# University of Rajasthan
# Jaipur

## SYLLABUS

## B.Sc. (Hons.) Part-I

## Examination - 2019

# CONTENTS

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# SCHEME OF EXAMINATION
## B.Sc. (Honours) Part-I
## (10+2+3 Pattern)

For a pass at each examination, a candidate shall be required to obtain a minimum of 36% marks in each subsidiary subject and 40% marks in the Honours subjects, passing separately in the practicals, wherever prescribed.

Successful candidates will be classified as under :

| | | |
|---|---|---|
| First Division | 60% | of the aggregate marks prescribed both in Honours and subsidiary subject of |
| Second Division | 50% | Part-I, Part-II and Part III Examinations |

All the rest Shall be declared passed the examination if they obtain a minimum of 40% marks in the aggregate.

No division shall be awarded at the Honours Part I.

The number of papers and practicals, wherever prescribed the duration of examination, maximum marks and minimum pass marks shall be shown in the relevent sections.

A candidate shall be required to offer the Honours subject and one subsidiary subject out of the following subjects to the condition that the same were offered by him as optional subjects at the First Year T.D.C. Examinations of the University or an examination recognised by the Universities equivalent thereto :

*Honours Subjects* :

1. Physics
2. Chemistry
3. Zoology
4. Botany
5. Mathematics

6. Psychology
7. Geography

N.B. : Candidates shall be required to offer Four papers and practical (wherever prescribed) of the Honours subject offered by him.

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## सामान्य हिन्दी

**पूर्णांक 100**   3 H88.   **न्यूनतम उत्तीर्णांक 36**

नोट : 36 से कम अंक लाने पर छात्रों को उत्तीर्ण नहीं किया जायेगा। इस प्रश्न–पत्र में प्राप्त अंकों को श्रेणी निर्धारण हेतु नहीं जोड़ा जायेगा।

अंक विभाजन – प्रश्न पत्र में दो भाग होंगे – 1. साहित्य खण्ड एवं 2. व्याकरण खण्ड। साहित्य खण्ड में दो भाग होंगे – गद्य भाग एवं पद्य भाग। प्रत्येक खण्ड के लिए 50 अंक निर्धारित है।

**50 अंक**

| | | | |
|---|---|---|---|
| क | दो व्याख्या पद्य से (प्रत्येक में विकल्प देना है) | 5 x 2 = | 10 अंक |
| ख | दो व्याख्या गद्य से (प्रत्येक में विकल्प देना है) | 5 x 2 = | 10 अंक |
| ग | आलोचनात्मक प्रश्न पद्य से (विकल्प देना है) | 7½ x 2 = | 15 अंक |
| घ | आलोचनात्मक प्रश्न गद्य से (विकल्प देना है) | 7½ x 2 = | 15 अंक |

## साहित्य खण्ड – 'क' :– गद्य–पद्य की निर्धारित रचनाएँ
### गद्य भाग –

| | | |
|---|---|---|
| 1. | कहानी | प्रेमचन्द – बडे भाई साहब |
| | | विजयदान देथा – सिकंदर और कौआ |
| 2. | संस्मरण | कन्हैयालाल मिश्र 'प्रभाकर' – बयालिस के ज्वार की उन लहरों में |
| 3. | रेखाचित्र | रामवृक्ष बेनीपुरी– रजिया |
| 4. | विज्ञान | गुणाकर मुले – शनि सबसे सुन्दर ग्रह |
| 5. | निबंध | अगरचन्द नाहटा – राजस्थान की सांस्कृतिक धरोहर |
| 6. | व्यंग्य | शरद जोशी – जीप पर सवार इल्लियाँ |
| 7. | पर्यावरण | अनुपम मिश्र – आज भी खरे हैं तालाब |

### पद्य भाग :– (कबीर ग्रंथावली से सं. – श्यामसुंदर दास)

| | | |
|---|---|---|
| 1. | कबीर | साखी सं. – गुरूदेव को अंग – 7,12,26,30 |
| | | सुमरन को अंग – 10,17,24,26 |
| | | विरह को अंग – 2,6,10,18 |
| 2. | सूरदास सूरसागर सार | सं. डॉ. धीरेन्द्र वर्मा |
| | | विनय भक्ति पद सं. – 21,33 |
| | | गोकुल लीला पद सं. – 55,58 |
| | | वृंदावन लीला पद सं. – 10,28 |
| | | उद्धव संदेश पद सं. – 77,79 |
| 3. | तुलसीदास | विनय पत्रिका, गीताप्रेस, गोरखपुर पद सं. – 87,88,90,156,158 |
| 4. | मीरां | पदावली सं. – नरोत्तम स्वामी पद सं. – 1,3,4,5,10 |
| 5. | रहीम (दस दोहे) | रहीम ग्रंथावली संपादक विद्यानिवास मिश्र, गोविन्द रजनीश (दोहावली) 186,191,211,212,214,218,219,220,223,224 |
| 6. | मैथिलीशरण गुप्त | मनुष्यता, हम राज्य लिए मरते हैं (गीत–साकेत के नवम सर्ग से) |
| 7. | सुमित्रानंदन पंत : | नौका विहार |
| 8. | सूर्यकान्त त्रिपाठी निराला | वह तोड़ती पत्थर |
| 9. | सच्चिदानंद हीरानंद वात्स्यायन 'अज्ञेय' | हिरोशिमा |
| 10. | रामधारी सिंह दिनकर : | विपथगा, समर शेष है |

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खण्ड – 'ख'

व्याकरण/व्यावहारिक हिन्दी खण्ड                                             50 अंक

1. निबन्ध लेखन          –    शब्द सीमा 300 शब्द                               8 अंक
2. कार्यालयी लेख        –    शासकीय – अर्द्धशासकीय पत्र, कार्यालय ज्ञापन, विज्ञप्ति एवं
                              कार्यालय आदेश, अधिसूचना, पृष्ठांकन 4 x 2 =           8 अंक
3. संक्षेपण             –                                                    4 अंक
4. पल्लवन              –                                                    5 अंक
5. शब्द निर्माण प्रविधि   –    उपसर्ग, प्रत्यय, संधि, समास                       5 अंक
6. शब्द शुद्धि एवं वाक्य शुद्धि                                                5 अंक
7. मुहावरे एवं लोकोक्ति                                                      5 अंक
8. पारिभाषिक शब्दावली                                                      5 अंक
9. शब्द के प्रकार       –    संज्ञा, सर्वनाम, विशेषण, क्रिया एवं क्रिया विशेषण       5 अंक

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# 2. GENERAL ENGLISH

**Duration: 3 hrs.**                    **Max. Marks: 100**

**Minimum Pass Marks: 36**

**The syllabus aims at achieving the following objectives:**

1. Introducing students to phonetics and enabling them to consult dictionaries for correct pronunciation (sounds and word stress)
2. Reinforcing selected components of grammar and usage
3. Strengthening comprehension of poetry, prose and short-stories
4. Strengthening compositional skills in English for paragraph writing. CVs and job applications.

The Pattern of the Question Paper will be as follows:

**Unit A: Phonetics and Translation**                    **(20 marks)**
**(10 periods)**

| | |
|---|---|
| I Phonetic Symbols and Transcription of Words | (05) |
| III Translation of 5 Simple sentences from Hindi to English | (05) |
| from English to Hindi | (05) |
| IV Translation of 05 Words from Hindi to English | $(2^{1/2})$ |
| from English to Hindi | $(2^{1/2})$ |

**Unit B: Grammar and Usage**                    **(25 marks)**
**(10 periods)**

| | |
|---|---|
| I  Elements of a Sentence | (05) |
| II Transformation of Sentences | (05) |

(a) Direct and Indirect Narration

(b) Active and Passive Voice

II Modals                                    (05)

III Tense                                    (05)

IV Punctuation of a Short Passage with 10 Punctuation Marks

(05)

(As discussed in Quirk and Greenbaum)

## Unit C: Comprehension                    (25 marks)

Following Essays and Stories in *Essential Language Skills* revised edition compiled by Macmillan for University of Rajasthan General English B. A. /B. Com./B. Sc.
Candidates will be required to answer 5 questions of two lines each to be answered out of 10 questions. There would be two questions from the prescribed text.                                    (10)

| | |
|---|---|
| Sujata Bhatt | Voice of the Unwanted Girl |
| Ruskin Bond | Night Train for Deoli |
| M.K. Gandhi | The Birth of Khadi |
| J.L. Nehru | A Tryst with Destiny |
| A.P.J. Abdul Kalam | Vision for 2020 |

**The candidates will be required to answer 5 questions from the given unseen passage.**                                    (10)

**One vocabulary question of 10 words from the given passage.**    (5)

## Unit D: Compositional Skills             (30 marks)
**(15 periods)**

I Letters-Formal and Informal                (10)

II CV's Resume and Job Applications and Report    (10)

III Paragraph Writing                        (10)

(6)

## Recommended Reading:

Sasikumar, V., Dutta and Rajeevan, A Course in Listening and Speaking-I Foundation Books. 2005.

Sawhney, Panja and Verma eds. English At the Workplace, Macmillan 2003.

Singh, R.P. Professional Communication. OUP. 2004

Judith Leigh. CVs and Job Applications. OUP. 2004

Arthur Waldhorn and Arthur Zeiger, English Made Simple. Upa and Co.

Gunashekar ed. A Foundation English Course for Undergraduates. Book I, CIEFL, Hyderabad.

Quirk and Greenbaum: A University Grammar of English Longman, 1973

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# **3 COMPULSORY PAPER OF ENVIRONMENTAL STUDIES**

Compulsory in I Year for all streams at undergraduate level

## Scheme of examination

| Time | Min Marks | Max. Marks |
|------|-----------|------------|
| 3 hrs | 36 | 100 |

This paper will contain 100 multiple choice questions. Each question will carry 1 mark.

Students should be encouraged to visit places of Environmental Importance including Natural and Manmade Habitat.

Note:
1. The marks secured in this paper shall not be counted in awarding the division to a candidate.
2. The candidates will have to clear this compulsory paper in three chances.
3. Non-appearing or absence in the examination of compulsory paper will be counted as a chance.

## Unit.1: The Multidisciplinary nature of environmental studies

Definition, scope and importance- Relationship between Environmental Studies and other branches of science and social sciences.

Need for Environmental awareness, Environmental education in present day context.

## Unit.2: Natural Resources and Challenges

a. Natural resources and associated problems, Classification of resources: renewable resources,non renewable resources, classes of earth resources, resources regions: Definition and criteria, resource conservation.

b. Forest resources: Use and over- exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

c. Water resources: Use and over-utilization of surface and groundwater, floods, drought conflicts over water, dams-benefits and problems.

d. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

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e    Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticides problems, water logging, salinity, case studies.

f.    Energy resources: Growing energy need, renewable and nonrenewable energy sources, use of alternate energy sources. Case studies.

g.    Land resources: Land as a resource, Land degradation man induced Landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.

- Equitable use of resources for sustainable lifestyles.

## Unit 3: Ecosystems, Concepts, Structure, Functions and Types
- Concept of an ecosystem
- Structure and function of an ecosystem
- Producers, consumers and decomposers
- Energy flow in the ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids
- Introduction, types characteristics features, structure and function of the following ecosystem:
a. Forest ecosystem, Tropical Temperate and Alpine Ecosystem
b. Grassland ecosystem and Their Types
c. Desert ecosystem with emphasis on Thar Desert
d. Aquatic ecosystems(ponds, streams, lakes, rivers, oceans, estuaries) and Wet Lands

## Unit 4: Biodiversity and its conservation
- Introduction –Definition, genetic, species and ecosystem diversity
- Biogeographically classification of India
- Value of biodiversity :consumptive use, productive use, social ethical., aesthetic and option values
- Biodiversity at global, National and local level
- India as a mega-diversity nation
- Hot-sport of biodiversity
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts
- Endangered, Threatened and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity
- Red Data Book

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## Unit 5 : Environmental Pollution and Control Measures
Definition

- Causes, effects and control measures of:
a) Air Pollution
b) Water Pollution
c) Soil Pollution
d) Marine Pollution
e) Noise Pollution
f) Thermal Pollution
g) Nuclear Hazards

- Solid waste management" Causes, effects and control measures of urban and industrial wastes
- Role of an individual in prevention of pollution
- Pollution case studies
- Disaster management: floods earthquake, cyclone and landslides

## Unit 6 : Social issues, Environment, Laws and Sustainability

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case studies
- Environmental ethics: Issues and possible solution.
- Climate change, global warming, acid rain ozone layer depletion, nuclear accidents and holocaust. Case studies
- Wasteland reclamation.
- Consumerism and waste product.
- Environmental Protection Act.
- Air (Prevention and Control of Pollution)Act
- Wild life protection Act
- Forest Conservation Act
- Biological Diversity Act
- Issues involved in enforcement of environmental legislation
- Public Awareness.

## Unit 7:   Human Population and the Environment

- Population growth, variation among nations
- Population explosion-Family Welfare Programme
- Environment and Human health
- Human Rights
- Value Education
- HIV/AIDS
- Women and Child Welfare
- Role of Information Technology in Environment and human health
- Case Studies

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**Suggested Readings:-**

1. Chauhan, Surendra Singh. 2001. Biodiversity, Biopiracy and Biopolitics: The Global Perspectives, Kalinga Publications, New Delhi.
2. Chauhan, Surendra Singh. 2004. Environmental Protection and Management: From Stockholm to Rio and After, Kalinga Publications, New Delhi.
3. Diwan A.P. and Arora D.K.1995. Human Ecology Anmol Publication Pvt.Ltd.,New Delhi.
4. Dubey, R.M.1992. Human Ecology and Environmental Education,Chaugh Publications,Allahabad.
5. Goudie,Andrew.The Human Impact.
6. Husain Maxia.1994 Human Geography,Rawat Publication,Jaipur.
7. Johnston, R.J.Ed.1986 Dictionary of Human geography,National Publication,New Delhi.
8. Malik,S.L.and Bhattacharya D.K.1986. Aspects of Human Ecology,Northern Book Center,New Delhi.
9. Mishra,R.P and Bhooshan,B.S.1979.Human Settlements in Asia.Public,Polices and programmes Haritage publisher,New Delhi.
10. Nathawat, G.S.1985. Human Ecology,An Indian perspective,Indian Human Ecology Council,Jaipur.
11. Russel, Bartrand, 1976.Impact of Science of society Unwin,Publisher,Indian. (paper back).
12. Sinha Rajiv, 1996.Gloobal Biodiversity Ina.,Shri publication,Jaipur.
13. Sinha Rajiv K., 1994. Development without Desertrction
14. Environmentalist,Jaipur. Sinha Rajiv K., 1996.Environmental Crises and Human at Risk,In A Shri Publication,Jaipur.
15. Smith, Dlanne, 1984.Urban Ecology,George Allen,London.
16. Swarnkar, R.C.1985.Indian Tribes.Printwell publisher,Jaipur.
17. Tivy,Joy and O'Hugegreg,1985.Human Impact on the Ecosystem Edinburgh George Allen Boyd.
18. United Nations Development Report, 1996.Human Development Report, 1996.Oxford University Press,Delhi.
19. Vannathony & Rogers Paul, 1974. Human Ecology and World Development,Flehum Press,New York.

