B.Sc.	Botany Hons	2020-21	SUTAPA MANDAL
B.Sc.	Botany Hons	2020-21	SANJEEV MANDAL
B.Sc.	Botany Hons	2020-21	SWAPAN TUDU
B.Sc.	Botany Hons	2020-21	MAANAT KUMAR
B.Sc.	Botany Hons	2020-21	MEGHNES MARANDI
B.Sc.	Botany Hons	2020-21	ANITA KISKU

B.Sc.	Botany Hons	2020-21	DOLY SUSANNA SOREN
-------	-------------	---------	--------------------


**work/internship during last five years (10)**

## CERTIFICATE

This is to certify that **SWAPAN TUDU** of this institute has carried out a project work on **"Sericulture"** under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

  
Dr. Abarna Roy  
Head


Department of Zoology  
Mayurakshi Gramin College, Ranishwar

  
Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology


Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **SUTAPA MANDAL** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

  
Dr. Abarna Roy  
Head


Department of Zoology  
Mayurakshi Gramin College, Ranishwar

  
Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology


Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **SUPRIYO GHOSH** of this institute has carried out a project work on “**Sericulture**” under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

  
23/08/21  
Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar


  
Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar




## CERTIFICATE

This is to certify that **SUJAY DAS** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

  
Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

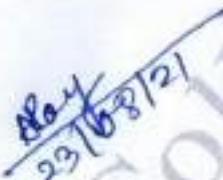
  
Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar




## CERTIFICATE

This is to certify that **SUJAN KUMAR GHOSH** of this institute has carried out a project work on "Sericulture" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

  
Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

  
Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **SUDIP KUMAR DAS** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Dr. Roy*  
23/08/21

Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*Majid*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **SUDHANGSHU PRASAD** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Abarna Roy*  
23/08/21

Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar


*Majid Ahsan*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology


Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **SUBRATA GORAIN** of this institute has carried out a project work on “**Sericulture**” under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

  
Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

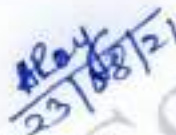
  
Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar




## CERTIFICATE

This is to certify that **SUDIP KUMAR DAS** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

  
Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

  
Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **SOUVIK ROOJ** of this institute has carried out a project work on **"Sericulture"** under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*APR 23/08/21*

Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*majid*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **SOUVIK MONDAL** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Dr. Abarna Roy*  
23/08/21

Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*Prof. Majid Nadim Ahsan*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **SOUMYAJIT SARKAR** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Dr. Abarna Roy*  
23/08/21

Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*Prof. Majid Nadim Ahsan*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **SOFIUR RAHMAN** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Dr. Roy*  
23/08/21

Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*M. Ahsan*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **SHEELA HEMBROM** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

AD Roy  
23/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

remsh

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **SHASHI PRIYA HANSDAK** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Dr. Abarna Roy*  
23/08/21


Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*Prof. Majid Nadim Ahsan*


Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **SANJEEV MANDAL** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

  
Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

  
Prof. Majid Nadim Ahsan  
Assistant Professor

Department of Zoology  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **SAMAPTI GHOSH** of this institute has carried out a project work on “**Sericulture**” under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of **BACHELOR OF SCIENCE (B.Sc.)** in **ZOOLOGY (Hons.)**.

*Dr. Abarna Roy*  
23/08/21

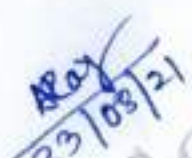
Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*Prof. Majid Nadim Ahsan*


Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **RIMPA KARMAKAR** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.)..

  
Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

  
Prof. Majid Nadim Ahsan  
Assistant Professor

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **RIMA PAUL** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Dr. Roy*  
23/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*M. N. Ahsan*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **RIJAUL ANSARI** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*AB Roy*  
23/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*mnst*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **PRIYANKA PAL** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

  
23/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar



Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **PAKEEZA NAAZ** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

Dr. Roy  
23/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

Prof. Ahsan

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **NURSING SOREN** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of **BACHELOR OF SCIENCE (B.Sc.)** in **ZOOLOGY (Hons.)**.

*ARoy*  
*23/03/21*  
Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*mna*  
Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **NOOR NISHA** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Ray*  
23/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*mst*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **NISHA PANDIT** of this institute has carried out a project work on “**Sericulture**” under **Prof. Majid Nadim Ahsan**, and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

ARoy  
23/03/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar



Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **NICE AFROJA** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Dr. Roy*  
*23/08/21*  
Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*mstg*  
Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **NEPALI SOREN** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

ARoy  
23/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar



Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **MEGHNES MARANDI** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Ray*  
23/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar


*mm*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **MD NURUL HASSAN** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of **BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.)**.

  
23/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar



Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **MARSHILA MARANDI** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Dr. Roy*  
23/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*M. Ahsan*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **MAMATA MALLICK** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Dr. Roy*  
23/08/21

Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*Prof. Ahsan*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **MAANAT KUMAR GORAIN** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan**, and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

  
23/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar



Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **LUKHI SOREN** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Dr. Roy*  
29/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*M. Ahsan*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **JAYANTI MARANDI** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan**, and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

23/08/21

Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar



Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **IMRAN SK** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan**, and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Dr. Roy*  
23/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar



Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **GOSTOGOPAL DASGUPTA** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan**, and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Dr. Abarna Roy*  
29/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*Prof. Majid Nadim Ahsan*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **FILUNI TUDU** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan**, and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Ray*  
23/08/21

Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*Majid*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **DOLY SUSANNA SOREN** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan**, and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Ray*  
23/08/21

Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*Majid*

Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **DATTA SADHU** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

*Dr. Abarna Roy*  
29/08/21

Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

*Prof. Majid Nadim Ahsan*

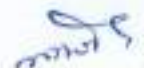
Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **BISHWAJITGHOSH** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY(Hons.).

  
23/08/21  
Dr. Abarna Roy  
Head

Department of Zoology  
Mayurakshi Gramin College, Ranishwar

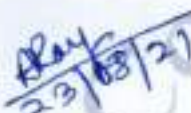
  
Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology


Mayurakshi Gramin College, Ranishwar



## CERTIFICATE


This is to certify that **BIBEK BHAKAT** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).


