

**ANDHRA PRADESH PUBLIC SERVICE COMMISSION::VIJAYAWADA****SCHEME AND SYLLABUS FOR RECRUITMENT TO THE POST OF JUNIOR LECTURERS IN GOVERNMENT JUNIOR COLLEGES IN A.P INTERMEDIATE EDUCATION SERVICE**

(As per Annexure-III to G.O. Ms. No.141, Finance (HR-I Plg. &amp; Policy) Dept., Dt: 01/08/2016)

<b>Written Examination (Objective Type)</b>			
<b>Papers</b>	<b>No. of Questions</b>	<b>Duration (Minutes)</b>	<b>Maximum Marks</b>
Paper-1: General Studies & Mental Ability <b>(Degree Standard)</b>	150	150	150
Paper-2: Concerned Subject (One only) <b>(P.G. standard)</b>	150	150	300
<b>TOTAL</b>			450

**NEGATIVE MARKS:** As per G.O. Ms. No.235 Finance (HR-I, Plg & Policy) Dept., Dt.06/12/2016, for each wrong answer will be penalized with 1/3<sup>rd</sup> of the marks prescribed for the question.

The Candidates have to write Paper-2 examination in the subject (relevant to the Post Code applied) studied at PG Level **One** from the following:

<b>Subject Code</b>	<b>Name of the Subject</b>	<b>Subject Code</b>	<b>Name of the Subject</b>
01	English	08	Chemistry
02	Telugu	09	Botany
03	Urdu	10	Zoology
04	Sanskrit	11	Economics
05	Oriya	12	Civics
06	Mathematics	13	History
07	Physics		

**PAPER – I****GENERAL STUDIES AND MENTAL ABILITY**

1. Major Current Events and Issues pertaining to International, National and State of Andhra Pradesh.
2. General Science and its applications to the day to day life Contemporary developments in Science & Technology and Information Technology.
3. History of India – emphasis will be on broad general understanding of the subject in its social, economic, cultural and political aspects with a focus on AP and Indian National Movement.
4. Geography of India with focus on Andhra Pradesh.
5. Indian polity and Governance: constitutional issues, public policy, reforms and e-Governance initiatives.
6. Indian Economy and planning
7. Sustainable Development and Environmental Protection
8. Disaster management: vulnerability profile, prevention and mitigation strategies, Application of Remote Sensing and GIS in the assessment of Disaster
9. Logical reasoning, analytical ability and logical interpretation.
10. Data Analysis: Tabulation of data Visual representation of data Basic data analysis (Summary Statistics such as mean, median, mode and variance) and Interpretation.

**PAPER-2 – (CONCERNED SUBJECT)****1. ENGLISH****I. Movements and Concepts**

Renaissance, Metaphysical poetry, Neo-classicism, Romanticism, Rise of the novel, Modernism, Postmodernism, Colonialism, Postcolonialism, Diaspora, Psychoanalytical criticism, Myth and archetype, Feminism, Structuralism, Poststructuralism, Deconstruction.

**II. Writers and Texts**

1)	William Shakespeare	<i>Hamlet, Tempest</i>
2)	John Milton	<i>Paradise Lost-Book 1 and 9</i>
3)	William Wordsworth	"Immortality Ode", <i>Tintern Abbey</i>
4)	John Keats	"Ode to a Nightingale", "To Autumn"
5)	Robert Browning	"My Last Duchess", "The Last Ride Together"
6)	<b>Charles Dickens</b>	<b><i>David Copperfield</i></b>
7)	<b>TS Eliot</b>	<b>"The Waste Land", <i>Murder in the Cathedral</i></b>
8)	<b>GB Shaw</b>	<b><i>Saint Joan</i></b>
9)	<b>Virginia Woolf</b>	<b>"A Room of One's Own"</b>
10)	<b>Samuel Beckett</b>	<b><i>Waiting for Godot</i></b>
11)	<b>William Golding</b>	<b><i>Lord of the Flies</i></b>
12)	<b>Robert Frost</b>	<b>"Home Burial", "The Road Not Taken"</b>
13)	<b>Eugene O'Neill</b>	<b><i>The Hairy Ape</i></b>
14)	<b>Toni Morrison</b>	<b><i>Beloved</i></b>
15)	<b>Mulk Raj Anand</b>	<b><i>Untouchable</i></b>
16)	<b>AK Ramanujan</b>	"Love Poem for a Wife", "Small-Scale Reflections on a Great House"
17)	<b>Girish Karnad</b>	<b><i>Hayavadana</i></b>
18)	<b>Salman Rushdie</b>	<b><i>Midnight's Children</i></b>
19)	<b>Chinua Achebe</b>	<b><i>Things Fall Apart</i></b>
20)	<b>Margaret Atwood</b>	<b><i>Edible Woman</i></b>
21)	<b>AD Hope</b>	<b>"Australia", "Crossing the Frontier"</b>
22)	<b>Bessie Head</b>	<b><i>A Question of Power</i></b>