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# 4 Elementary Computer Applications

Work load : Teaching 2 hours per week          3 H&&  .
Practical 2 hours per week

Max Marks: 100 (Main University Exam: Theory -60 Marks, Practical- 40 Marks )

Each candidate has to pass in Theory and Practical Examinations separately.

**Main University Examination : Question pattern for Theory Paper**          *Max Marks: 60*

**Part – I (very short answer)** consists 10 questions of **one marks** each with two questions from each unit. Maximum limit for each question is up to 20 words.

**Part – II (short answer)** consists 5 questions of **two marks** each with one question from each unit. Maximum limit for each question is up to 40 words.

**Part – III (Long answer)** consists 5 questions of **eight marks** each with one question from each unit with internal choice. Maximum limit for each question is up to 400 words.

## Unit – I

Introduction to Information Technology. evolution and generation of computers, type of computers. micro, mini. mainframe and super computer. Architecture of a computer system: CPU, ALU. Memory (RAM. ROM families) cache memory. input/output devices, pointing devices.

Concept of Operating system, need types of operating systems, batch, single user, multi-processing, distributed and timeshared operating systems, Introduction to Unix, Linux. Windows, Windows NT. Programming languages    Low level and high level languages, generation of languages. 3 GL and 4 GL languages. Graphic User Interfaces.

## Unit – II

**Word Processing Tool** - Introduction. Creating. Saving. Copy, Move and Delete. Checking Spelling and Grammar. Page Layout. interface. toolbars. ruler, menus, keyboard shortcut. editing. Text Formatting. insert headers and footers. Bullets and Numbering, Find and Replace etc., Insert Table and Picture. Macro, Mail Merge.

**Power Point:** Creating and viewing a presentation, managing Slide Shows, navigating through a presentation using hyperlinks, advanced navigation with action setting and action buttons, organizing formats with Master Slides, applying and modifying designs, adding graphics, multimedia and special effects

## Unit - III

Electronic Spreadsheet - Worksheet basics Create, save and open a worksheet. Entering data text. numbers and formula in a worksheet. Inserting and deleting cells cell formatting. inserting rows and columns in a worksheet. formatting worksheets, Using various formulae and inbuilt functions. Update worksheets using special tools like spell check and auto correct. Setup the page

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and margins of worksheets for printing. Format the data in the worksheet globally or selectively, creating charts. Enhance worksheets using charts, multiple worksheets-concepts

## Unit – IV

The Internet - History and Functions of the Internet, Working with Internet, Web Browsers, World Wide Web, Uniform Resource Locator and Domain Names. Uses of Internet, Search for Information, Email, Chatting, Instant messenger services, News, Group, Teleconferencing, Video-Conferencing, E-Commerce and M-Commerce.

Manage an E-mail Account, E-mail Address, configure E-mail Account, log to an E-mail, Receive E-mail, Sending mails, sending files an attachments and Address Book, Downloading Files, online form filling, E-Services - E-Banking and E-Learning.

## Unit - V

Social, Ethical and Legal Matters - Effects on the way we: Work Socialise, Operate in other areas, Cyber crime, Prevention of crime. Cyber law: Indian IT Act, Intellectual property, Software piracy, Copyright and Patent, Software licensing, Proprietary software. Free and Open source software.

Network Security - Risk assessment and security measures, Assets and types (data, applications, system and network). Security threats and attacks (passive, active): types and effects (e.g. Identity theft, denial of services, computer virus etc.), Security issues and security measures (Firewalls, encryption/decryption), Prevention.

**Question Paper pattern for Main University Practical Examination**      *Max Marks: 40*

**Practical**

The practical exercises will be designed to help in the understanding of concepts of computer and the utilization in the areas outlined in the theory syllabus. The emphasis should be on practical usage rather than on theoretical concepts only.

The practical examination scheme should be as follows –

- Three Practical Exercise (including Attendance & Record performance)        30 marks
  - Operating system
  - MS Word
  - MS Excel
  - MS Power Point
  - Internet
- Viva-voce                                                                         10 marks

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# 5. बी.ए. प्रथम वर्ष : प्रारम्भिक हिन्दी

पूर्णांक : 100 अवधि : 3 घण्टे

अंकों का विभाजन

1. पुस्तकों पर आधारित प्रश्न      50 अंक
2. व्याकरण से संबंधित प्रश्न      24 अंक
3. रचना से संबंधित प्रश्न      26 अंक
   (क) लोकोक्तियाँ मुहावरे
   (ख) पत्र लेखन अथवा निबंध

पाठ्यक्रम

1. गद्य संग्रह
2. व्याकरण : शब्द विचार, वाक्य विन्यास, वाक्य खण्ड, पद क्रम का ज्ञान तथा इनमें होने वाली सामान्य त्रुटियों का ज्ञान।
3. (क) मुहावरों एवं लोकोक्तियों का प्रयोग, वाक्यों में रिक्त स्थानों की पूर्ति, समान दिखने वाले शब्दों का अर्थ भेद अथवा वाक्यों में प्रयोग
   (ख) पत्र लेखन अथवा निबंध

पाठ्य पुस्तकें

1. गद्य–संग्रह–राष्ट्रीय गौरव के चिन्ह– डॉ. हरिकृष्ण देवसरे
   प्रकाशक–नेशनल पब्लिशिंग हाउस, नई दिल्ली

व्याकरण एवं रचना

1. आधुनिक हिन्दी व्याकरण तथा रचना – लेखक कृष्ण विकल
   प्रकाशक–नेशनल पब्लिशिंग हाउस, नई दिल्ली
2. सुबोध व्याकरण एवं रचना–सम्पादक–व्यथित हृदय–संशोधनकर्ता–डॉ.अम्बा प्रसाद सुमन
   प्रकाशक – श्रीराम मेहरा एण्ड कम्पनी, आगरा

# ①. PHYSICS

## SUBJECTS (HONOURS SUBJECTS)

### 1. PHYSICS

#### Paper-I : Mechanics

Note : Five questions are to be set taking one from each unit (each question will have an internal choice). Student will attempt all the five questions. 40% weightage will be given to problems and numericals.

#### Unit-I

**Inertial and Non-Inertial Frames:**

(i) Inertial and non-inertial frames of reference, examples. Transformation of displacement, velocity and acceleration between different frames of reference involving translation. Invariance of Newton's Laws and energy conservation in a collision process.

(ii) Postulates of special theory of relativity, Lorentz transformations of velocity and acceleration, time dilation and length contraction. Lorentz transformations as rotation in space-time, world line and Minkowski space, time-like and space-like vectors, Macro causality, Light cone and past, present and future.

(iii) Transformation of displacement, velocity and acceleration between different frames rotating with respect to each other, pseudo forces, centrifugal and coriolis forces, Motion relative to earth (in northern and southern hemispheres), variation with latitude, Effect of coriolis force on various bodies in motion on earth, Focault's pendulum.

#### Unit-II

Conservation laws : Conservative forces, Potential energy in gravitational and electrostatic field, Rectilinear motion under conservative forces, Discussion of potential energy curves and motion of a particle. Centre of mass, two particle system: Motion of the CM and motion of one particle relative to another. Reduced mass, Conservation of linear momentum, Collision of two particles in one and two dimensions (elastic and inelastic).

Slowing down of neutrons in a moderator. Motion of a system with varying mass. Angular momentum conservation and charged particle scattering by a nucleus. Mechanics of system of particles: Motion of the centre of mass of a system of particles. Motion relative to C.M.. Relationship for kinetic energy and angular

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momentum of a system of particles in the lab frame and the CM frame. Conservation of energy, Equation of rotational motion of a system of particles, Conservation of angular momentum.

### Unit-III

Gravitation and Motion under Central forces : Law of gravitation, Gravitational and inertial mass, Gravitational potential energy and gravitational field, Principle of superposition, Gravitational field due to a large plate. Spherical shell and sphere.

General motion under central forces, general solution and discussion of trajectories, Rutherford scattering case of elliptical and circular orbits. Keplers Laws.

### Unit-IV

Relativistic Kinematics : Four vectors, Transformation of energy and momentum, Transformation between Lab and the CM frames, Transformation of four frequency vector, longitudinal and transverse Doppler effect. Four momentum conservation, Elastic and inelastic collision of particles of two particles, Kinematics of decay products of an unstable particle, reaction threshold energy, Pair production, Compton effect.

### Unit-V

(i) Rigid Body Dynamics : Equation of motion of a rotating body Inertial coefficients, Moment of inertia of a disc, cylinder, spherical shell, sphere, rectangular and circular cross section. Case of I not parallel to ω, Kinetic energy of rotation and principal axes. Precessional motion of spinning top, Gyroscope, spin precession in constant magnetic field.

(ii) Elastic Properties of Matter : Elasticity, Youngs modulus, Bulk modulus, Modulus of rigidity, Poisson's ratio and derivation of relations between various classic constants, Bending of a beam, Torsion of a cylinder, Experimental determination of elastic constants by static and dynamical methods.

**Books Recommended :**

1. Berkeley Physics Course Vol-I, Mechanics.
2. Fundamental University Physics Vol-I, Mechanics by Alonso and Finn.

### Paper-II : Oscillations and Waves

Note : Five questions are to be set taking one from each unit (each question will have an internal choice). Student will attempt all

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the five questions. 40% weightage will be given to problems and numericals.

## Unit-I

Free oscillations of systems with one degree of freedom, oscillations in an arbitrary potential well, Simple harmonic motion-solution using complex exponentials, Examples of mechanical and electrical system, Energy of the oscillator, Power Dissipation and damping of the oscillator under viscous and solid friction. Superposition of (i) two and (ii) N-linear undamped harmonic oscillations, beats. Combination of two oscillations at right angles. Anharmonic Oscillators-pendulum as an example.

## Unit-II

Undamped Oscillator with harmonic force, forced oscillations with damping. Effect of varying the resistive term, Transient phenomenon, power absorbed by a driven oscillator, Frequency response, phase relations, quality factor, Resonance : Electrical Oscillations, Series and parallel LCR circuit.

Electromechanical System —ballistic galvanometer, effect of damping. Optical Thermal expansion of a crystal. Non-linear effects in electrical devices. Non-linear effects in Acoustic Waves.

## Unit-III

Motion of two coupled simple harmonic oscillators, Differential equation for stiffness or capacitance coupled oscillators. Normal modes, Motion in mixed modes, transient behaviour. Effect of coupling. Normal modes of vibration for $CO_2$ and $H_2O$ molecules. Calculation of normal mode frequencies. Forces oscillations and resonance for two coupled oscillators. Electrically coupled circuit, frequency response. Reflected impedance effect of coupling (inductive case) and resistive load.

## Unit-IV

Many coupled Oscillators : N-coupled oscillators, Normal modes and their properties, Longitudinal Oscillators, Equation of motion for one dimensional monoatomic and diatomic lattices, acoustic and optical modes, dispersion relations, concept of group and phase velocities. Electrical transmission line, propagation velocity, looses, characteristic impedance, standing waves, effect of termination.

## Unit-V

Wave equation in one dimension and its solution for elastic waves in : Solid rod, Gas column, transverse waves on a string.

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Normal modes of a two dimensional system. Waves n two and three dimensions, Spherical waves.

Reflection and transmission of waves on a string at a boundary. Reflection and transmission of energy. Matching of impedances. Standing waves on a string of fixed length. Energy of a vibrating string, energy in each normal mode of a vibrating string. Standing Wave Ratio. Fourier series and Analysis of triangular sawtooth and square functions. Plane Electromagnetic wave. Wave equation and its plane wave solution, energy and momentum. Radiation pressure. Radiation resistance of free space. EM wave in dispersive media (normal case). Spectrum of electromagnetic radiations.

**Recommended Books :**
1. Vibrations and Waves—A.P. French.
2. Physics of vibrations and waves—H.J. Pain.
3. Waves and Oscillation, Berkeley Physics Course Vol 3.

## Paper-III : Electricity and Magnetism

**Note :** Five questions are to be set taking one from each unit (each question will have an internal choice). Student will attempt all the five questions. 40% weightage will be given to problems and numericals.

### Unit-I

**Vector Fields :** Partial derivative, Gradient of scaler field function, Line integral of a vector field. Divergence in Cartesian coordinate. Gauss divergence theorem, Physical meaning of divergence of a vector, concept of solid angle. Gauss law and inverse square law, Gauss law in differential form. The Laplacian operator, Poisson and Laplace equations. Curl of a vector function, Curl in Cartesian coordinates. Stoke's theorem. The physical meaning of curl of a vector. Vector identities using del operator.

### Unit-II

**The field of Moving Charges :** Concept of Electrostatic field and potential due to discrete charges and continuous charge distribution, Potential energy of a system of charges, Application : Energy required to build a uniformly charged sphere, classical radius of an electron. The potential and field due to short dipole (in polar and three dimensional Cartesian coordinates), the torque and force on a dipole in an external field.

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Magnetic forces, measurement of charge in motion; invariance of charge. Electric field measured in different frames of reference, field of a point charge moving with constant velocity. Force on a moving charge. Interaction between moving charge and other moving charges.

### Unit-III

The magnetic field in free space and matter : The definition of magnetic field, properties of the magnetic field. Ampère's circuital law with applications. Ampère's law in differential from Vector potential. Poison's equation for vector potential, Vector potential and evaluation of B for (i) a current in an infinite solenoid (ii) outside a current carrying long straight wire (iii) Inside a long straight wire carrying uniform current. Field of any current carrying wire and deduction of Biot-Savart law.

Transformation relations for different components of electric and magnetic fields between two inertial frames.

The field of a current loop. The force on a magnetic dipole in an external field. Electric currents in atoms—Bohr magneton Orbital gyromagnetic ratio. Electron spin and magnetic moment. Magnetic susceptibility. The magnetic field caused by magnetized matter magnetization current. free currents and the field H.

### Unit-IV

Electric Field in Matter : The Electrical moments of a system of discrete charges and continuous charge distribution, dipole and quadrupole moments of discrete charge distribution, simple examples, Atomic and molecular dipoles. Atomic polarizability. Permanent dipole moments. Dielectrics. Capacitor filled with a dielectric. The potential and field due to a polarized sphere, Dielectric sphere placed in uniform field. The field of a charge in dielectric medium and Gauss law. The connection between electric susceptibility and atomic polarizability, Polarization in changing fields. The bound charge (polarization) current.

### Unit-V

Electromagnetic Induction and Maxwell's Equation : Faraday's law of electromagnetic induction, a conducting rod moving through a uniform magnetic field, a loop move through a non-uniform magnetic field, a loop with the field source moving, Betatron. Differential form of Faraday's law, Inductance, self-inductance of a

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solenoid of finite length, Mutual inductance, mutual inductance between two coils, self-inductance of a straight conductor. Energy stored in an inductor and in the magnetic field. Displacement current, Modified Ampere's law, Maxwell's equations in differential and integral form. Maxwell's equations in material media, Boundary conditions for electric and magnetic fields at vacuum-dielectric and vacuum-metal boundaries.