  
Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

  
Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

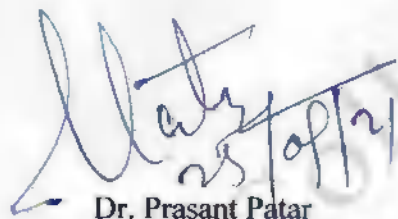
This is to certify that **BASANTI MURMU** of this institute has carried out a project work on "**Sericulture**" under **Prof. Majid Nadim Ahsan** and **Dr. Abarna Roy**, Assistant Professor, Department of Zoology, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in ZOOLOGY (Hons.).

  
Dr. Abarna Roy  
Head  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

  
Prof. Majid Nadim Ahsan  
Assistant Professor  
Department of Zoology  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Suvasish Mandal** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Prof. Reena Kumari**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head

Department of Botany  
Mayurakshi Gramin College, Ranishwar

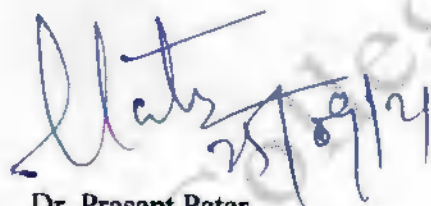


Prof. Reena Kumari  
Assistant Professor

Department of Botany  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Anindita Chakraborty** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Dr. Prasant Patar**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



**Dr. Prasant Patar**  
Head  
Department of Botany  
Mayurakshi Gramin College, Ranishwar

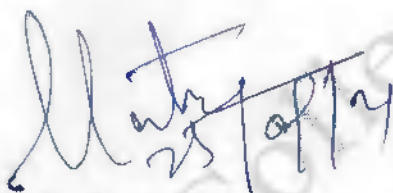


**Prof. Reena Kumari**  
Assistant Professor  
Department of Botany  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Babli Mandal** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under Prof. **Reena Kumari** ,Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



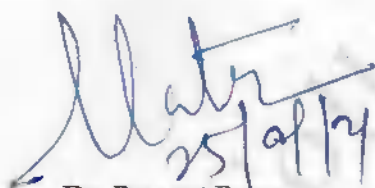
Dr. Prasant Patar  
Head  
Department of Botany  
Mayurakshi Gramin College, Ranishwar



Prof. Reena Kumari  
Assistant Professor  
Department of Botany  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Bablu Murmu** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Prof. Reena Kumari**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head  
Department of Botany  
Mayurakshi Gramin College, Ranishwar



Prof. Reena Kumari  
Assistant Professor  
Department of Botany  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Sukanta Paul** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Dr. Prasant Patar**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.

  
25/08/21

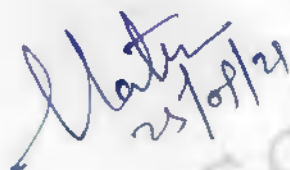
Dr. Prasant Patar  
Head  
Department of Botany  
Mayurakshi Gramin College, Ranishwar

  
25/09/21

Prof. Rina Kumari  
Assistant Professor  
Department of Botany  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Stephen Soren** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Dr. Prasant Patar**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head  
Department of Botany  
Mayurakshi Gramin College, Ranishwar



Prof. Reena Kumari  
Assistant Professor  
Department of Botany  
Mayurakshi Gramin College, Ranishwar

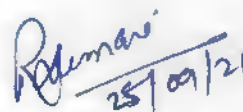
## CERTIFICATE

This is to certify that **Sonia Pandey** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Prof. Reena Kumari**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head

Department of Botany  
Mayurakshi Gramin College, Ranishwar




Prof. Reena Kumari  
Assistant Professor  
Department of Botany

Mayurakshi Gramin College, Ranishwar

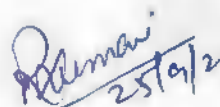
## CERTIFICATE

This is to certify that **Shilpi Parira** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Dr. Prasant Patar**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head

Department of Botany  
Mayurakshi Gramin College, Ranishwar

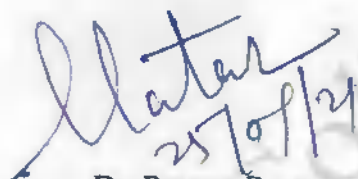


Prof. Reena Kumari  
Assistant Professor

Department of Botany  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Sallika Laha** of this institute has carried out a project work on topic **"Ethno botanical Studies of Medicinal plants in Ranishwar block"** under **Prof. Reena Kumari**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head

Department of Botany  
Mayurakshi Gramin College, Ranishwar



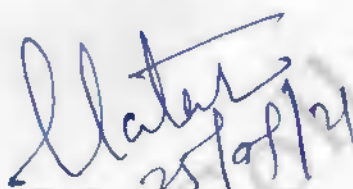
Prof. Reena Kumari  
Assistant Professor  
Department of Botany

Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Rohit Chakraborty** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Dr. Prasant Patar**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head

Department of Botany  
Mayurakshi Gramin College, Ranishwar



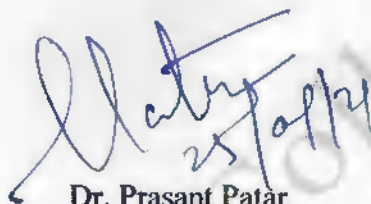
Prof. Reena Kumari  
Assistant Professor  
Department of Botany

Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Rahul Mandal** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under Prof. **Reena Kumari**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



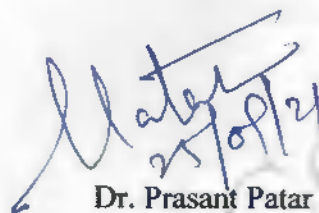
Dr. Prasant Patar  
Head  
Department of Botany  
Mayurakshi Gramin College, Ranishwar



Prof. Reena Kumari  
Assistant Professor  
Department of Botany  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Nisha Yadav** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Dr. Prasant Patar**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head

Department of Botany  
Mayurakshi Gramin College, Ranishwar

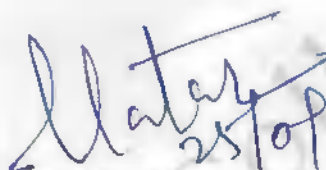


Prof. Reena Kumari  
Assistant Professor

Department of Botany  
Mayurakshi Gramin College, Ranishwar


## CERTIFICATE

This is to certify that **Megha Paul** of this institute has carried out a project work on topic **"Ethno botanical Studies of Medicinal plants in Ranishwar block"** under **Prof. Reena Kumari**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.