*Books Recommended :*

1. Berkeley Physics Course, Vol. 2, Electricity and Magnetism.
2. Feynman in Physics Vol 2.
3. An Introduction to Electrodynamics by Griffiths
4. Fundamental University Physics, Vol 2, Fields - Alonso & Finn

Paper-IV : Thermal and Statistical Physics

Note : Five questions are to be set taking one from each unit (each question will have an internal choice). Student will attempt all the five questions. 40% Weightage will be given to problems and numericals.

*Unit I*

Thermal and adiabatic interactions : Thermal interaction, Zeroth law of thermodynamics, system in thermal contact with a heat reservoir (canonical distribution), Energy fluctuations, Entropy of a system in a heat bath, Helmholtz free energy, Adiabatic interaction and enthalpy, General interaction and first law of thermodynamics, Infinitesimal general interaction, Gibbs free energy, Phase transitions, Triple point, first and second order phase transition, Clausius-Clapeyron equation, Vapour pressure curve, transformation of disorder into order, Heat engine and efficiency of engine, carnot's Cycle, Thermodynamic scale as an absolute scale, Maxwell relations and their applications.

*Unit II*

Kinetic Theory : Derivation of Maxwell's law of distribution of velocities and its experimental verification, Most probable, average and RMS velocities, Diffusion, Equip partition Theorem, Classical theory of Specific heat capacity, specific heat of solid.

Transport Phenomenon : Mean free path, Distribution of free path, Coefficients of viscosity, thermal conductivity and diffusion. Brownian motion, Langevin's and Einstein's theories, Experimental determination of Avogadro number.

## Unit-III

Production of low temperatures : Cooling by Adiabatic expansion, Coefficient of performance, Joule-Thomson effect, J-T coefficient, for ideal as well as Vander Waal's gases. Porous plug experiment Temperature of inversion, Regenerative cooling. Air Liquefiers. Adiabatic demagnetization of paramagnetic substances. Nuclear paramagnetism. Liquid He I and He II, Superfluidity. Quest for absolute zero, Third law of thermodynamics and Nernst Heat Theorem.

## Unit-IV

Classical Statistics : Validity of classical approximation, Phase space, Micro and Macro states, Thermodynamic probability. Entropy and probability, Monoatomic ideal gas Barometric equation, Specific heat of diatomic gas, Ortho and para hydrogen, Specific heat capacity of solids, Langevin's theory of Paramagnetism.

## Unit-V

Quantum Statistics : Bose-Einstein and Fermi-Dirac distribution laws, Calculation of the thermodynamic functions of an ideal weak degenerate gas, Strong degeneration, Calculation of the thermodynamic functions of an ideal Bose gas, Derivation of Planck law, Flux of radiation energy, radiation pressure. Thermodynamic functions of an ideal Fermi electron gas, Free electron model for metals, Specific heat of metals, Richardson's equation of thermionic emission, Relativistic Fermi gas, White dwarf stars Chandrasekhar mass limit.

**Reference Books :**

1. Berkeley Series, Vol. V, Statistical Physics.
2. Reif-Thermodynamics and Statistical Physics.
3. Lokanathan and Khandelwal—Thermodynamics and Statistical Physics.
4. Sears-Thermodynamics, Kinetic Theory of Gases and Statistical Physics.
5. Kittle-Thermal Physics.

### PRACTICAL

Max. Marks 100 Duration:2 Practicals in two days Min. Pass
(5 hrs. duration each day)       Marks 40

Students are expected to perform atleast 15 experiments in the academic session. The suggestive list of experiments is given below.

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The institution if necessary may introduce new experiments of the same standard and communicate the list to the Convener, Board of Studies.

**Experiments on Linear Track :**
1. Constant velocity motion.
2. Acceleted motion.
3. Harmonic motion.
4. Anharmonic motion.
5. Potential energy curves and energy conservation.
6. Elastic collisions and conservation laws.

**Experiments with simple oscillator :**
7. Inelastic collisions.
8. Variation of time period with amplitude.
9. Composition of two perpendicular S.H.M's.
10. Frequency response.
11. Damping and 'Q' value.
12. Phase curves.

**Experiments with coupled oscillator :**
13. Excitation of normal modes and frequency measurement.
14. Period of energy transfer as a function of coupling strength.

**Experiments with Torsional wave apparatus :**
15. Velocity of wave propagation.
16. Excitation of normal modes both ends open, one end open.
17. Impedance matching.

**Experiments with Electricity-Board :**
18. Study of R.C. circuit with D.C.
19. Study of source impedance.
20. Study of R.C. Circuit with A.C nonsinusoidal.
21. Study of R.C. Circuit with AC sinusoidal.

**Other Experiments :**
22. Study of interference pattern by 1,2,3,4,5 ... slits.
23. Study of Fresnel's diffraction pattern. (a) Circular hole (b) Single slit.
24. Study of Franhofer diffraction.
25. Michelson's interfermeter.
26. Study of thermo e.m.f.
27. Change of B.P. of a liquid with pressure.
28. Rydberg constant from a given spectrum of hydrogen.

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29. Experiment for displacement current.
30. Study of Radiation-patters from dipole, quadruple.

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# 2. CHEMISTRY

## CHEMISTRY
### Scheme

Max Marks: 400

|  | Duration (hrs) | Max. Marks | Min. Pass Marks |
|---|---|---|---|
| Paper I | 3 | 75 |  |
| Paper-II | 3 | 75 | 120 |
| Paper-III | 3 | 75 |  |
| Paper-IV | 3 | 75 |  |
| Practical | 7 | 100 | 40 |

(*Complete in One day*)

**Notes:**

1. There shall be four theory papers for Part-I Examination. The duration of examination for each paper shall be three hours and the maximum marks shall be 75.
2. Each paper will contain ten (10) questions having two (02) questions from each unit. Candidates are required to attempt five questions in all selecting atleast one questions from each unit.

## Paper-I: Inorganic Chemistry
### (4 hrs/week)

### Unit-I

**Ionic Bond:**

General characteristics, types of ions, size effects, radius ratio and coordination number, Madelung-constant, Born-Haber cycle, Applications of lattice energy, polarizing power, polarizability, Fajan's rules, hydration energy, solubility of ionic-compounds, defects in structures, Frankel and Schottky defects, Non-stoichiometric compounds.

**Solids:**

Metallic bond: Qualitative idea of free electron, valence bond and band theories, semiconductors and insulators, conduction in ionic solids, electrical and magnetic properties of solids, introduction to superconductors and super-conductivity.

### Unit-II

**Covalent bond:** General characteristics, Valence bond theory and its limitations. Directional characteristics of covalent bond, Resonance and resonance energy, Hybridisation involving s, p and d-orbitals.

**Valence Shell Electron Pair Repulsion (VSEPR) Theory** to $NH_3$, $H_2O$, $H_3O^+$, $SF_4$, $ClF_3$, $ICl_3$, shapes of simple inorganic molecules and ions. Dipole moment, percentage ionic-character from dipole moment and electronegativity difference.

**Molecular Orbital Theory:** Detailed description of linear combination of atomic orbital (LCAO), Homonuclear ($H_2$, $He_2$, $B_2$, $C_2$, $N_2$, $O_2$, $F_2$) and heteronuclear diatomic molecules (CO, NO) and their ions, comparison of valence bond and molecular orbital theories, multicentre bonding in electron deficient molecules, bond strength and bond energy.

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## Unit-III

**Weak Interactions:**
Hydrogen bond, theories of hydrogen bonding: Valence bond treatment, weak intermolecular forces of attraction, van der Waals forces.

**Chemistry of Noble Gases:**
Position in the periodic table, discovery, Isolation, important compounds of noble gases with special references to xenon compounds: Synthesis, bonding and their stereochemistry.

**s-Block elements:**
Comparative study, diagonal relationship, salient features of hydrides, solvation and complexation tendencies including their functions in biosystems, an introduction to alkyls and aryls.

## Unit-IV

**p-Block elements:**
Comparative study of the p-block elements and group trends, electronic configuration, physical and chemical properties, diagonal relationship, atomic and ionic radii, ionization potentials, electron affinity, electronegativity and oxidation states, oxidation state diagrams on the basis of redox potentials, inert pair effect, catenation.

**Compounds of p-block elements:**
Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), silicones, oxygen fluorides, peracids of sulphur, tetrasulphurtetranitride, basic properties of halogens, interhalogen compounds and polyhalides.

## Unit-V

**d-Block elements:**
**Chemistry of the elements of first transition series:** Electronic configuration and comparative study with respect to atomic and ionic radii, oxidation states and ionization potentials. Redox potentials, oxidation state diagrams on the basis of redox potentials, binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry, metallic nature, magnetic properties, catalytic activity, colour and spectral properties of transition metal ions.

**Chemistry of the elements of second and third transition series:** Electronic configuration, general characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry.

## Paper-II: Organic Chemistry
### (4 hrs/week)

### Unit-I

**Structure and Bonding :** Hybridization, Inductive effect, hyperconjugation, resonance, van der Waals interactions, inclusion compounds, clatherates, charge transfer complexes, hydrogen bonding.

**Mechanism of Organic Reactions :** Free radical and ionic reactions, homolytic and heterolytic bond breaking, electrophiles and nucleophiles, types of organic reactions, energy considerations, transition state, reactive intermediates-carbocations, carbonions, free radicals, carbenes, arynes and nitrenes. Methods of determination of reaction mechanism.

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Alkanes: Nomenclature of branched and unbranched alkanes. Classification of carbon atoms in alkanes. Isomerism in alkanes, methods of formation (with special reference of Wurtz reaction. Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids) physical properties and chemical reaction of alkanes. Mechanism of free-radical halogenation of alkanes, orientation, reactivity and selectivity.

## Unit-II

Cycloalkanes: Nomenclature, methods of formation, chemical reactions. Baeyer's strain theory and its limitations. Ring strain in small rings (cyclo-propane and cyclo-buttane). Theory of strain less rings. The case of cyclopropane ring: banana bonds.

Alkenes: Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes-mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoffs rule, hydroboration-oxidation. Oxymercuration-demercuration, epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene.

Cycloalkenes: Methods of formation, conformations and chemical reactions.

Dienes: Nomenclature and classification, isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reaction-1,2 and 1,4 additions. Diels-Alder reaction.

Alkynes: Nomenclature, structure and bonding, Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization.

## Unit-III

Arenes and Aromaticity: Nomenclature of benzene derivatives. The aryl group, aromatic nucleus and side chain. Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture.

Aromaticity: The Huckel rule and its applications. Energy level, molecular orbital diagram (ethane, 1-3-butadiene, benzene). Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and $\pi$-complexes, mechanism of nitration, halogenation, sulphonation, and Friedel-Crafts reaction. Effect of substituent groups (inductive, mesomeric and hyperconjugative effect), activating and deactivating groups, directive influence of groups, determination of orientation up to disubstituted derivatives, ortho/para ratio, Birch Reduction.

Method of formation and chemical reactions of benzene, alkyl benzenes and biphenyl.

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution, reactions of alkyl halides $S_N2$ and $S_N1$ reactions with energy profile diagrams.

Methods of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions.

Relative reactivities of alkyl halides V/s allyl vinyl and aryl halides. Preparation and properties of vinly, allyl and benzyl halides. Synthesis and uses of DDT and BHC.

## Unit-IV

Stereochemistry of Organic Compounds: Concept of isomerism. Types of isomerism.

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**Optical Isomerism :** Elements of symmetry, molecular chirality, enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds resolution of enantiomers, inversion, retention and racemization, Asymmetric synthesis.

Relative and absolute configuration, sequence rule, D & L and R & S systems of nomenclature.

**Geometric isomerism:** Determination of configuration of geometrical isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

**Conformational isomerism:** Conformational analysis of ethane and n-butane. Newman projection and Sawhorse formulae. Fischer and flying wedge formulae.

Difference between configuration and conformation.

## Unit-V

**Electromagnetic Spectrum: Absorption Spectra**

**Ultraviolet (UV) absorption spectroscopy:** Absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. Absorption bands of simple molecules like alkenes, Conjugated dienes, carbonyl compounds, enones, acids and aromatic compounds.

**Infrared (IR) absorption spectroscopy:** Molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of simple organic compounds, alkanes, alkenes, alkynes, alcohols, aldehydes, ketones, carboxylic acids and their derivatives.

## Paper-III Physical Chemistry
### (4 Hrs. /Week)

### Unit I

**States of matter:**

**Ideal gases:** Concept of molar mass and molar volume. Determination of molar mass of a gas and volatile substances. The barometric distribution law. Maxwell distribution law of molecular velocities. The Maxwell energy distribution. The Maxwell energy distribution law and it's experimental verifications.

**Real gases:** Causes of deviations from ideal gas behavior. Van der waal's equations and it's implications. Isotherms of van der waal's gas. Critical phenomenon and critical constant. Reduced equation of state and law of corresponding states.

### Unit II

**Liquid State:**

Thermal expansion and compressibility, Heat of vaporization. Determination of Vapour pressure and Heat of vaporization. Disorder in liquid state and structure of liquid water. Intermolecular forces. Cohesion of liquids. Eyring theory of liquids. Crystalline and amorphous states. Isotropy and anisotropy. Elements of symmetry. Law of rational indices. Weiss and miller indices and equation of plane in intercept form. Law of constancy of interfacial angles. Unit cell and lattice powder method of X-ray examination of crystals, seven segment cell.

## Unit III

**Chemical Kinetics:**

Rate, Initial rate, specific rate, rate constant and units. Method of determination of initial rate. Order, molecularity and stoichiometry of reaction. Methods of determination of order of reaction. Derivation of integrated rate equations- Zero order, first order, second order and third order. Graphical applications of these equations for the determinations of rate constant. Effect of temperature on rate constant, arrhenius equation, energy of activation and it's determination. Complex reactions and their nature. How do these reactions differ from simple reactions? Derivation of rate equation for the opposing reactions $(A+B \leftrightarrow C)$; Parallel reactions (P's are products) and consecutive reactions $(A \rightarrow B \rightarrow C)$ characteristics of consecutive reactions.

## Unit IV

**Thermodynamics:**

Definitions of thermodynamic terms. Concept of work and heat. Work of expansion and compression. Zeroth law of thermodynamics, exact and inexact differential. First law of thermodynamics under isothermal and adiabatic conditions respectively. Enthalpy and changes at constant temperature and pressure. Concept of Cp and Cv and their thermodynamic relationship. Application of first law of thermodynamics. The heat of reaction and heat of formation. Hesse's Law. Heat of reaction at constant Pressure and volume. Variation of heat of reaction with temperature. Bond enthalpies and bond energies.

## Unit V

**Solutions:**

Solutions of gases in liquids, Henry's law and it's application to respiration. Solutions of solids in liquids and distribution law. distribution law and extraction processes. Osmosis, Osmotic pressure, Determination of Osmotic pressure. Lowering of vapour pressure. Relative Lowering of vapour pressure and Rault's Law. Depression in Freezing point and elevation in boiling point. Vant's Hoff factor and it's implications.

**Phase Equilibria:**

Explanation of terms phase, component and degrees of freedom. Phase rule and it's thermodynamic derivation. Restricted phase rule. Analysis of (a) One component system such as sulfur and water (b) two component system such as lead-silver system.