  
25/09/21

Dr. Prasant Patar  
Head

Department of Botany  
Mayurakshi Gramin College, Ranishwar

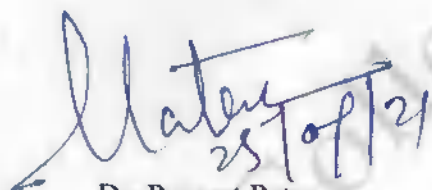
  
25/9/21

Prof. Reena Kumari  
Assistant Professor

Department of Botany  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Md Sk Yasin** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Dr. Prasant Patar**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head  
Department of Botany  
Mayurakshi Gramin College, Ranishwar



Prof. Reena Kumari  
Assistant Professor  
Department of Botany  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Mamoni Kumari** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Dr. Prasant Patar**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head

Department of Botany  
Mayurakshi Gramin College, Ranishwar

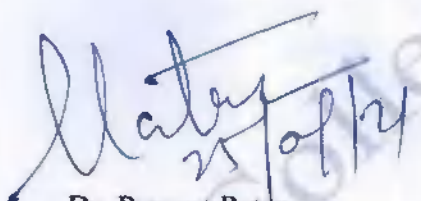


Prof. Reena Kumari  
Assistant Professor  
Department of Botany

Mayurakshi Gramin College, Ranishwar

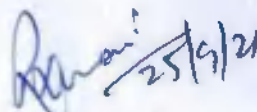
## CERTIFICATE

This is to certify that **Lipika Das** of this institute has carried out a project work on topic **"Ethno botanical Studies of Medicinal plants in Ranishwar block"** under **Dr. Prasant Patar**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head

Department of Botany  
Mayurakshi Gramin College, Ranishwar



Prof. Reena Kumari  
Assistant Professor

Department of Botany  
Mayurakshi Gramin College, Ranishwar




## CERTIFICATE

This is to certify that **Hirak Bhandari** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Prof. Reena Kumari**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head

Department of Botany  
Mayurakshi Gramin College, Ranishwar

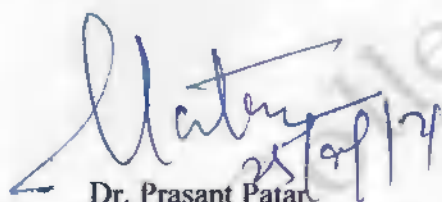


Prof. Reena Kumari  
Assistant Professor

Department of Botany  
Mayurakshi Gramin College, Ranishwar

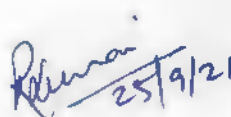
## CERTIFICATE

This is to certify that **Faruk Ansari** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under Prof. **Reena Kumari**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head

Department of Botany  
Mayurakshi Gramin College, Ranishwar



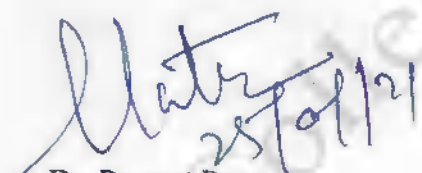
Prof. Reena Kumari  
Assistant Professor  
Department of Botany

Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Falguni Saha** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Prof. Reena Kumari**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head  
Department of Botany  
Mayurakshi Gramin College, Ranishwar



Prof. Reena Kumari  
Assistant Professor  
Department of Botany  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Ejajul Ansari** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Dr. Prasant Patar**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



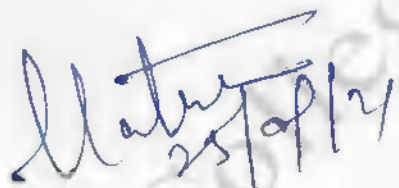
Dr. Prasant Patar  
Head  
Department of Botany  
Mayurakshi Gramin College, Ranishwar



Prof. Reena Kumari  
Assistant Professor  
Department of Botany  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Beauty Gorain** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Dr. Prasant Patar**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



Dr. Prasant Patar  
Head

Department of Botany  
Mayurakshi Gramin College, Ranishwar



Prof. Reena Kumari  
Assistant Professor

Department of Botany  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Sujit Hembrom** of this institute has carried out a project work on topic "**Ethno botanical Studies of Medicinal plants in Ranishwar block**" under **Prof. Reena Kumari**, Assistant Professor, Department of Botany, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF SCIENCE (B.Sc.) in BOTANY.



25/09/21

Dr. Prasant Patar  
Head  
Department of Botany  
Mayurakshi Gramin College, Ranishwar




25/09/21


Prof. Reena Kumari  
Assistant Professor  
Department of Botany  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Miss Chaitali Mondal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head of the Department  
of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Chand Gopal Ghosh** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*[Signature]*  
8/7/21  
Head Of The Department  
Of Geography  
Mayurakshi Gramin College, Ranishwar


Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

*[Signature]*  
8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

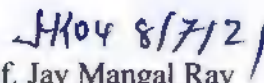


## CERTIFICATE

This is to certify that **Miss Chandana Ray** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Debashis Das** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature*  
8/7/21  
Head of the Department  
of Geography  
Mayurakshi Gramin College, Ranishwar

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

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8/7/21

Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Debilal Mardi** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature*  
8/7/21

Head Of The Department  
Of Geography

Prof. Humayun Kabir

Head

Department of Geography

Mayurakshi Gramin College, Ranishwar

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8/7/21

Prof. Jay Mangal Ray

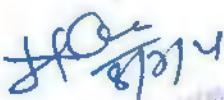
Assistant Professor

Department of Geography

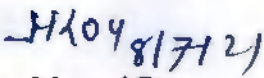
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Deepak Kumar Singh** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
HEAD OF THE DEPARTMENT  
Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Dulari Kumari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature*  
Prof. Humayun Kabir  
Head