### Paper-IV: Analytical Chemistry
#### (4 hrs/week)

#### Unit-I

Principle of Gravimetric analysis, precipitation methods, super saturation and precipitate formation, the purity of the precipitate, coprecipitation, post precipitation, conditions of precipitation, precipitation from homogeneous solution, washing of the precipitate. Ignition of the precipitate, masking and demasking agents.

#### Unit-II

Solvent extraction : Principles and process of solvent extraction, the distribution law and the partition coefficient, liquid-liquid extraction, factors favouring solvent extraction, choice of solvent for solvent extraction, stripping, solid liquid extraction, organic reagents used in solvent

extraction.

Organic reagents in quantitative inorganic analysis. Application of the following organic reagents: DMG, Cupferron, 8-hydroxyquinoline, cupron, salicylaldehyde, oxime, l-nitroso-2-naphthol, 4-bromoandelic acid, nitron, tannic acid, arsonic acids, pyridine, anthranilic acid, pyrogallal, ethylendiamine.

## Unit-III

Completion of gravimetric results, compilation of results, reliability of results-accuracy and precision, cleaning and calibration of glassware, standard derivation, t, Q and F tests, correction, significant figures, errors in analysis.

Volumetric analysis: Principle and applications of Redox titrations, iodometry and iodimetry. Theory of complexation titrations. Methods of end point detection, EDTA as Titrant, types of EDTA titration of mixtures, selectivity masking and demasking agents, metal indicators.

## Unit-IV

Distillation methods of organic solvents, steam, fractional, vacuum and molecular distillations, monometers and monostates. Analysis of oils and fats, saponification value, iodine value, RM value, acid value.

Quantitative estimation of following functional group: alcoholic phenolic, carboxylic acids and unsaturated groups (olefinic & acetylenic).

Polarimetry: Basic principle, instrumentation, experimental techniques, determination of (a) specific rotation of a substance (b) concentration of the substance & applications. An elementary idea of Refractometry, Interferometry-circular dichroism & optical rotatory dispersion.

## Unit-V

Water pollutants and their analysis: Water analysis pollutants, Analysis of water for dissolved oxygen, B.O.D. and C.O.D. Biological treatment methods. Prevention of water pollution by treatment of industrial wastes with special reference to cement industry, fertilizer industries and dyeing industries.

Air pollution: General consideration types of air pollutants, unit of measurement sampling monitoring and analysis of CO and $SO_2$ in atmosphere effect of air pollutants on plants and human health method for pollution control, especially for pollution by automobiles.

### B.Sc. (HONS.) PART-I CHEMISTRY PRACTICALS
(8 hrs or 12 periods / week) (Spread over four days)

INORGANIC CHEMISTRY

A.     Qualitative: To analyze the given mixture containing six radicals (three acidic and three basic) including interfering acid radicals - fluoride, borate, oxalate, phosphate and excluding insolubles.

B.     Quantitative:
 1. Volumetric exercises—involving
    (i) Complexometric titrations (EDTA): Estimation of $Ca^{2+}$ & $Mg^{2+}$
    (ii) Iodometric and Iodimetric titrations.
 2. Determination of total hardness of water.
 3. Determination of number of molecules of water of Crystallization in oxalic acid crystals.
 4. Estimation of sodium carbonate and bicarbonate in mixed solution.

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5. Estimation of sodium carbonate and sodium hydroxide in a mixed solution.
6. Estimation of Ferrous and Ferric sulphates in a mixed solution.

## ORGANIC CHEMISTRY

1. Identification of functional groups in organic compounds and preparation of suitable derivative: unsaturation, alcoholic (–OH), phenolic (=C–OH), aldehydic, ketonic, carboxylic, ester, carbohydrate, nitro, amido, amino, sulphonic acids and halogen derivatives.
2. Purification of solid substance by recrystallization.
3. Separation of two miscible liquids by fractional distillation.
4. Preparation of acetanilide from aniline.
5. Preparation of an azo-dye.
7. Determination of m.p. and mixed m.p.

## PHYSICAL CHEMISTRY

1. To study the solubility curve of salts such as potassium nitrate, etc.
2. To Study the solubility curve of phenol in water and hence study the effect of separate addition of substances such as naphthalene, potassium chloride and acetic acid.
3. Determination of pH of different buffer solutions and evaluate the $PK_a$ of an acid by Handerson equation.
4. Determine the relative viscosity of a liquid by using viscometer.
5. Determine the relative surface tension of a liquid by using stalagnometer.
6. Determine the heat of neutralization of an acid by alkali.
7. Determine the molecular complexity of benozoic acid in benzene by Distribution Law.
8. Determine the heat of reaction and verify Hess's law.

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### (Instructions to the Examiner)
### B.Sc.(HONS.) Pt-I CHEMISTRY PRACTICAL EXAMINATION

**Max. Marks: 100**          **Duration of Exam: 7 hrs.**          **(Complete in One day)**

**Inorganic Chemistry**

Ex.1  Qualitative: To analyze the given mixture containing six radicals (three acidic and three basic) including interfering acid radicals - fluoride, borate, oxalate and phosphate. No insolubles will be given.          18

Ex.2  Quantitative: One of the exercises mentioned in the syllabus.          12

**Organic Chemistry**

Ex. 3  Identification of functional group of the given two compounds and preparation of their suitable derivative, if feasible.          25

**Physical Chemistry**

Ex. 4  Perform one of the physical chemistry experiments given in the syllabus.          25
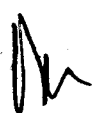
Ex. 5  Viva-voce          10

Ex. 6  Record          10

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# University of Rajasthan
## Syllabus: B.Sc. Zoology (Hons.) Part-I
### (2018-19)

**Scheme:**

| | | |
|---|---|---|
| Paper I | : Animal Diversity-1 | Max. Marks-50 |
| Paper II | : Animal Diversity-2 | Max. Marks-50 |
| Paper III | : Biochemistry | Max. Marks-50 |
| Paper IV | : Cell Biology | Max. Marks-50 |
| Paper V | : Molecular Biology | Max. Marks-50 |
| Paper VI | : Genetics and Biostatistics | Max. Marks-50 |
| Practicals | : 2 Days (8 hrs.) | Max. Marks-100 |

**Scheme of Examination:**                                      **Max. Marks: 50**

1. There will be 5 Questions in each paper. All questions will be compulsory and carry equal marks.
2. Question number 1 will comprise 10 very short answer (maximum 25 words) type questions, each of 1 mark. Questions should be evenly distributed covering entire syllabus.
3. Each paper is divided into four units/sections. There will be one question from each unit/section. The question number 2 to 5 will have internal choice.

**Seminars, posters, models, educational tour report, practical record etc. will carry internal marking which will be added in the practicals**

## Paper-I: Animal Diversity –I (Non-chordates)

### Section - A

1. Principles of classification: Salient features and classification up to orders in non-chordates (Protozoa to Aschelminthes).
2. Protozoa: Type study– *Entamoeba, Paramecium, Plasmodium, Trypanosoma* and *Leishmania*.
3. Origin of Metazoa: Metamerism, Organization of coelom and symmetry.

### Section - B

4. Porifera:
   (i) Type study- *Sycon*; Types and evolution of canal system.
   (ii) Development of Sycon
5. Coelenterata:
   (i) Type study – *Obelia* and *Aurelia*: Polymorphism in Hydrozoa.
   (ii) Metagenesis.

### Section – C

6. Ctenophora  Type study  *Beroe*; Affinities of Ctenophora

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7.  Platyhelminthes: Type study: *Fasciola hepatica* and *Taenia solium*; Parasitic adaptations.
8.  Aschelminthes: Type study – *Ascaris* ; Parasitic adaptations.

## Section – D

9.  Economic importance of Protozoa and parasitism.
10. Economic importance of Porifera, Corals, Coral reefs (types, formation and distribution with reference to India, and their conservation) Polymorphism in siphonophores
11. Helminths and human diseases.

## Paper-II: Animal Diversity-II (Non-chordates)

### Section – A

1.  Salient features and classification up to orders (Annelida to Hemichordates).
2.  Annelida: Type study- *Pheretima*, *Leech* and *Neries* ; Metamerism in Annelida.
3.  Onychopora: Type study – *Peripatus* ; Affinities.

### Section - B

4.  Arthropoda: Type study – *Prawn*; Crustacean larval forms; Mouth parts and vision in Arthropods; Social insects (*Termite* and *honey bee*).
5.  Mollusca: Type study - *Pila* and *Unio*; Torsion and distortion in Gastropods, Molluscan larvae

### Section – C

6.  Echinoderms: Type study – *Asterias*; Larval forms of Echinodermata; Affinities of Echinodermata.
7.  Hemichordates: *Balanoglossus* – External morphology, coelom, reproductive system and development; Phylogenetic significance.

### Section - D

8.  Applied aspects of -
    (i)   Vermiculture.
    (ii)  Sericulture and Ericulture.
    (iii) Lac culture.
    (iv)  Apiculture.
9.  Economic importance of Arthropods; Metamorphosis in insects; Integrated pest management.
10. Economic importance of Mollusca; Pearl culture.

## Paper-III: Biochemistry

### Section - A

1.  Basic chemical concepts, bonds and functional groups
2.  Carbohydrates: Classification, structure and clinical significance

3. Lipids: Classification, structure and clinical significance.
4. Vitamins: Types (water and fat soluble), structure, function and clinical significance.

## Section - B

5. Proteins: Classification and structural properties.
6. Enzymes: Nature of enzymes and classification of co-enzymes, co-factors, inhibition (competitive, un competitive and non-competitive), iso-enzymes, factors contributing to catalytic efficiency.

## Section - C

7. Regulation of metabolism:
    (i) Carbohydrates: Oxidation of glucose through glycolysis, Kreb's cycle and oxidative phosphorylation, glycogenesis, glycogenolysis and gluconeogenesis.
    (ii) Proteins: Essential and non essential amino acids, transformation of amino acids, deamination, transamination, decarboxylation, fate of ammonia, synthesis of urea (Ornithine cycle), fate of carbon skeleton.

## Section - D

   (iii) Lipids: β-oxidative pathway of fatty acids, brief account of biosynthesis of triglycerides, cholesterol and its metabolism.
   (iv) Inborn errors of metabolism [Galactosemia, Glycogen storage disease (type I-V), Hurler syndrome, Phenylketonuria, Alkaptonuria, Maple syrup urine disease, Lysosomal storage disease (Fabry disease, Gauchers disease, Nieman Pick disease, Lesch-Nyhan syndrome)].

## Paper-IV Cell Biology

## Section - A

1. Microscopy: General principle of compound microscope, fluorescent and electron microscope.
2. Principles and uses of instruments: pH meter, colorimeter, spectrophotometer and centrifuge.
3. Separation of cellular organelles through centrifugation and their characterization.

## Section - B

4. Structure of prokaryotic and eukaryotic cells; Diversity of cell size and shape.
5. Plasma membrane: Danielli-Davson model, Unit membrane model, Greater membrane model and Fluid mosaic model of Singer and Nicholson; Structure and functions of plasma membrane.
6. Structure and function of cell organelles: Golgi complex, endoplasmic reticulum, ribosomes, (prokaryotes and eukaryotes), lysosomes, peroxisomes and mitochondria.

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## Section - C

- Nucleus and nuclear envelope: Ultrastructure of interphase nucleus and nuclear envelope.
8. Chromosome structure: Morphology, chromonema, chromomeres, primary and secondary constrictions and telomeres.
9. Chromosome types and function. Polytene and Lampbrush chromosomes
10. Cell junctions: Tight junctions, desmosomes (belt and spot) and gap junctions.
11. Transport: Osmosis, diffusion (facilitated and mediated), active transport ($Na^+/K^+$ ATPase pump, $Ca^{2+}$ ATPase pump) and ionic basis of membrane excitation.

## Section - D

12. Cell-cell signaling: Endocrine, paracrine and autocrine signaling; second messenger cAMP and $IP_3$ DAG system.
13. Microtubular organelles: Structure and function of cilia, flagella and centrioles.
14. Eukaryotic cell cycle: Mitotic and meiotic cell division and their significance.

## Paper-V: Molecular Biology

### Section - A

1. Chromosome remodeling: Nucleosome concept, solenoid and scaffold formation, heterochromatin and euchromatin.
2. RNA: Structure and types (mRNA, rRNA and tRNA).
3. Replication mechanism in prokaryotes.
4. Transcription in prokaryotes.
5. Translation in *E. coli.*

### Section - B

6. DNA structure: Polymorphism (A, B and Z type).
7. DNA replication: Semiconservative replication and replication mechanism in eukaryotes.
8. Genetic code.

### Section – C

9. Transcription in eukaryotes.
10. Translation and post- translational modifications in eukaryotes.
11. Gene expression: Operon concept; lac operon

### Section - D

12. DNA repairs: Direct, reversal, base-excision repair, alkylation, nucleotide excision repair and human diseases.
13. Transposons: LTR, reverse transcription of retroviral genomic- RNA to DNA.
14. Gene transfer (Conjugation, transformation and transduction) and gene therapy.

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# Paper-VI: Genetics and Biostatistics

## Section - A

1. Mendelian inheritance; Deviation from Mendelian inheritance.
2. Chromosomal theory of inheritance.
3. Multiple alleles, gene interaction, epistasis, lethality and pleiotropic genes.
4. Linkage, crossing over and linkage maps.
5. Sex chromosome system and sex linkage.

## Section - B

6. Non chromosomal inheritance.
7. Sex determination and dosage compensation in Drosophila and mammals.
8. Mutation: Types and molecular basis: Variation in chromosomal number.
9. Gene concept: Recon, muton and cistron.

## Section – C

10. Human genetics: somatic cell genetics, meiotic consequences, single gene disord
    (Albinism, Tay Sachs disease, Familial hypercholesterolemia, Sickle cell anem
    Haemophilia, Thalassemia, Fragile X-syndrome & Duchenne muscular dystroph
    genetic disorders (Down's syndrome, Patau's syndrome, Turner's syndrom
    Klinefelter's syndrome, Cri-du-chat syndrome, Philadelphia syndrom
    Hermaphroditism and pseudohermophroditism).
11. Eugenics, euthenics and euphenics.

## Section – D

12. Introduction, scope and application of biostatistics.
13. Understanding the concept of descriptive and inferential statistics.
14. Frequency distribution.
15. Diagrammatic and graphical presentation of data (bar diagrams, histograms, frequen
    polygons & Pie charts).
16. Measures of central tendency: Mean, median and mode (direct, short-cut & st
    deviation methods) and their merits & demerits.
17. Standard deviation and standard error and their merits & demerits.

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Min. Marks 40             8 hrs. /week             Max. Marks: 100

# Practicals

I.   **Microscopic techniques**

1.   Organization and working of optical microscopes: (Dissecting and compound microscopes).
2.   General methods of microscopic permanent preparations: Narcotization; fixing and preservation, washing, staining and destaining, dehydration, clearing and decolourization & mounting.
3.   General idea of composition, preparation and use of:
   (a)   Fixatives: Formalin and Bouin's fluid.
   (b)   Stains: Borax carmine, Aceto-carmine, Aceto-orcein, Haematoxylin Eosin.

II.   **Collection and culture methods**

1.   Collection and culture of *Euglena, Daphnia, Cyclops* etc.
2.   Culture of *Paramecium* in the laboratory and study of its structure, life process and behavior.

III.   **Museum specimen**

1.   Porifera: *Sycon, Leucosolenia, Euplectella* and *Spongilla*.
2.   Coelenterate: *Obelia* (Polyp & medusa form), *Millepora, Physalia, Porpita, Velella, Aurelia, Alcyonium, Tubipora, Gorgonia, Sea anemone, Pennatula, Fangia, Favea* and *Astraea*.
3.   Ctenophora: *Pleurobranchia / Coeloplana* and *Ctenophora / Beroe* (any one).
4.   Platyhelminthes: *Fasciola, Taenia* and *Planaria*.
5.   Aschelminthes: *Ascaris*.
6.   Annelida: *Nereis, Heteronereis, Chaetopterus, Arenicola, Glossiphonia, Pontobdella, Hirudinaria* and *Polygordius*.
7.   Onychophora: *Peripatus*.
8.   Arthropoda: *Limulus,* Spider, Scorpion, Centipede, Millepede, *Lepas, Balanus, Squilla, Eupagarus,* Crab, *Mantis, Apis, Locust,* silkworm and *Beetle*.
9.   Mollusca: *Chiton, Dentalium, Aplysia, Cypraea, Mytilus,* Pearl oyster, *Loligo* and *Nautilus*.
10.   Echinodermata: *Antedon, Holothuria, Cucumaria, Echinus, Pentaceros* and *Ophiothrix*
11.   Hemichordata: *Balanoglossus*.

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IV. **Microscopic slides**

1. Protozoa: *Euglena, Trypanosoma, Entamoeba, Leishmania, Giardia, Elphidium, Foraminiferous shell, Monocystis, Plasmodium, Paramecium, Paramecium* (Binary fission & conjugation), *Opalina, Nyctotherus, Balantidium* and *Vorticella.*
2. Porifera: L.S. & T. S. of *Sycon,* spongin spicules, spongin fibres and gemmules .
3. Coelentrata: *Obelia, Hydra* and *Obelia* medusa.
4. Platyhelminthes: T.S. of *Fasciola,* Miracidium, Sporocyst, Redia and Cercaria larvae of *Fasciola, Taenia*-scolex, T.S. of *Taenia* through mature proglottid, cysticercus larva.
5. Annelida T S of body of *Nereis,* Heteronereis-parapodium.
6. Arthropoda: *Pediculus,* Bedbug, Termite (various types), *Cyclops, Daphnia,* Crustacean larvae, identification of vectors of diseases of diseases - *Anopheles, Culex* and *Aedes.*
7. Mollusca: V.S. Shell, W.M. of gill of *Pila,* T.S. gill of *Unio,* glochidium.

V. **Anatomy: Study of the following with Dissection.**

1. *Pheretima:* External features, general viscera, alimentary canal, nervous system and reproductive system.
2. *Periplanata:* External features, appendages, mouth parts, alimentary canal nervous system and reproductive system.
3. *Paleomon/ Squilla :* External features, appendages, alimentary canal and nervous system.
4. *Pila:* External features, pallial organs and nervous system.

VI. **Permanent Preparation**

*Amoeba, Paramecium, Euglena,* Foraminifera shells, Sponge spicules, Sponge fibres, Gemmules, *Hydra, Obelia* colony, Parapodium of *Nereis* and Heteronereis, salivary gland, mouth parts and trachea of *Periplanata.* Nerve ring, septal nephridia and ovary of Pheretima, Ospharadium, gill lamella and radula of Pila, Statocysts and hastate plate of Paleomon / Squilla, whole mount of mosquito larva.

VII. **Exercises in Biochemistry**

1. Detection of carbohydrates, proteins and lipids in the given sample.
2. Identification of mono-, di- and polysaccharide in the given sample.
3. Quantitative estimation: Standard curve of total cholesterol, total protein and glycogen.
4. Paper chromatography - radial chromatography and ascending/descending chromatography (Amino acids).

VIII. **Exercises in Cell Biology**

1. Squash preparation for the study of mitosis in onion root tip.
2. Squash preparation for the study of meiosis in Grasshopper *Periplanata* testes
3. Study of giant chromosomes in salivary glands of *Chironomus/Drosophila* larva.

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4   Study of mitochondria using vital stain (Janus Green B).
5   Permanent slides of mitosis and meiosis (all stages).

## IX.   Exercises in Genetics

1   Study of *Drosophila* Culture and its life cycle
2   Identification of male & female *Drosophila*
3   Identification of wild and mutant (Yellow body, Ebony body, Vestigial wings, White eyes etc.) *Drosophila*.
4   Permanent preparation of W.M. of *Drosophila*
5   Permanent preparation of sex comb of *Drosophila*
6   Study of Barr body from buccal smear.
7   Identification of blood groups in men (A, B, AB, O and Rh)
8   Numerical problems based on Mendel's Laws.
9   Study of chromosomal aberrations: Klinefelter's syndrome, Down's syndrome, Turner's syndrome.

## X.   Exercises in Biostatistics

1.  Construction of frequency tables, bar diagrams, histograms, frequency polygon and Pie charts.
2.  Exercises on Mean, median and mode (Direct, short-cut and step deviation methods).
3.  Exercises on standard deviation and standard error.

### B.Sc. Zoology (Hons.) Part-I

### Scheme of practical examination and distribution of marks

### 8 Hrs. (2 days, 4hrs /day)

Min marks: 20                                                    Max marks: 50
    I⁰ day                                                       Regular

|  |  |  |
|---|---|---|
| 1. | Anatomy | 08 |
| 2. | Permanent preparation | 04 |
| 3. | Exercise in Biochemistry | 07 |
| 4. | Identification and Comments on spots ( 1 to 8 ) | 16 |
| 5. | Viva voce | 05 |
| 6. | Class Record | 05 |
| 7. | Seminar /Project Report/ | 05 |

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Min marks: 20                                      Max marks: 50

**II<sup>nd</sup> day**

| | | |
|---|---|---|
| 1. | Exercise in Cell Biology | 07 |
| 2. | Exercise in Genetics | 06 |
| 3. | Exercise in Biostatistics | 06 |
| 4. | Identification and Comments on spots ( 1 to 8 ) | 16 |
| 5. | Viva voce | 05 |
| 6. | Class Record | 05 |
| 7. | Seminar/Project Report/Collection | 05 |

**Note:**

1. With reference to anatomy, and prescribed types, candidates must be well versed in the study of various systems with the help of charts/models/CD ROMs / multimedia computer based simulations including computer assisted learning (CAL) and other softwares.

2. With reference to whole mounts and museum specimens in case of the animal types may be substituted with diagrams/photographs/ models etc.

3. Students will keep record of all the work done in the practical records.

4. It should be ensured that animals used in the practical exercises are not covered under the wild life act 1972 and amendments made subsequently.

5. The details methodology may be asked to be written where ever is necessary.
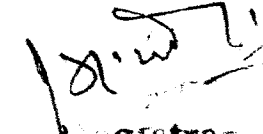
**Recommended Books:**

1. Ahsan J and Sinha SP: A Hand book on Economic Zoology. 9<sup>th</sup> edition S. Chand & Co. Ltd., 1981.

2. Bailey NTJ: Statistical Methods in Biology. English Universities Press, 1964.

3. Barrington EJW: Invertebrate Structure and Function. 2<sup>nd</sup> edition John Wiley & Sons Inc., 1978.

4. Brusca RG and Brusca GJ: Invertebrates. 2<sup>nd</sup> edition Sinauer/Panima Books, 2003.

5. Cooper GM and Hausman RE.: The Cell: A Molecular Approach. 4<sup>th</sup> edition ASM Press Washington DC. 2007.

6. Cooper GM and Hausman RE: The Cell: A Molecular Approach. 6<sup>th</sup> edition ASM Press Washington, DC/ Sinauer/Panima Books, 2013.

7. De Robertis EDP and De Robertis Jr EMF: Cell and Molecular Biology. 8<sup>th</sup> edition Lippincot Williams & Wilkins, 2006.

8. Gardner EL, Simmons MJ and Snustad DP: Principles of Genetics 8<sup>th</sup> edition John Wiley & Sons, Inc., 2006.

9. Gupta PK. Genetics: Classical to Modern. Rastogi Publications, 2007.

10. Gurumani N: An Introduction to Biostatistics. MJP Publishers, 2011.

11. Jordan EL and Verma PS: Invertebrate Zoology. S. Chand & Company Ltd., 2012.

12. Karp G: Cell & Molecular Biology: Concepts and Experiments. 7<sup>th</sup> edition John Wiley & Sons, Inc., 2013.

13. Kotpal RL: Modern Text Book of Zoology: Invertebrates. Rastogi Publications, 2012.

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14. Lal SS: Practical Zoology Invertebrate. 11th revised edition Rastogi Publications, 2014.

15. Lehninger AL: Biochemistry. 2nd edition Kalyani Publishers, 1991.

16. Lodish H, Berk A, Kaiser CA, Krieger M, Scott MP, Bretscher A, Ploegh H, Matsudaira P: Molecular Cell Biology. 6th edition W.H Freeman and Company, New York, 2008.

17. Lodish H, Berk A, Matsudaira P, Kaiser CA, Krieger M, Scott MP, Zipursky SL, Darnell J: Molecular cell Biology. 5th edition W.H Freeman and Company, New York, 2004.

18. Lodish H, Berk A, Kaiser CA, Krieger M, Bertscher A, Ploegh H, Amon A, Scott M P: Molecular Cell Biology. 7th edition Mac Millian High Education (International edition) England, 2013.

19. Lodish H, Berk A, Zipursky SL, Matsudaira P, Baltimore D, Darnell J: Molecular Cell Biology. 4th edition WH Freeman & Company, New York, 2000.

20. Mahajan BK: Methods in Biostatistics. 7th edition Jaypee Publishers, 2010.

21. Morgan DD: The Cell Cycle: Principles of Control. Sinauer /Panima Books, 2007.

22. Nelson DL and Cox MM: Lehninger Principles of Biochemistry. 5th edition W. H. Freeman, 2008.

23. Nelson DL and Cox MM: Lehninger Principles of Biochemistry. 6th edition W. H. Freeman, 2013.

24. Petsko GA and Ringe D: Protein Structure and Function. Sinauer/Panima Books, 2004.

25. Singh SP and Tomar BS: Cell Biology. 10th edition Rastogi Publications, Meerut, New Delhi, 2014.

26. Snustad DP and Simmons MJ: Principles of Genetics. 4th edition John Wiley & Sons, Inc., 2005.

27. Sunder Rao PSS and Richard J: Introduction to Biostatistics and Research Methods. PHI Publisher,s 2012.

28. Verma PS: A Manual of Practical Zoology: Invertebrates. S. Chand & Co. Ltd. New Delhi, 1971.

29. Verma PS and Jordan EL: Invertebrate Zoology. S Chand & Co. Ltd, New Delhi, 2001.

30. Voet D and Voet JG: Biochemistry. 4th edition, John Wiley & Sons, Inc., 2011.

31. Winchester AM: An Introduction to Genetics. Barners & Noble, Canada, 2002.

32. Winchester AM: Genetics: A Survey of Principles of Heredity. Oxford & IBH Publishing Co., 1967.

33. Winchester AM: Human Genetics. Ohio Charles E. Merrill Publishing Co., 1971.

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# 4. BOTANY

## B.Sc. Part I (Hons)

**Maximum Marks: 400**

**Min. Pass Marks: 160**

- Paper-I Cytology, Genetics and Plant Breeding
- Paper- II Algae, Fungi and Bryophyta
- Paper-III Plant Physiology and Biochemistry
- Paper-IV Ecology and environmental science
  Practical (6 hrs.)

75marks
75marks
75marks
75marks
100marks

## B.Sc. Part II (Hons)
**Maximum Marks: 400**

**Min. Pass Marks: 160**

I. Paper-I Molecular biology
II. Paper-II Pteridophyta, Gymnosperm and Paleobotany
III. Paper-III Morphology and Anatomy of angiosperms
IV. Paper-IV Microbiology and plant pathology
V. Practical (6 hrs.)

75marks
75marks
75marks
75marks
100marks

## B.Sc. Part III (Hons)
**Maximum Marks: 400**

**Min. Pass Marks: 160**

- Paper-I Plant Biotechnology
- Paper-II Systematics of angiosperms
- Paper-III Plant utilization and Ethanobotany
- Paper-IV Embryology of angiosperms and Seed science
  Practical (6 hrs.)

75marks
75marks
75marks
75marks
100marks

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# Scheme of Examination (Common for all theory papers)

Each theory paper shall have two parts A & B. Part A will be compulsory having 30 very short answer type questions (with a limit of 20 words) of one mark each with a total of 30 marks.

Part B of question paper shall be divided into three units. There will be one question from each unit. Question number 2-4 will have internal choice. Each question will carry 15marks with a total of 45marks.

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# Paper I- Cytology, Genetics and Plant Breeding

## UNIT-I

**The Cell:** Introduction to modern tools and techniques of cell biology (Light and Electron microscopy); History; cell theory; cell size and cell structure of Prokaryotic and Eukaryotic cells.

**Cell wall and cell membrane:** Origin, ultra structure, chemical constituents and functions of cell wall; models of cell membrane organization; cellular transport and signaling.

**Mitochondria and chloroplast:** Origin of organelles; organelles structure and biogenesis; organelle membranes and organization of macromolecular complexes; variation in size, shape and number; types of plastids organelle-nuclear interactions; organelle genome organization.

**Structure/function of other sub-cellular structures:** Golgi complex; endoplasmic reticulum; ribosome; lysosomes ; microbodies-peroxisomes and glyoxysomes; cytoskeleton.

## UNIT-II

**Nuclear organization:** ultra-structure; nuclear envelope and nuclear pore complex; nuclear matrix and nucleoplasm; DNA and histones; nucleosome and higher level of organization

**Cell division and its regulation:** Mitosis and meiosis-historical perspective and significance; various stages of cell division progression; cytokinesis; role of centromere, kinetochore and spindle apparatus; animal and plant cell cycle; mechanisms of cell cycle regulation; apoptosis.

**Chromosomal Alterations:** Origin, types and effects of duplications, deletions, inversions and translocations; meiosis in structural heterozygotes.Origin, types and

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effects of auto and allopolyploidy; origin and meiosis in nullisomics, monosomics and trisomics.

**Genetic alterations :** Spontaneous and induced mutations; mutagens—types and mode of action; transitions, transversions and frame-shift mutations.

# UNIT-III

**Mendelism:** Mendel's experiment and principles of inheritance, back cross and test cross, gene interaction and modified dihybrid ratios – complementary, supplementary, duplicate and epiststic factors.

**Multiple allelism:** multiple alleles in *Drosophila* (eye colour) man (blood group).

**Linkage and sex determination:** coupling and repulsion phases; two and three point test crosses, linkage map; mechanism of sex determination; sex linked, sex limited and sex influenced characters.