Department of Geography  
Mayurakshi Gramin College, Ranishwar

*Handwritten signature*  
Prof. Jay Mangal Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Eitika Mondal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Geeta Hembrom** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

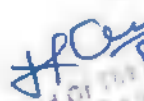
  
Head of the Department  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar


## CERTIFICATE

This is to certify to **Golam Nabiun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head of Department  
of Geography

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Mr. Gour Roy** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify to **Abdul Karim** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Prof. Humayun Kabir

Head

Department of Geography

Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray

Assistant Professor


Department of Geography

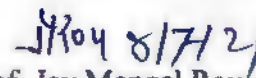
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE


This is to certify that **Abdur Rouf Samim** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head of the Department  
OF S. Head  
M.G. College,  
Bunka Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray/  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE


This is to certify that **Abhishek Mondal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE


This is to certify that **Abu Hasan** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
OF G.  
M.G. College,  
Ranishwar  
Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE


This is to certify that **Afsana Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Afroza Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

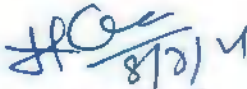
  
Head of The Department  
OF Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Afrin Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar  
Dumka

**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

**Prof. Jay Mangal Ray**  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Alina Hembrom** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature of Prof. Humayun Kabir*

Head Of The Department  
OF Geography  
M.G. College, Ranishwar  
Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

*Handwritten signature of Prof. Jay Bhargal Ray*

Prof. Jay Bhargal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

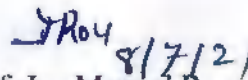
## CERTIFICATE

This is to certify that **Imdadul Haque** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.



Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar



Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography

Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify to **Budiram Hansdak** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*HKoy 8/7/21*  
Head of The Department  
of Geography  
Mayurakshi Gramin College, Ranishwar

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*HKoy 8/7/21*  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Amir Khan** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


H.K. 8/7/21

Head of The Department  
of Geography  
M.G. College,  
Ranishwar  
Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar


H.M. 8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Amit Bhandari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography


Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Anant Kumar** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College,  
Ranishwar

Prof. Humayun Kabir  
Head

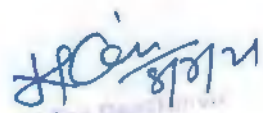
Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Animesh Mondal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
Of Geography  
M.G. College  
Ranishwar  
Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar




## CERTIFICATE

This is to certify to **Anisur Rahaman** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
Of Geography  
M.G. College  
Guntur

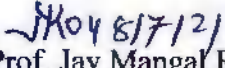
Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

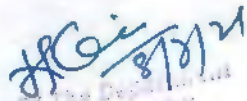
This is to certify that **Mr. Apu Bhandari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
Of Geography  
M.G. College  
Dumka Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Arefin Mondal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

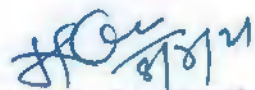
  
Head of the Department  
Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

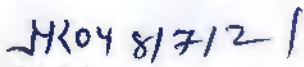


## CERTIFICATE

This is to certify that **Arif Mahamad** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

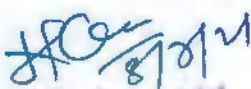
  
Head Of The Department  
Of Geography  
M.G. College,  
Dumka

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Arnab Mitra** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

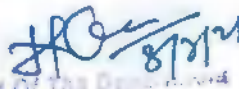
  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Arti Kumari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head of the Department  
Of Geography  
M.G. College, Ranishwar

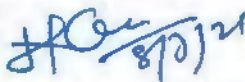
**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Ashim Akram Reza** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of  
M.G. College,  
Ranishwar

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Asbish Kumar Mandal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*[Signature]*  
8/7/21

Head of The Department  
OF G  
M.G. College, Ranishwar  
Dumka  
Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar


*[Signature]*  
8/7/21


Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE


This is to certify to **Ashok Murmu** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Bishoka Kumari Dhibar** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic Session 2020-21. The work has been done in partial fulfilment of the requirement for the Award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head of the Department  
of Geography  
Mayurakshi Gramin College

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Bittini Soren** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*HKC*  
8/7/21  
HEAD OF THE DEPARTMENT  
OF GEOGRAPHY

Prof: Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*JK04* 8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Jahanara Begam** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*HKabir*  
8/7/21

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*Hkoy* 8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar


## CERTIFICATE

This is to certify that **Jayanti Chowdhury** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
8/7/21

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

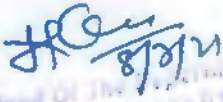
  
8/7/21

Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography

Mayurakshi Gramin College, Ranishwar


## CERTIFICATE

This is to certify that **Jayendra Ray** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
8/7/21

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
8/7/21

Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Jaytun Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
8/7/21

**Prof. Humayun Kabir**  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

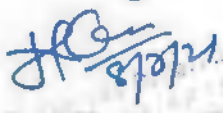
  
8/7/21

**Prof. Jay Mangal Ray**  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Jiaul Islam** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Joydeb Dhibar** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature and date 8/7/21*

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

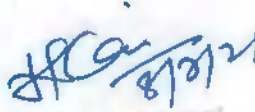
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Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar



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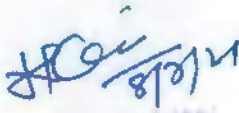
This is to certify that **Ashwni Kumar Saha** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kahir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar  
Dumka  
Prof. Humayun Kahir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Ataur Rahaman** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G.C. Ranishwar

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

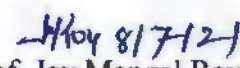


## CERTIFICATE

This is to certify that **Ayan Bose** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
of Geography  
M.G.C. College,  
Ranishwar

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Babu Dhibar** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify to **Babulal Tudu** of this institute has carried out a project work on topic **"Socio Economic"** under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*HKC 8/7/21*

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*JKR 8/7/21*  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Babusol Hansda** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.