**Maternal influence on inheritance:** shell coiling in snails and Kappa particles in *Parameciu*·; cytoplasmic inheritance in yeast (mitochondria) and *Mirabilis jalapa* (plasmid)

**Plant breeding :**Introduction, objectives of plant breeding. Types of plant reproduction: vegetative, sexual and apomixes, their effect on generating and fixing genotypic variation; Green revolution.

**Methods of plant improvement:** Pureline and mass selection; hybridisation in self and cross pollinated crops; introduction and acclimitisation; hybrid vigour and inbreeding depression.

**Suggested laboratory exercises:**

**Cytology**

- Stud· of prokaryotic cells of various organisms.
- Bacteria, (*Bacillus, Coccus, Streptococcus, Spirillum*).
- Stud· of eukaryotic cells of various organisms.
- Comparative study of cell structure in onion cells, *Hydrilla* and     *Spirogyra.*

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- Study of cyclosis in *Tradescantia* staminal hairs.
- Bacterial staining (Gram's staining).
- Study of plastids (Cassia, Lycopersicum, Capsicum).
- Mitosis- all stages- onion root tip.
- Meiosis –permanent slides.

## Genetics and Plant Breeding

- Study of sex chromosomes.
- Preparation of chromosome maps-Gene mapping with a Three-Point Cross.
- Exercise based on Mendal's Laws.
- Exercise on gene Interaction and modified hybrid ratios.
- Emasculation and hybridisation.

## Suggested Readings:-

1. Alberts; B., Bray, D.J.,Raff, M., Roberts, K. and Wasson, L.D. Molecular Biology of cell, Garland Publishing Co., Inc., New York(2001).

2. Gupta P.K. 1999. A text book of cell and molecular biology, Rastogi publication, Meerut.

3. Lodish and Darnell J. 2000. Molecular cell (4th edition). W.H. Freemam & Co. New York, USA.

4 Choudhary, H.K. Elementary Principles of Plant Breeding. Oxford and IBM Publishing Co., New Delhi, 1989.

5. Miglani, GS. : Advanced Genetics, Narosa Publishing House, New Delhi (2000).

6. Russel, PI Genetics. The Benejamins/Cummings Publishikng Co., Inc. U.S.A. (1998)

7. Shukla, R.S. and Chandel, P.S. : Cytogenetics, Evolution and Plant Breedings, S. Chand & Co. Ltd., New Delhi (2000).

8. Singh, R.B. : Text Book of Plant Breeding, Kalyani Publishers, Ludhiana (1999)

## Paper II Algae, Fungi and Bryophyta

## UNIT-I

**Algae**: History, occurrence and distribution, general characters, thallus organization and evolutionary tendencies, ultrastructure of algal cell, classification and economic importance; important features and life history of Chlorophyceae-*Volvox* and *Chara* , Xanthophyceae-*Vaucheria and Oedogonium* Pheophyceae-*Ectocarpus* and Rhodophyceae-*Polysiphonia*.

## UNIT-II

**Fungi**: History, occurrence and distribution, general characters, ultrastructure of fungal cell, classification and economic importance, nutrition, reproduction, important features and life history of Mastigomycotina-*Psythium, Phytophthora*; Zygomycotina-*Mucor*; Ascomycotina-*Saccharomyces, Eurotium, Chaetomium, Peziza*; Basidiomycotina-*Puccinia, Agaricus*; Deuteromycotina-*Cercospora, Colletotrichum* General account of Lichens.

## UNIT-III

**Bryophytes**: History, occurrence and distribution, general characters, classification, ecological and economic importance, Study of comparative morphology, anatomy and reproduction among bryophytes, Detailed features of Hepaticopsida-*Riccia and Marchantia*. Anthocerotopsida-*Anthoceros* ,Byropsida- *Funaria*.

**Suggested laboratory exercises:**

**Algae**

External Morphology and Permanent slides of-
- *Volvox* Volvox colony, daughter colony, Antheridia, Zygote.
- *Chara*- ual organs, Globule and Nucule
- *Oedogonium*- Thallus structure, Sexual Stage, Antheridia and Oogonia,

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- *Vauche...a- Thallus structure, Sexual Stage, Antheridia and Oogonia*
- *Ectoca...as- Thallus structure, Unilocular and Pleurilocular sporangia*
- *Polysip...nia- Thallus structure, Cystocarp, Tetrasporophyte.*

## Fungi

External Mor...logy and Permanent slides of-
- *Chaetom...in*-Sexual reproduction-Ascospores
- *Peziza- Sexual* Reproduction-Apothecia V.S.
- *Puccinia* Wheat leaf: Uredospore and Teleutospore
- *Agaricus*- Pileus (V.S.)
- *Colletotrichum*-Thallus

## Bryophyta

Study of Specimens and external morphology of the following-
- *Riccia-Thallus structure*
- *Marchantia-Thallus structure, ,Gemma cup, male and female gametophyte*
- *Anthoceros-Thallus structure,sporpphyte*
- *Funaria Thallus structure ,sporophyte*

## SUGGESTED BOOKS

1. Bold H.C., Alexopoulos, C.J. and Deltevoryas I.1980. Morphology of Plant and Fungi (4th edition). Harper and Foul Co., Newyork.
2. Dube H.C 1990. An introduction to Fungi, Vikas publishing House Pvt. Ltd., Delhi
3. Gilber M.S. 1988. Introductory Phycology. Affiliated East-West Press Lid. New York.
4. Puri P. 1985. Bryophytes, Atmaram & Sons, Delhi.
5. Singh V. Pandey P.C. and Jain D.K.2013 A text book of Botany (4th edition) Rastogi Publication , Meerut.

## Paper-III Plant Physiology and Biochemistry

### UNIT-I

**Plant-water relations**: Water transport processes: diffusion and osmosis ; water potential and chemical potential, absorption of water transport through tracheids and

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xylem ; transpiration and its significance factors affecting transpiration ; exchange of gases, role of stomata, mechanism of stomatal movement; antitranspirants, guttation.

**Mineral nutrition**: criteria of essentiality of element ; macro and micronutrient; role of essential elements; mineral deficiency symptoms and plants disorders; nutrients uptake and transport mechanism; role of cell membranes, ions pumps and carriers; ion antagonism and toxicity.

**Transportation of organic substances**: transport of photosynthetic; source sink relationship the mechanism of translocation in the phloem assimilate partioning.

## UNIT-II

**Photosynthesis** : Structure of photosynthetic apparatus; photosynthetic pigments ; electron transport pathways in chloroplast membranes ; photophosphorylation ; Calvin cycle; C4 carbon cycle ; Crassulacean acid metabolism ; photorespiration.

**Respiration**: Glycolysis; TCA cycle and its regulation; electron transport in mitochondria; oxidative phosphorylation, pentose phosphate pathway.

**Nitrogen metabolism**: Biological nitrogen fixation; reduction of $N_2$ to ammonia, nif genes; regulation of nitrate reductase and nitrogenase; nitrate and ammonium assimilation.

## UNIT-III

**Growth and development**: Phases of growth ; Seed dormancy and seed germination; concept of photoperiodism ; physiology of flowering; the florigen concept and role of hormones; vernalistaion; Senescence and fruit ripening ; importance of respiratory climacteric; discovery, physiological role and mechanism of action of the phytohormones- auxins, cytokinin, gibberellins, abscisic acid, Signal transduction basic concept; plant movement-tropic and nastic ;Biological clock.

**Secondary metabolites**: Introduction of secondary metabolites (alkaloids, flavonoids and steroids) and their importance.

**Suggested laboratory exercises:**

**Physiology and Biochemistry**

- Root Pressure-To demonstrate root pressure.
- Transpiration-To demonstrate rate of transpiration by use of potometers.
- Photosynthesis -Photosynthesis by inverted funnel method, Moll's experiment.
- Respiration-To demonstrate anaerobic and aerobic respiration.

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- Respiration-R.Q. by Ganong's respiromater.
- Growth Measurement-Measurement of growth using auxanometer.
- Plasmolysis- To determine the osmotic potential of vacuolar sap by plasmolytic method.
- Osmosis-Demonstration of phenomenon of osmosis by use of potato osmometer.
- Permeability-To study the effect of temperature of permeability of plasma membrane.
- Chloroplast Pigments- To separate chloroplast pigments by solvent method.
- Chloroplast Pigments -To separate chloroplast pigments using paper chromatography.
- Separation of Amino acids-To separate amino acids in a mixture by paper chromatography.
- Enzymes-To demonstrate the enzyme activity - Catalase, Peroxidase and Amylase and effect of pH and temperature on enzyme activity.
- Histochemical Test- Cellulose; Lignin; Starch; Fat; Protein and; Tannin

## SUGGESTED BOOKS

1. Glaston A.W. 1989. Life Process in Plants, Scientific American Hall, Library, Springer- Verlage, New York, USA.
2. Hooykass. P.J.J., M.A. and Libbenga, K.R. (eds) 1999. Biochemistry and Molecular Biology Of Plant Hormones. Elsevier, Amsterdam, The Natherlands.
3. Hopkings G.C. 1995. Introduction to Plant Physiology. John Wiley & Sons. Inc., New York, USA.
4. Moore T.C. 1989 Biochemistry and Physiology of Plant Hormones (2$^{nd}$ edition). Springer- Verlage, New York, USA.

## Paper IV Ecology and Environmental Science

### UNIT-I

Plants and Environment: Atmosphere (stratosphere, troposphere, mesosphere and thermosphere) Adaptations (Morphological, anatomical and physiological) Hydrophytes, Xerophytes and Halophytes. Light (global radiation, photosynthetically active radiation Zonation in water body: littoral, limnetic and profoundal zones;

heliophytes and sciophytes) Temperature (Raunkier's classification of plants: megatherm, mesotherm, microtherm, heikistotherm; themoperiodicity ). Soil (soil profile, development-weathering and maturation). Soil texture, soil types, role of pH, organic matter, soil water, soil nutrients. Interactions among organisms (neutralism, amensalism, allelopathy), competition, predation, parasitism,protocooperation, mutualism.

Ecosystems- Concept, Structure and Function of Ecosystem; Energy flow models and principles trophic levels; Food chains and Food webs; Productivity; Ecological Pyramids; Ecological efficiency; Biogeochemical Cycles- C, N and P; Ecosystem Diversity – Aquatic (freshwater) and Terrestrial (Forests).

## UNIT-II

**Population ecology:** Characteristic (Density, Dispersion, Natality, Mortality, Survivorship curves, Age Structure); Diversity and pattern; Population growth, Carrying capacity. Population regulation: - r and k selection.

**Communities** Concept of ecological niche, Ecological amplitude, Ecotone and Edge effect; Success- r types, Climax concept, Species diversity ($\alpha$, $\beta$).

**Phytogeography** Phytogeography of India, Vegetation of Rajasthan.

## UNIT III

**Natural resource management:** Renewable and non renewable resource, management and conservation; Endangered conventional and non conventional energy sources; Conservation of Biodiversity.Hot Spots, IUCN categories of threatened species.

**Impact of human activities:** - Pollution of Air, Water, and soil and their prevention and control Environmental Protection Act (EPA) and Global Warming .Environment Impact Assessment (EIA)

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## Suggested laboratory exercises

- Determination of pH of various soil and water samples by pH meter and pH paper.
- Analysis of chlorides and dissolved oxygen in water samples (titration method).
- Determination of bulk density and soil porosity and water holding capacity in soil samples.
- Determination of organic matter in soil samples by Walkley and Black method.
- Determination of species area curve by minimal quadrate size to study the herbaceous vegetation.
- Quantitative analysis of herbaceous vegetation for frequency, density and abundance.
- Estimation of biomass of aerial and belowground part of herbaceous plants (fresh and dry weight).
- Study the adaptation of following Hydrophytes :-
- Hydrophytes – *Hydrilla* stem, *Typha* leaf and *Nymphea/Eicchhornia* petiole.
- Xerophytes – *Calotropis, Capparis,* and *Cassurina* stem and *Nerium* leaf.

## SUGGESTED BOOKS

1. Odum EP 1983, Basic Ecology, Saunders, Philadelphia.
2. Barbour M G., Burk J. H. and Pitts W.D. 1987. Terrestrial P

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# MATHEMATICS

Appendix-V

**Teaching : 3 Hours per Week per Theory paper.**
**2 Hours per Week per Batch for Practical**
**(20 candidates in each batch)**

**Examination:**
**Scheme:**

Min. Pass Marks
Science – 160

Max. Marks
400

| | | Duration | Max.Marks |
|---|---|---|---|
| Paper – I | Discrete Mathematics | 3 hrs. | 85 |
| Paper – II | Calculus | 3 hrs. | 85 |
| Paper – III | Conic Section and Three Dimensional Geometry | 3 hrs. | 85 |
| Paper – IV: | Number Theory | 3 hrs. | 85 |
| Practical: | Optimization Theory | 2 hrs. | 60 |

**Note:**

1. Common paper will be set for both the Faculties of Social Science and Science. However, the marks obtained by the candidate in the case of Faculty of Social Science will be converted according to the ratio of the maximum marks of the papers in the two Faculties.

2. Each candidate is required to appear in the Practical examination to be conducted by internal and external examiners. External examiner will be appointed by the University and internal examiner will be appointed by the Principal in consultation with Local Head/Head, Department of Mathematics in the college

3. An Internal/external examiner can conduct Practical Examination not more than 100 (Hundred) candidates (20 Candidates in one batch).

4. Each candidate has to pass in Theory and Practical examinations separately.

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**Paper – I: Discrete Mathematics**
**Teaching : 3 Hours per Week**
**Duration of Examination : 3 Hours**          **Max. Marks: 85**

**Note:** This paper is divided into FIVE Units. TWO questions will be set
from each Unit. Candidates are required to attempt FIVE questions in all
taking ONE question from each Unit. All questions carry equal marks.

**Unit 1 :** Sets, Cardinality, Principal of inclusion and exclusion, Mathematical induction.
Relations and Functions- Binary relations, Equivalence relations and Partitions, Partial
ordered relations and Lattices, Chains and Antichains, Pigeon Hole principle.

**Unit 2:**
Boolean Algebras- Lattices and Algebraic structure, Duality, Distributive and
Complemented Lattices. Boolean Lattices. Boolean functions and expressions.
Fundamental theorem of arithmetic, divisibility in Z, Congruences. Chinese Remainder
Theorem, Euler's -function, primitive roots.

**Unit 3:** Logic and Propositional Calculus. Propositions. Simple and compound
Propositions, Basic Logical operations. Truth tables. Tautologies and contradictions.
Propositional Functions, quantifiers.
Discrete numeric functions and Generating functions. Recurrence relations and Recursive
Algorithms – Linear Recurrence relations with constant coefficients. Homogeneous
solutions. Particular solution. Total solution. Solution by the method of generating
functions.

**Unit 4:** Graphs – Basic terminology, Multigraphs. Weighted graphs. Paths and circuits.
Shortest paths. Introduction to Eulerian and Hamiltonian Graphs. Travelling Salesman
problem. Union, Join, Product and composition of graphs. Planar graphs and Geometric
dual graphs.

**Unit 5:** Trees – Properties, Spanning tree. Binary and Rooted tree.
Digraphs – Simple digraph, Asymmetric digraphs. Symmetric digraphs and complete
digraphs. Digraph and Binary relations. Matrix representation of graphs and digraphs.