HEAD OF THE DEPARTMENT  
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M.G. COLLEGE  
RANISHWAR

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar




Prof. Jay Mangal/Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Baby Kumari Shaw** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

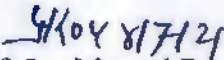
  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Badal Thakur** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar



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This is to certify that **Baleshwar Maji** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature of Prof. Humayun Kabir*

Head of the Department  
of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar


*Handwritten signature of Prof. Jay Mangal Ray*

Prof. Jay Mangal Ray  
Assistant Professor

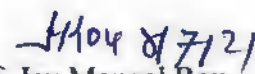
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Barun Kumar Dehri** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head of the Department  
of Geography  
Mayurakshi Gramin College,  
Ranishwar

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Basudeb Bagti** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature*  
Head of the Department  
Of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

*Handwritten signature*  
8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Bhagan Marandi** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature and date: 8/17/21*


**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

*Handwritten signature and date: 8/17/21*

**Prof. Jay Mangal Ray**  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Bhairab Nath Das** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College,  
Ranishwar

**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Bhola Hembrom** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*HKC 8/7/21*  
Head Of The Department  
Of Geography  
M.G. College,  
Ranishwar


Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

*JKR 8/7/21*  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Bidisha Mondal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
OF Geography

Prof. Humayun Kabir

Head

Department of Geography

Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray

Assistant Professor

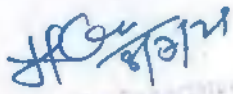
Department of Geography

Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Bikash Mal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.



Head of the Department  
Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar



Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Bikash Marandi** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature of Prof. Humayun Kabir*  
8/7/21

Head  
Department of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

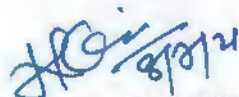
*Handwritten signature of Prof. Jay Mangal Ray*  
8/7/21

Prof. Jay Mangal Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Bikram Mondal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of  
M.G. College  
Burdwan

**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Biplah Mondal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kahir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*HK* 8/7/21  
Head of Dept.  
Of Geog.  
M.G. College, Ranishwar  
Dumka

Prof. Humayun Kahir  
Head


Department of Geography  
Mayurakshi Gramin College, Ranishwar

*JKoy* 8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Bishal Bhakat** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

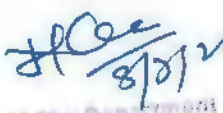
  
Head of the Department  
of Geography  
M.G. College, Ranishwar


Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Amartya Dey** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head of the Department  
Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Amina Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature of Prof. Humayun Kabir*

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

*Handwritten signature of Prof. Jay Mangal Ray*

Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Amina Perween** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Md SANwar Ansari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department

01/Prof. Humayun Kabir

M.G. College, Ranishwar

Department of Geography

Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray

Assistant Professor

Department of Geography

Mayurakshi Gramin College, Ranishwar




## CERTIFICATE

This is to certify that **Manobi Mondal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

Prof. M. Umayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

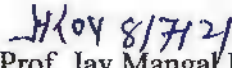
## CERTIFICATE

This is to certify that **Mr. Manoj Mal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G.College, Ranishwar

Prof. Manayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar




## CERTIFICATE

This is to certify that **Martha Murmu** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar  
Dumka

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Md Abdur Raqeeb** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*H.K. 8/7/21*  
Head Of The Department  
Of Geography

M.G. College, Ranishwar  
Dumka  
Head


Department of Geography  
Mayurakshi Gramin College, Ranishwar

*JR 8/7/21*  
Prof. Jay Mangal Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Md Al Amin** of this institute has carried out a project work on topic **"Socio Economic"** under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

Prof. Hamayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Md Alam Ansari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head of Department  
Of Geography  
M.G. College, Ranishwar  
Dumka  
Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Md Izazul Islam** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir

Head

Department of Geography

Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray


Assistant Professor

Department of Geography

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Md Miraj Uddin Sekh** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar  
Prof. Humayun Kabir  
Head


Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

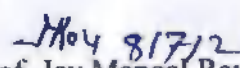
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Kanchan Paul** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
Prof. Jay Mangal Ray  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Kandin Tudu** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*HCi*  
8/8/21  
Head Of The Department  
Of Geography  
M. G. College, Ranishwar  
Dumka  
Head


Department of Geography  
Mayurakshi Gramin College, Ranishwar


*JHoy* 8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Kanha Baskey** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Khuteb Ansari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*HCe*  
*8/7/21*  
Head Of The Department  
Prof. Jay Mangal Ray  
M.G. College, Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*J04 8/7/21*  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Kiran Gorain** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Department of Geography  
Mayurakshi Gramin College, Ranishwar  
M.G. College, Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Kripasindhu Bagdi** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
H.C.  
Head of The Department  
Of Geography  
Mayurakshi Gramin College, Ranishwar  
M.O. dated 8/7/21  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Krishna Dhibar** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature*  
8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*Handwritten signature*  
8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Mr. Krishna Rajak** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature*  
8/7/21

Prof. H. Of The Department  
Head of the Department  
M.G. College, Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*Handwritten signature*  
8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Kusum Singha** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature of Prof. Humayun Kabir*

Prof. Humayun Kabir

Head of the Department

Department of Geography

Mayurakshi Gramin College, Ranishwar

*Handwritten signature of Prof. Jay Mangal Ray*  
Prof. Jay Mangal Ray

Assistant Professor

Department of Geography

Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Kshama Chowdhury** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*HCin*  
*8/7/21*  
Prof. Jay Mangal Ray  
Head of the Department  
of Geography  
Mayurakshi Gramin College,  
Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*Ko4*  
*8/7/21*  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Lakhi Mohali** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*[Signature]*  
8/7/21  
Head Of The Department  
Prof. Jay Mangal Ray  
Mayurakshi Gramin College, Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*[Signature]*  
8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Madhab Karmakar** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature*  
8/7/21  
Prof. H. Karmakar  
Head of the Department  
of Geography  
M.G. College, Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*Handwritten signature*  
8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Maha Prasad Mandal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature*  
8/7/21

Head of the Department  
Prof. Jay Mangal Ray  
Mayurakshi Gramin College, Ranishwar