**Reference Books:**

1. V.K.Balakrishnan, Introductory Discrete Mathematics, Prentice-Hall, 1996.
2. N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India.
3. S. Wiitala, Discrete Mathematics A Unified Approach, McGraw-Hill Book Co.
4. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1995.
5. Ian Anderson, A First course in Combinatorial Mathematics, Springer, 1989.
6. C.L. Liu, Elements of Discrete Mathematics, (Second Edition), McGraw Hill, International Edition, 1986.
7. Kenneth H. Roson, Discrete Mathematics and its Applications, Tata McGraw Hills, New Delhi, 2003.

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**Paper- II: Calculus**
**Teaching : 3 Hours per Week**
**Duration of Examination : 3 Hours**      **Max. Marks: 85**

Note: This paper is divided into FIVE Units. TWO questions will be set from each Unit. Candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

**Unit 1:** Series – Infinite series and Convergent series. Tests for convergence of a series – Comparison test, D'Alembert's ratio test, Cauchy's n-th root test, Raabe's test, De-Morgan-Bertrand's test, Cauchy's condensation test, Gauss's test, (Derivation of tests is not required). Alternating series. Absolute convergence. Taylor's theorem. Maclaurin's theorem. Power series expansion of a function. Power series expansion of $\sin x$, $\cos x$, $e^x$, $\log_e(1+x)$, $(1+x)^n$.

**Unit 2:** Derivative of the length of an arc. Pedal equations. Curvature – Various formulae, Centre of curvature and Chord of curvature. Partial differentiation. Euler's theorem for homogeneous functions. Chain rule of partial differentiation. Total Differentiation. Differentiation of implicit functions.

**Unit 3:** Envelopes and evolutes. Maxima and Minima of functions of two variables. Lagrange's method of undetermined multipliers. Asymptotes. Multiple points. Curve tracing of standard curves (Cartesian and Polar curves).

**Unit 4:** Beta and Gamma functions, Reduction formulae (simple standard formulae), Double integrals in Cartesian and Polar Coordinates, Change of order of integration. Triple integrals. Dirichlet's integral.

**Unit 5:** Areas, Rectification, Volumes and Surfaces of solids of revolution.

**Reference Books:**

1. Chandrika Prasad and Gorakh Prasad, A Text Book on Differential Calculus, Pothishala Pvt. Ltd., Allahabad, 1992.
2. Chandrika Prasad and Gorakh Prasad. A Text Book on Integral Calculus, Pothishala Pvt. Ltd., Allahabad, 1992.
3. Shanti Narayan and P.K. Mittal, Differential Calculus, S. Chand & Co., N. D., 2013.
4. Shanti Narayan and P.K. Mittal, Integral Calculus, S. Chand & Co., N. D., 2013.
5. H.S.Dhami, Differential Calculus, Age Int. Ltd., New Delhi. 2012.
6. M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
7. H. Anton, I. Bivens and S. Davis, Calculus (7th Edition), John Wiley and sons (Asia), Pt Ltd., Singapore, 2002.
8. G.B. Thomas, R. L. Finney, M. D. Weir, Calculus and Analytic Geometry, Pearson Education Ltd, 2003.

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## Paper-III: Conic Section and Three Dimensional Geometry
**Teaching: 3 Hours per Week**
**Duration of Examination: 3 Hours**                                  **Max. Marks: 85**

**Note:** This paper is divided into FIVE Units. TWO questions will be set from each Unit. Candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

### Unit 1: Polar equation of conics, Polar equation of tangent, normal and asymptotes, chord of contact, auxiliary circle, director circle of conics

**Unit 2:** Sphere, Cone.

**Unit 3:** Cylinder, Central Conicoids – Ellipsoid, Hyperboloid of one and two sheets, tangent lines and tangent planes, Direct sphere, Normals.

**Unit 4:** Generating lines of hyperboloid of one sheet and its properties. Reduction of a general equation of second degree in three-dimensions to standard forms.

**Unit 5:** The linear programming problem. Basic solution. Some basic properties and theorems on convex sets. Fundamental theorem of L.P.P. Theory of simplex method only Duality. Fundamental theorem of duality, properties and elementary theorems on duality only.

### Reference Books:
1. Hamdy A. Taha, Operations Research, An Introduction (9th edition), Prentice-Hall, 2010.
2. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.
3. R.J.T. Bell, Elementary Treatise on Co-ordinate geometry of three dimensions, Macmillan India Ltd., 1994.
4. N.Saran and R.S.Gupta, Analytical geometry of Three Dimenssions, Pothishala Pvt. Ltd., Allahabad, 1992.
5. P.K. Jain and Khalil Ahmed, A Text Book of Analytical geometry of Three Dimenssions, Wiley-Eastern Ltd., 2000.

### Practical: Optimization Techniques
**Teaching: 2 Hours per Week per Batch**

**Examination:**                                          **Duration: 2 Hours**
**Scheme**
Max.Marks                                                  60
Min.Pass Marks                                             20
Distribution of Marks:
Two Practicals one from each group

| | | |
|---|---|---|
| 20 Marks each | = | 40 Marks |
| Practical Record | = | 10 Marks |
| Viva-voce | = | 10 Marks |
| Total Marks | = | 60 Marks |

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Group A: Modelling of industrial and engineering problems into LPP and its dual and their solution by Simplex Method.
Group B: Modelling of industrial and engineering problems into Assignment Problems and Transportation Problems and their solutions.

**Note:**
1. Problems will be solved by using Scientific Calculators (non-Programmable)
2. Candidates must know about all functions and operations of Scientific Calculator.
3. Each Candidate (Regular/non-Collegiate) has to prepare his/her practical record.
4. Each Candidate has to pass in Practical and Theory examinations separately.

**Paper IV: Number Theory**
**Teaching : 3 Hours per Week**
**Duration of Examination : 3 Hours**                    **Max. Marks: 85**

**Note:** This paper is divided into FIVE Units. TWO questions will be set from each Unit. Candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

**Unit 1:** Divisibility – Division Algorithm, g.c.d. the Euclidean algorithm. l.c.m.. Prime. Infinitude of primes. Fundamental theorem of Arithmetic. Fibonacci sequence

**Unit 2:** Congruence – Linear conguruence, Fermat, Little and Wilson's theorems. Fermat's last theorem. Euler's factorization, Mersenne's factorization.

**Unit 3:** Number theoretic functions, $\tau$ and $\sigma$-functions, the Mobius function, Greatest integer function, Euler phi function and the properties of Phi function. Application to Cryptography.

**Unit 4:** Diophantine equations – $ax + by = c$, $ax + by + cz = d$, $x^2 + y^2 = z^2$, $x^4 + y^4 = z^4$. General Integers solution of the equation $x^2 + y^2 + z^2 = w^2$ $(x,y,z,w = 1)$.

**Unit 5:** Quadratic residues, Quadratic reciprocity. Quadratic congruence. Primitive roots for primes. Composite numbers having primitive roots. Theory of indices

**Reference Books:**

1. S.Telang and M. Nadkarni, Number Theory, Tata McGraw-Hill, 2001.
2. David M. Burton. Elementary Number Theory (6th Edition), Tata McGraw-Hill Edition, Indian reprint, 2007.
3. I. Niven and H. Zukerman. An Introduction to the theory of Numbers. Wiley Eastern University Edition, New Delhi, 1985.
4. Neville Robinns. Beginning Number Theory (2nd Edition), Narosa Publishing House Pvt. Limited. Delhi, 2007.

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# 6. PSYCHOLOGY

## B.A./B.Sc. Honours Part-I

### SCHEME OF EXAMINATION :

| Papers | Nomenclature | Duration | Max. Marks | Min. Pass Marks |
|---|---|---|---|---|
| Paper-I | Advanced General Psychology | 3 Hrs. | 75 | |
| Paper-II | Social Psychology | 3 Hrs. | 75 | |
| Paper-III | Developmental Psychology | 3 Hrs. | 75 | 120 |
| Paper-IV | Statistical Foundations in Psychology | 3 Hrs. | 75 | |
| Practicals | | 3 Hrs. | 100 | 40 |

### NOTE :-

1. There will be four theory Papers in Psychology in B.A. Honour Part-I. It would be common for Arts and Science. Each paper will be of 3 hours. It would comprise 3 Sections A, B and C and would cover the entire course content of the paper.

**Section-A** will contain 10 questions of 20 words consisting of 1.5 marks each. Thus, Part-A will be of 15 marks.

**Section-B** will contain 7 questions of 50 words each, out of which students are required to attempt 5 questions. Each question will be of 3 marks. Thus, Part-B will be of 15 marks.

**Section-C** will contain 3 long questions each with internal choice. Each question will be of 15 marks. Thus, Part-C will be of 45 marks.

For clarification the distribution of marks is tabulated as below:-

| Section | No. of Questions | Marks | Total |
|---|---|---|---|
| **B.A. Honours(Psychology)Part-I** | | | |
| A | 10 | 1.5 | 15 |
| B | 5 (Out of 7) | 03 | 15 |
| C | 3 (with internal choice) | 15 | 45 |
| | | Total Marks | 75 |

2. Use of simple calculator will be allowed for statistical portions of all papers.

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**PAPER-I:**

**ADVANCED GENERAL PSYCHOLOGY**

## Section-A

1.  Introduction to Psychology: Definition, Goals, History, Recent Trends and Methods.

2.  Perception: Definition and Determinants; Gestalt view of Perception. Types of Illusion and Depth Perception.

3.  Consciousness: Definition and Functions, Altered States of Consciousness - Sleep, Dreams, Hypnosis.

## Section-B

4.  Learning: Meaning and Nature; Theories-Classical Conditioning, Trial and Error learning, Operant Conditioning, Cognitive Learning, Observational learning; Verbal learning.

5.  Memory: Meaning and Models - Level of Processing, Information Processing and Parallel Distributed Processing; STM and LTM, Forgetting Curve and Causes of Forgetting.

6.  Intelligence: Definition and Nature, Theoretical approaches-, Spearman, Guilford, Cattell, Sternberg, Gardner; Measurement of Intelligence.

## Section-C

7.  Thinking and Problem Solving : Basic Elements of Thought: Mental Imagery, Concepts, Reasoning and Decision Making; Problem Solving: Trial and Error, Algorithms, Heuristics, Insight; Barriers to Problem Solving; Methods of Problem Solving.

8.  Motivation and Emotion: Nature, Types and Approaches to Motivation; Definition, Elements and Theories of Emotions.

9.  Personality : Definition, Theories, Determinants and Measurement of Personality.

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**Books Recommended:**

- Morgan, King & Robinson (1986). - Introduction to Psychology.

- Atkinson-Introduction to Psychology

- Wood worth, R.S. & Scholosberg, H- Experimental Psychology, Indian Edition, Oxford & I.B.H. publication, Calcutta, 1971.

- Baron. R.A. (2003). Psychology. Allyn and Bacon. New Delhi Prentice Hall India.

- Gerrig, R.J. and Zimbardo, P.G. (2005). Psychology and Life. New Delhi. Pearson Education.

- Ciccarelli; S.K. and Meyer, G.E. (2006).Psychology. New Delhi, Pearson Education.

- सिंह. अरुणकुमार (2002). आधुनिक सामान्य मनोविज्ञान. नई दिल्ली, मोतीलाल. बनारसीदास

## Paper-II:

## Social Psychology

### Section-A

1. Introduction : History, Scope, Goals and Methods; Social Psychology as an Applied Science.

2. Social Cognition: Schemas, Mental Frame work for Organizing Social Information; Heuristics and Automatic Processing; Potential Sources of Errors in Social Cognition; Affect and Cognition.

3. Social Motivation and Interpersonal Attraction : Social Motivation: Meaning and Types; Theories of Achievement Motivation. Interpersonal Attraction - Meaning, Determinants and Theories.

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## Section-B

4. Social Attitude : Development and Functions; Attitude Change and Measurement of Attitude.

5. Groups and Organizations: Basic Characteristics of Group Structure; Norms and Ideology, Performance in Group and Individual Situation; Cooperation and Conflict, Decision Making in Groups.

6. Leadership: Origin and Attributes of leadership; Functions, Type and Theories of leadership.

## Section-C

7. Prejudice and Stereotypes: Prejudice- Meaning, Nature and Origin; Stereotypes-Beliefs about Social Groups, Reasons of forming and using Stereotypes, Techniques for countering Prejudice and Stereotypes.

8. Public Opinion and Propaganda : Public Opinion: Meaning, Formation and Measurement; Propaganda - Meaning, Nature and Principles, Effect of Media on Propaganda, Propaganda as an Effective Tool.

9. Social Tension and Social Change: Social Tension-Meaning, Types, Causes and Effects; Methods of Reducing Social Tension. Social Change - Meaning, Characteristics and Agents; Resistance to Social Change and Effects of Social Change.

Books Recommended:

- Baron, R.A. and Byrne, D. (2010). Social psychology (11th edition), New Delhi: Person education.

- Mohammad, S. (2009). उच्चतर समाज मनोविज्ञान. New Delhi: Motilal Banarsi Das.

- Myers, D. (2007). Sooial psychology. New Delhi: Cengage learning.

- Singh, A.K. (2009). Samaj Manovigyan ke ruprekha. New Delhi: Motilal Banarsi Das.

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- Taylor, S.E. David, L.A. and Sears, O. (2009). Social psychology (12th Edition). New Delhi: Pearson education.

**Paper-III:**

**Developmental Psychology**

## Section-A

1. Human Development : Definition and Themes of Development, Methods of Studying Development. Nature and Nurture : Controversy and Challenges.

2. Theories of Human Development : Psychoanalytic, Learning and Cognitive Developmental Theories.

3. Prenatal Period and Infancy : Characteristics and Periods of Prenatal Development; Hazards during Prenatal Period; Characteristics of Infancy; Adjustment to Postnatal Life.

## Section-B

4. Early and Late Childhood: Characteristics and Developmental Tasks; Personality Development in Early and Late Childhood.

5. Adolescence: Characteristics of Adolescence, Social Changes during Adolescence; Adolescent Interests; Sex Interests and Sex Behaviour; Personality Changes during Adolescence.

6. Adulthood: Characteristics and Developmental Tasks; Vocational and Marital Adjustment; Adjustment to Parenthood.

## Section-C

7. Old Age: Mental Abilities and Interests in Old Age; Changes in Motor Abilities; Adjustment to Physical Changes; Adjustment to Retirement and Changes in Family Life.

8. Family: Socialization within the family; Parenting Styles and Development. Variations in Child Rearing, Family Transitions, Vulnerable Families and Child Mal-treatment.

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9.  Peers, Media and Schooling: Importance of Peer Relations; Influences on Peer Sociability -Peer Groups, Peer Relations and Socialization; Television, Computers, Schooling.

**Books Recommended:**

- Berk, L.E. (2003) Child Development. Delhi, Prentice-Hall of India Pvt. Ltd.

- Santrock, J.W. (1999), Lifespan Development. New York, McGraw Hill.

- Hurlock, E. (2003) Developmental Psychology. Delhi, Tata McGraw Hill

- Papalia, S. and Feldman, C. (2002) Adult Development and Aging. Delhi, Tata McGraw Hill.