Department of Geography  
Mayurakshi Gramin College, Ranishwar

*Handwritten signature*  
8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Juhi Khatun** of this institute has carried out a project work on topic **"Socio Economic"** under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
Mayurakshi Gramin College, Ranishwar

Prof. Jay Mangal Ray

Head

Department of Geography

Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray

Assistant Professor

Department of Geography

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Kaberi Adhya** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

Prof. Humayun Kabir

Department of Geography

Mayurakshi Gramin College, Ranishwar

Prof. Jay Mangal Ray

Assistant Professor

Department of Geography

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Kajal Kumari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*[Handwritten signature]*  
8/7/21  
Head of the Department  
of Geography  
Mayurakshi Gramin College  
Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar


*[Handwritten signature]*  
8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify to **Kalpana Kora** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

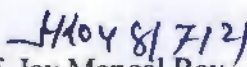
  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Kamlesh Marandi** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Prof. Humayun Kabir  
Head of Department  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify to **Gulshan Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*[Signature]*  
8/8/21  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

*[Signature]*  
JK08/7/21  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Hema Kisku** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Prof. Humayun Kabir

M.G. College, Ranishwar

Department of Geography

Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray


Assistant Professor

Department of Geography


Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Jabed Ansari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Prof. Humayun Kabir  
Head

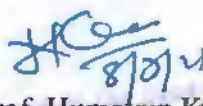
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray/  
Assistant Professor

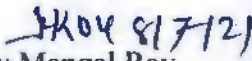
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Mayurakshi Gramin College, Ranishwar

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This is to certify that **Mr. Jagatjyoti Singha** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Prof. Humayun Kabir  
Head


Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify to **Rajesh Konai** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar  
Dumka  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Rajesh Mahato** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar  
Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify to **Puja Paul** of this institute has carried out a project work on topic  
“**Socio Economic**” under **Prof. Jay Mangal Ray**, Assistant Professor, Department of  
Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-  
21. The work has been done in partial fulfilment of the requirement for the award of  
degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*HG*  
8/7/21  
Head Of The Department  
Of Geography  
M.G.College, Ranishwar

Prof. Humayun Kabir

Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*JKoy* 8/7/21  
Prof. Jay Mangal Ray

Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar




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This is to certify that **Puja Adhya** of this institute has carried out a project work on topic **"Socio Economic"** under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G.College,Ranishwar  
Dumka

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography

Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Priyanka Tudu** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir

Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray

Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Pushpa Soren** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar  
Dumka

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Pinki Maji** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography

M.G. College, Ranishwar  
Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray

Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Pintu Das** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature*  
Head Of The Department  
Of Geography

Prof. Hemayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*Handwritten signature*  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar


## CERTIFICATE

This is to certify to **Poonam Kumari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.



Head Of The Department  
Of Geography  
M.G. College, Ranishwar  
Prof. Humayun Kabir  
Head


Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Pradeep Mistri** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
MG College, Ranishwar  
Prof. Humayun Kabir  
Head


Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar


## CERTIFICATE

This is to certify that **Payal Adhya** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G.College, Ranishwar

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar



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This is to certify to **Pinki Khatun** of this institute has carried out a project work on topic **"Socio Economic"** under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*HCi 8/7/21*  
Head Of The Department  
Of Geography  
M.G.College, Ranishwar  
Gumka

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar


*JKoy 8/7/21*  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar



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Head Of The Department  
Of Geography  
M.G.College,Ranishwar

Prof. Humayun Kabir  
Head

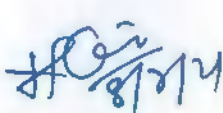
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Pani Marandi** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
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M.G. College, Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
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Assistant Professor

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This is to certify that **Pani Tudu** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*HK*  
8/7/21

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar


*JK*  
8/7/21

Prof. Jay Mangal Ray  
Assistant Professor


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This is to certify that **Parsoma Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

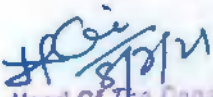
  
Head of the Department  
of Geography  
M.G. College, Ranishwar  
Dumki

Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Parvin Aktary** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
Of Geography  
Mayurakshi Gramin College,  
Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar

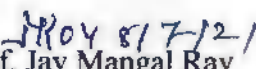
  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Pampa Mandal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G.College, Ranishwar

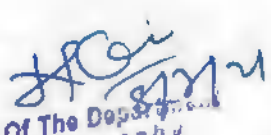
**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
**Prof. Jay Mangal Ray**  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Nazmul Seikh** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G.College,Ranishwar


**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Neba Parween** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar




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This is to certify to **Nila Bbandari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M. Prof. Humayun Kabir  
Head

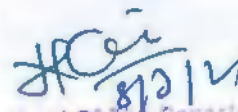
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Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify to **Nilmuni Murmu** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of the Department  
Of Geography  
MG College, Ranishwar  
Dumka  
Head


Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

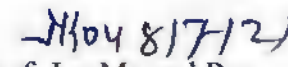
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Nityanand Pal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

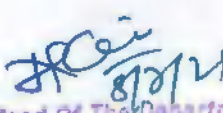
  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Nur Alam Mollah** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Munna Prasad Choudhari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*H/Kabir 8/7/21*  
Head of The Department  
Of Geography  
M.G. College, Ranishwar  
Prof. **Mayun Kabir**  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*H/04 8/7/21*  
Prof. **Jay Mangal Ray**  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Munni Kumari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar



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This is to certify to **Nafis Ansari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar


**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Nandita Shivastava** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College Ranishwar  
Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Miss Nashrin Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head of the Department  
of Geography  
M.G. College, Ranishwar  
Pumka

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Nawaj Sharif Mondal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
**Prof. Jay Mangal Ray**  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Nazmal Alam** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G.College, Ranishwar


**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Mousumi Das** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Prof. Hariyuni Kabir  
M.G. College, Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Mukesh Murmu** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*[Signature]*  
8/7/21

Head Of The Department  
Prof. Jay Mangal Ray  
M.G. College, Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*[Signature]*  
8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Mukesh Mahato** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*HCg*  
8/7/21  
Head Of The Department  
Of Geography  
Prof. Humayun Kabir  
Dumka  
Head

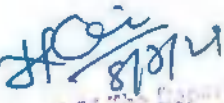
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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Prof. Jay Mangal Ray/  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar




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This is to certify that **Muktar Ansari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head of the Department  
M.G. College,  
Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify to **Miliangel Soren** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Prof. Humayun Kabir

Head  
M.G. College, Ranishwar

Department of Geography

Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray

Assistant Professor

Department of Geography

Mayurakshi Gramin College, Ranishwar



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This is to certify that **Mir Shartaz Aziz** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head of Department  
Of Geography

M.G. College, Ranishwar

Department of Geography

Mayurakshi Gramin College, Ranishwar

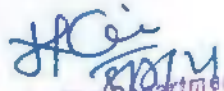
  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography


Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Mirju Murmu** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head of The Department  
of Geography  
M.G. College  
Dumka

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of ~~Zoology~~ *Geography*  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Monika Hansda** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.



Prof. Humayun Kabir  
Head


Department of Geography  
Mayurakshi Gramin College, Ranishwar




Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Monika Kumari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head of Geography  
MG College, Ranishwar  
Department of Geography

Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Mosiur Rahaman Mallick** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature*  
8/7/21

Prof. Humayun Kabir

Department of Geography

Mayurakshi Gramin College, Ranishwar

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8/7/21

Prof. Jay Mangal Ray

Assistant Professor

Department of Geography

Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Moumita Das** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*8/7/21*  
Head Of The Department  
Prof. Jay Mangal Ray  
M.G. College, Ranishwar


Department of Geography  
Mayurakshi Gramin College, Ranishwar

*8/7/21*  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Moumita Mandal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
8/7/21  
Head Of The Department  
Of Geography  
M.G. College,  
Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
8/7/21  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Md Kabirul Islam** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Prof. Humayun Kabir  
M.G. College, Ranishwar

Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar




## CERTIFICATE

This is to certify that **Md Satar Hussain** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G.College,Ranishwar  
Dumka

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

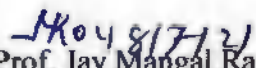
  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Md Sboaib Rizvi** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G.College, Ranishwar  
Dumka

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Meena Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*JKG 8/7/21*  
Head Of The Department  
Of Geography  
M.G.College, Ranishwar  
Dumka

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

*JKO 8/7/21*  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Rihana Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*Handwritten signature*  
8/8/21

Head Of The Department  
Of Geography

M.G. College, Ranishwar  
Dumka

Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

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8/7/21

Prof. Jay Mangal Ray

Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Safiuddin Mallick** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
HEAD OF THE Department  
Of Geography  
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Dumka

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of ~~Geology~~ Geography.  
Mayurakshi Gramin College, Ranishwar

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This is to certify to **Rinku Mal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*H. Kabir*  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

*J. Mangal Ray*  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify to **Rinu Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

*HK 8/12/21*  
Head Of The Department  
Of Geography  
M.G.College, Ranishwar  
Dum Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar


*JK 4 8/7/21*  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify to **Riya Ghosh** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography

M.G. Pradyuman Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar



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This is to certify that **Riya Mandal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Riya Roy** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head of The Department  
Of Geography  
M.G. College, Ranishwar

**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
**Prof. Jay Mangal Ray**  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Raju Mondal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of **BACHELOR OF ARTS (B.A.) in GEOGRAPHY**.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar  
Dumka


Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Rakesh Chandra Mondal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.O. College, Ranishwar  
Dumka


Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **RAKESH MANDAL** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of **BACHELOR OF ARTS (B.A.)** in **GEOGRAPHY**.


  
Head Of The Department  
Of Geography  
M.G.College, Ranishwar  
Dumka

Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Rathin Kshirahari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar

**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Rafiya Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head of The Department  
Of Geography  
M.G. College, Ranishwar

Prof. Humayun Kabir  
Head


Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor


Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Raghubir Yadab** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar  
Dumka


Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify that **Rahika Soren** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head of The Department  
Of Geography  
M.G.College,Ranishwar

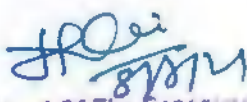
**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar


## CERTIFICATE

This is to certify to **Rahul Shaikh** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography

Prof. Humayun Kabir  
Head


Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Rafika Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head of the Department  
Of Geography  
M.G. College, Ranishwar  
Prof. Jay Mangal Ray  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Rajesh Kisku** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography

M.G. College, Ranishwar  
Prof. Humayun Kabir  
Head


Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify to **Uma Shill** of this institute has carried out a project work on topic **"Socio Economic"** under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G.College, Ranishwar  
Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar


## CERTIFICATE

This is to certify that **Uttam Hembrom** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G.College,Ranishwar

Prof. Humayun Kabir  
Head

Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar



## CERTIFICATE

This is to certify to **WASIM AKRAM** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
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M.G. College, Ranishwar


**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Tanushri Rooj** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar  
Dumka

**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar




## CERTIFICATE

This is to certify that **Teresa Tudu** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
Of Geography  
M.G.College, Ranishwar


Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Tousifur Rahaman Mallick** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G.College, Ranishwar  
Du Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Manoj Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Udai Mandal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
Of Geography  
M.G. College, Ranishwar


**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

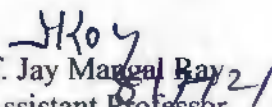
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This is to certify to **Ujjwal Dhibar** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
Head Of The Department  
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**Prof. Humayun Kabir**  
Head  
Department of Geography  
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**Prof. Jay Mangal Ray**  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

## CERTIFICATE

This is to certify that **Sumona Mandal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
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M.G. Humayun Kabir  
Head

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Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify to **Supriyo Pal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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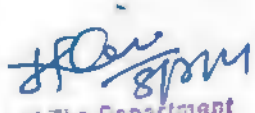
Prof. Humayun Kabir  
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Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar




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This is to certify that **Susmita Ray** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