- Berk, L.E. (2010) Development through the Life Span. Delhi, Pearson Education.

- Sigelman, C.K. and Rider E.A. (2009) Human Development. Wadsworth Cengage Learning.

**Paper-IV:**

**Statistical Foundations in Psychology**

## Section-A

1.  Introduction: Nature and Scope of Statistics and Psychological Data; Application of Statistics in Psychology; Nature and Levels of measurement- Categorical and Continuous Variables.

2.  Frequency Distribution and Normal Distribution: Drawing of Frequency Distribution. Bivariate Frequency Distribution, Graphical Representation of Grouped Data- Histogram, Polygon, Normal Distribution - Meaning, Importance and Properties.

3.  Measurement of Central Tendency: Purpose and Types; Characteristics and Computation of Mean, Median and Mode.

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## Section-B

4. Measures of Variability: Concept and Uses; Characteristics and Computation of Range, Quartile Deviation, Average Deviation and Standard Deviation.

5. Correlation: Concept and Types- Pearson's Product Moment Correlation (for Ungrouped Data by Assumed Mean and Actual Mean); Spearman's Rank Order Correlation.

6. Hypothesis Testing and Inferences Making: Population and Sample, Types of Sampling, Standard error of Mean, 't' test (Independent group), Interpretation of 't' values, levels of Significance.

## Section-C

7. Non Parametric Tests: Nature and Assumptions of Distribution-free Statistics; Chi-Square - Equal Probability, 2 x 2 Contingency Table; Median Tests.

8. ANOVA: Purpose and Assumptions of ANOVA. One way and Two way ANOVA

9. Computer Analysis: Preparation of Data, Uses of SPSS.

## Books Recommended:

- Minimum E.W, King B.M. and Bear. G. (1993): Statistical Reasoning in Psychology and Education, New York, John Wiley.

- Siegel. S. (1994): Non-parametric Statistics, New York, MCGraw Hill.

- Aron, A. Aron, E. and Coups, E. (2007). Statistics for psychology. (IV edition). New Delhi, Pearson Education.

- Guilford, J.P. (1975) Fundamental statistics in psychology and education. New York: McGraw Hill

- Garrett, H. (1981) Statistics in psychology and education. Mumbai: Vakil febber and Simons.

- Kapil H.K.: Sankhyiki Ke Mool Tatwa, Vinod Pustak Mandir, Agra.

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## Practicals:

1. Human Maze Learning

2. Serial Position Effect (Non-sense syllables)

3. Bilateral Transfer of Training

4. Retroactive Inhibition

5. Figure Ground Reversal

6. Concept Formation

7. Measurement of Attitude

8. Assessment of Emotional Maturity

9. Assessment of Social Maturity

10. Youth Problem Inventory

11. Normal Probability Curve

12. Measurement of Intelligence (Bhatia Battery)

# 7. GEOGRAPHY

## Scheme of Examination

Min. Pass Marks 160 (40%)                                              Max. Marks 400

| | | |
|---|---|---|
| Paper –I 3 hour duration | Physical Geography | Max. Marks 80 |
| Paper –II 3 hour duration | Human Geography | Max. Marks 80 |
| Paper –III 3 hour duration | Economic Geography | Max. Marks 80 |
| Paper –IV 3 hour duration | Geography of Rajasthan | Max. Marks 80 |
| Practical | | Max. Marks 80 |

### Notes

1. Students are permitted to use the stencils, simple calculator and log tables wherever Needed in both theory and practical examinations. Each theory paper will have a teaching of hours per week.

2. There will be a common paper for Arts and Science.

3. Q.1 will be compulsory and will cover the entire course of the paper.

   Q.No. 1 of 20% marks of the maximum marks be set in two parts.

   (a) Part (a) will have ten items for locating on a map (to be supplied by examination centre) carrying 10% marks of the maximum marks and candidates shall attempt any five items.

   (b) Part (b) will have 10 short answer questions carrying 10% marks of the maximum marks and candidates shall attempt any five items.

4. Remaining 9 questions carrying equal marks will be set with three questions from each section of the syllabus.

5. Candidate will attempt 5 questions in all including question No. 1 selecting at least one question from each section.

6. Practical examination will be conducted by the board of examiners.

7. The candidate will have to pass in theory and practical separately.

## SYLLABUS
### Paper I: Physical Geography

#### Section A

Definition, scope and development of physical geography, geological history of the Earth; zoning of Earth's interior, rocks , origin of continents and oceans; continental drift theory and plate tectonics; concept of isostasy: views of Airy, Pratt, Joly and Holmes. Earth movements: epeirogenic and orogenic; mountain building theories: Kober, Jeffreys, Daly, Joly and Holmes and plate tectonics; denudation, cycle of erosion: views of W.M. Davis and W. Penck, erosional and depositional topographies: river, under groundwater, glacier, wind and oceanic waves.

#### Section B

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## Section - B

Composition and structure of the atmosphere, insolation, air temperature, air pressure, pressure belts and planetary winds, monsoon and local winds, humidity, classification of clouds and precipitation, air masses, fronts and cyclones: tropical and temperate, classification of the world climates: Koppen and Thorthwaite, general climatic classification.

## Section C

Surface configuration of oceans bottom: Pacific, Atlantic and Indian oceans, ocean deposits, horizontal and vertical temperature of oceans, oceanic salinity, tides, oceanic waves and currents, coral reefs and their origin: views of Darwin and Dana, W.M. Davis, Murray, classification of marine resources, biosphere and its components, ecosystems; plant community and animal kingdom, biomes: equatorial rainforest, monsoon, savanna and temperate grasslands.

## Recommended Readings:

चौहान, वी.एस. व गौतम, ए. 2005, भौतिक भूगोल (जीवमण्डल सहित)। रस्तोगी पब्लिकेशन्स, मेरठ।
दयाल, पी. 2012, भौतिक भूगोल। राजेश पब्लिकेशन्स, नई दिल्ली।
गौतम, अल्का, 2012 : भौतिक भूगोल। रस्तोगी पब्लिकेशन, मेरठ।
Husain, M. 2001, Fundamentals of Physical Geography. Rawat Publication, Jaipur
Hess, D. 2012: Physical Geography : A Landscape Appreciation. PHI Learning Private Limited, New Delhi, Mcknight's revit Edition.
Khullar, D.R. 2012: Physical Geography. Kalyani Publishers, New Delhi
सिंह, सविन्द्र, 2005 : भू-आकृति विज्ञान। तारा पब्लिकेशन, वाराणसी।
सिंह, सविन्द्र, 2011: भौतिक भूगोल का स्वरूप। प्रयाग पुस्तक भवन, इलाहाबाद।
शर्मा, एच.एस., शर्मा, एम. एल. एण्ड मिश्रा, आर.एन. 2008: भौतिक भूगोल। पंचशील प्रकाशन जयपुर।
Sharma, R.C. and Vatal M. 1999. Oceanography for Geographers. Chaitanya Publishing House, Allahabad.
Strahler, A.N. and Strahler, A.H 1989: Elements of Physical Geography. John wiley & Sons, New York.
Tikkha, R.N. 1999: Physical Geography. Kedar Nath Ram Nath & C., Meerut.

# Paper II: Human Geography

## Section A

Introduction of human geography; meaning, definition, nature, scope and importance, branches of human geography and its relation with other social sciences, principles of human geography, essential elements of human geography: Brunhes and Huntington, approaches to human geography: environmental determinism, possibilism, stop and go determinism,

contribution of various scholars: Fredrick Ratzel, Miss Ellen Sample, Vidal de la Blache, Huntington.

## Section B

Evolution of man and races of mankind: distribution and characteristics. Early civilizations:- Indo-Gangatic, Egyptian and Tigris-Euphartis, centres of human civilization, human life and its adaptation of changing environment:- Eskimo, Pygmy, Bushmen, Khirgiz, Naga, Bhil, Gonds and Santhal.

## Section C

Building materials and house types, types and patterns of rural & urban settlement, internal structure of cities, transport foci and centers of specialized services, principal human occupations and principal agglomerations, their ecological and distributional aspects, trends of urbanization movement of mankind: definition, types, causes and effects in past and present times.

**Recommended Readings:**

Dohrs, F.E. and Summiners, L.W. (eds.) 1967: Introduction to Geography. Thomas Crowell Co. , New York.
Dear, M.J. and Flusty, S. (ed.) 2002: The spaces of Post modernity, Readings in Human Geography. Blackwell Publishers Ltd., Oxford.
Pellmen, Getis and Getis, J. 1998: Human Geography-Landscape of human activities. Longman, London.

Husain, M. 2012: Human Geography. Rawat Publications, Jaipur.
हसैन, एम. 2006: संसाधन भूगोल। वसुन्धरा प्रकाशन, गोरखपुर।
Leong, G.C. and Morgan, E.C. 1982: Human and Economic Geography. Oxford University Press, Oxford 2nd Edition.
कौशिक, एस.डी. 2012: मानव भूगोल। रस्तोगी पब्लिकेशन्स, मेरठ।
राव, बी.पी. एवं श्रीवास्तव, बी.के. 2008: मानव भूगोल। वसुन्धरा प्रकाशन, जयपुर।

Singh, R.L. 2005: Fundamentals of Human Geography. Sharda Pustak Bhawan, Allahabad.

# Paper III: Economic Geography

## Section A

Meaning and scope of economic geography, study of the geographical factors affecting production, consumption and distribution of principal raw materials and food stuffs.

## Section B

Man's utilization of natural resources and conservation, agricultural types and agricultural region of the world, irrigation systems, important minerals and their distribution iron, copper, aluminium and uranium, coal and petroleum.

## Section C

Industrial region of the world, major manufacturing industries and their localisation iron and steel, textile and chemical, study of economic regions – Damodar Valley, Hoogly and Ruhr region, world trade and transport, trade and trade routes – Sea, Air and Pipe lines.
(Questions will be on the basis of world regions and not on countries.)

**Recommended Readings :**

Alexander, J.W. 2001: Economic Geography. Prentice Hall. India, New Delhi.
Berry, B.J.L. et al 1976: Geography of Economic System. Prentice hall, Englewood, Cliffs, N.J., USA.
भारम, अलका 2010: आर्थिक भूगोल। रस्तोगी प्रकाशन, मेरठ।
Guha, J.L. and Chattora, P.R. : A New Approach to Economic Geography. World Press, Kolkatta.
हसन, एम. 2006: ससाधन भूगोल। वसुन्धरा प्रकाशन, गोरखपुर।
Janaki, V.A. 1985: Economic Geography Concept Publishing Co., New Delhi.
Leong, G.C. and Morgan, G.C. 1982: Human and Economic Geography. Oxford University, Press, London.
Singh, Kashi Nath and Siddiqui, A.R.: Economic Geography, Prayag Pustak Bhawan, Allahabad.
Wheeler, J.O. and Muller, O.? 1995: Economic Geography John Wiley, New York.

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# Paper IV: Geography of Rajasthan

## Section A

Physical aspects of Rajasthan: geological structure, relief, climate, drought, drainage, natural vegetation. Environmental pollution -causes and types; desertification, soils, soil erosion and conservation; availability, problems and conservation of water resources.

## Section B

Mineral resources distribution and production; Power and energy resources: distribution and production (hydro-electricity, coal, petroleum, solar energy and bio-energy) irrigation sources, irrigation intensity, crop wise irrigation, quality of irrigation water problems, irrigation projects: detailed study of Indira Gandhi canal project, Chambal valley project, Mahi Bajaj Sagar projects on physical and socio-economic aspects, agriculture: development under five year plans, problems of agriculture development, general land use, live-stock and dairy development, minerals.

Industries: textile, sugar, cement, marble and granite, fertilizer, zinc and copper smelting.

Transport & trade, development of tourism, desert development programme, tribal areas development programme, Aravali hill development programme.

## Section C

Cultural and development aspects: population-number, growth, distribution and density, rural and urban, male and female population, literacy status, occupational structure, schedule castes and schedule tribes, population problems, study of bhil, meena and garasia.

Settlement pattern, types of settlements, building materials and house types in Rajasthan with examples, factors affecting settlement.

## Recommended Readings:

Bhalla, L.R. 1996-97: Geography of Rajasthan. Kuldeep Publications, Jaipur.

Gujar,R.K 1992: Geography of Indira Gandhi Canal. Rajasthan Hindi Granth Academy.

Lodha, R. & Maheshwari, D. 2001: Geography of Rajasthan. Shahitya Bhawan Publication. Hospital Road, Agra

Mishra, V.C. 1967: Geography of Rajasthan. National book trust of India, New Delhi.

नाथुरामका, एल.एन., 2012-13: राजस्थान की अर्थव्यवस्था। कॉलेज बुक हाउस, जयपुर।

सांईवाल, स्नेह 2012: राजस्थान का भूगोल। कॉलेज बुक हाउस, जयपुर।

Sing, R.L. 1971 (ed): India A Regional Geography NGSI. Varanasi.

Attar Singh. 1992 Flood Prone Areas of India. Aviskar Publishers Jaipur

Sharma H.S. and M.L. Sharma 2014: Geography of Rajasthan. Panchcil Puplisher, Jaipur.

# Practicals

## Scheme of examination

Min. Pass Marks: 32                                                     Max. Marks: 80

| | Bifurcation of Marks | Time |
|---|---|---|
| Written test | 40 | 3 hrs. |
| Field survey and viva voce | 15+5 | 2½ hrs. |
| Record and viva voce | 15+5 | |
| Total Marks | 80 | |

N.B. 1.    There shall be 6 questions in written test selecting at least two questions from each section. Candidates are required to attempt 3 questions selecting 1 question from each section. All question carry equal marks. Each practical batch of 30 students will be allotted a teaching of 4 hrs per week for practicals.

### SYLLABUS

### Section A

The nature and scope of cartography, classification of maps, scales (plain, diagonal, comparative, vernier). Methods of showing relief: hachures, hill shading, contours. Profiles-serial, longitudinal, transverse, superimposed, composite, projected and their use in landform study.

### Section B

Enlargement and reduction of maps, use of pantograph, representation of temperature, pressure and rainfall data, use of line and bar graphs, isotherms, isobars and isohytes, construction and significance of climograph, hythergraph and climatograph.

### Section C

Study and interpretation of weather maps of india (particularly July and January)

Prismatic Compass survey: equipments, methods of measurement of bearings, correction of bearings, record of survey closing error and its corrections.

### Recommended Readings:

Monkhouse, F.J and Wilkinson, F.J. '85: Maps and Diagrams. Methuen, London.
Raisz, E. 1962. General Cartography. John Wiley and Sons, New York. 5th edition.
Sarkar, A.K. 1997: Practical Geography A Systematic Approach. Orient Longman, Kolkata.
Singh, R.L. and Singh Rana P.B. 1991 Elements of Practical Geography. Kalyani Publishers. New Delhi.
Singh, L.R. 2005: Fundamentals of Practical Geography. Sharda Pustak Bhawan, Allahabad.
शर्मा जे.पी. 2012. प्रायोगिक भूगोल। रस्तोगी पब्लिकेशन्स, मेरठ।

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