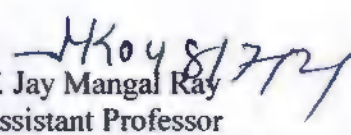
  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Sufiya Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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This is to certify that **Sulekha Pal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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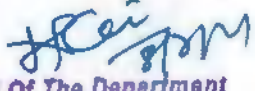
Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangar Ray  
Assistant Professor


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Mayurakshi Gramin College, Ranishwar

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This is to certify that **Sulli Rani Ghosh** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Assistant Professor  
Department of Geography  
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This is to certify that **Suman Mondal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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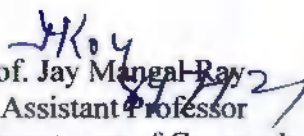
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Prof. Jay Mangal Ray  
Assistant Professor


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This is to certify that **Stenshila Hembrom** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

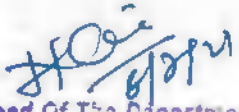
  
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This is to certify that **Stenshila Murmu** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Assistant Professor  
Department of Geography

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This is to certify to **Subhajit Rajak** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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**Prof. Humayun Kabir**  
Head


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Prof. Jay Mangal Ray

Assistant Professor  
Department of Geography  
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This is to certify that **Suban Murmu** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Assistant Professor

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This is to certify that **Sonia Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Prof. Humayun Kabir  
Head

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Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

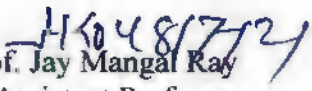
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This is to certify that **Somnath Mandal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
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Head  
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Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify to **Sonali bagti** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
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Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

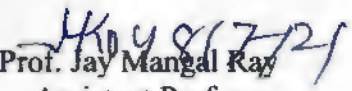
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This is to certify that **Sk Intaj Ali** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Dr. Prof. Humayun Kabir  
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Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

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Mayurakshi Gramin College, Ranishwar

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This is to certify to **Sk Monirul** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor

Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **SK SAHID ANOWAR** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
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M.G.College, Ranishwar  
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Department of Geography  
Mayurakshi Gramin College, Ranishwar


  
Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify to **Sk Sahidul Islam** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
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M.G.College, Ranishwar


**Prof. Humayun Kabir**  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

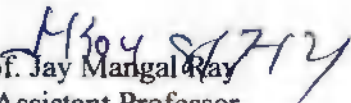
  
**Prof. Jay Mangal Ray**  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar



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This is to certify that **Shiv Murmu** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
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M.G.College, Ranishwar  
Prof. Humayun Kabir  
Head  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

  
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Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar



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This is to certify that **Shoylen Hembrom** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Mayurakshi Gramin College, Ranishwar

  
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Assistant Professor

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Mayurakshi Gramin College, Ranishwar


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This is to certify that **Shruti Saha** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

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Mayurakshi Gramin College, Ranishwar

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This is to certify that **Simaluddin Sheikh** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Prof. Humayun Kabir

Head

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Prof. Jay Mangal Ray

Assistant Professor

Department of Geography

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This is to certify that **Sk Hamidur Rahaman** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Prof. Humayun Kabir  
Head

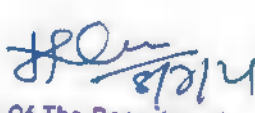
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Assistant Professor

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This is to certify that **Sanam Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Head  
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Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify to **Sanjida Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Prof. Jay Mangal Ray  
Assistant Professor

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Mayurakshi Gramin College, Ranishwar

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This is to certify that **Sanjoy Hansda** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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This is to certify that **Sarfaraj Ansari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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This is to certify that **Sarif Sekh** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

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Assistant Professor

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This is to certify to **Serafat Ali** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Assistant Professor


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This is to certify to **Sheela Murmu** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Department of Geography  
Mayurakshi Gramin College, Ranishwar

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This is to certify that **Shibu Baskey** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

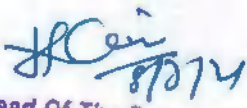
  
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This is to certify that **Shilpa Ghosh** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
Head Of The Department  
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Prof. Humayun Kabir  
Head  
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Prof. Jay Mangal Ray  
Assistant Professor

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This is to certify that **Shiv Hembram** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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**Prof. Humayun Kabir**  
Head

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Prof. Jay Mangal Ray  
Assistant Professor

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This is to certify that **Sahid Ansari** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Prof. Jay Mangal Ray  
Assistant Professor


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This is to certify that **Saikat Dutta** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Assistant Professor  
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This is to certify that **Salma Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Prof. Jay Mangal Ray


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This is to certify to **Salma Parween** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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This is to certify that **Samir Mondal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Assistant Professor


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This is to certify to **Ruma Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
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Prof. Jay Mangal Ray  
Assistant Professor  
Department of Geography  
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This is to certify to **Rumki Ghosh** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Prof. Jay Mangal Ray  
Assistant Professor

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This is to certify that **Rupa Mal** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.


  
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This is to certify that **Sadh Akkas** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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This is to certify that **Sagar Adhya** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Humayun Kabir**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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Prof. Humayun Kabir  
Head

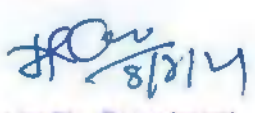
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Mayurakshi Gramin College, Ranishwar

  
Prof. Jay Mangal Ray  
Assistant Professor

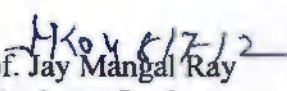
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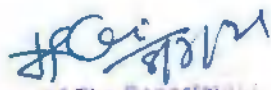
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Head  
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Prof. Jay Mangal Ray  
Assistant Professor

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This is to certify that **Roji Khatun** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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This is to certify that **Rakesh Yadav** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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This is to certify that **Rick Dutta** of this institute has carried out a project work on topic "**Socio Economic**" under **Prof. Jay Mangal Ray**, Assistant Professor, Department of Geography, Mayurakshi Gramin College, Ranishwar during the academic session 2020-21. The work has been done in partial fulfilment of the requirement for the award of degree of BACHELOR OF ARTS (B.A.) in GEOGRAPHY.

  
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