**III. English Language Teaching**

- 1) ELT in India: (History and status of English in India; English as Second Language, English as Foreign Language, and English as Global Language).
- 2) Methods and Approaches: (Grammar Translation method, Direct method, Audio-Lingual method; Structural approach, Communicative language teaching)
- 3) Teaching of Language Skills: (Teaching of Listening, Speaking, Reading, and Writing Skills; Teaching of Grammar and Functional English; Teaching of Vocabulary; Classroom techniques; Use of authentic materials)
- 4) Testing and Evaluation: (Principles, Types, Objectives of testing and evaluation)
- 5) Phonetics and Phonology; Syntax and Structure.

## 2. TELUGU

### తెలుగు

1. (ఎ) సంప్రదాయ సాహిత్యకవుల అధ్యయనం - కాలం - రచనలు  
 నన్నయ, తిక్కన, ఎర్రన, శివకవులు (నన్నెచోడుడు, మల్లికార్జున పండితారాధ్యుడు, పాల్కురికి సోమనాథుడు), నాచనసోమన - భాస్కర రామాయణ కవులు, రంగనాథ రామాయణ కవి - శ్రీనాథుడు - పోతన - పిల్లలమర్రి పినవీరభద్రుడు - గౌరన - జక్కన - అనంతామాత్యుడు - కొరవి గోపరాజు - నంది మల్లన, ఘంట సింగన - అష్టదిగ్గజ కవులు - తాళ్ళపాక కవులు - శ్రీకృష్ణదేవరాయలు - పొన్నగంటి తెలగన్న - చేమకూర వెంకటకవి - తంజావూరు రాజకవులు - కవయిత్రులు - కూచిమంచి తిమ్మకవి - జగ్గకవి.  
 (బి) వేమన తాత్వికత - సమకాలిక పరిశీలన, దృక్పథం - సమాజంపై వేమన కవిత్వ ప్రభావం.
2. సాహిత్య ధోరణుల అధ్యయనం - యుగప్రభావం - రూపాలు - మొదలైనవి. ఇతిహాసం - పురాణం ప్రబంధం - శతకం - సంకీర్తన సాహిత్యం - చారిత్రక కావ్యం - సంప్రదాయ, ఆధునిక గద్య రచనలు - నవల - కథానిక - వ్యాసం - ఏకాంకిక మొదలైనవి - వాదాలు (దళిత, హేతు, స్త్రీ, ప్రాంతీయ)
3. జానపద విజ్ఞానం - గేయాలు - కథాగేయాలు - గద్యాఖ్యానాలు - (పురాణగాథలు - ఇతిహాసాలు - కథలు), సామెతలు - పొడుపుకథలు - జానపద కళలు - (వీధి నాటకాలు, యక్షగానాలు, బొమ్మలాటలు, పగటివేషాలు, చిందు, గంగ జాతర కళారూపాలు.
4. ఆధునిక కవుల అధ్యయనం - ఆధునిక ధోరణులు వారి రచనలు - గురజాడ - రాయప్రోలు - వీరేశలింగం - చిలకమర్తి - పానుగంటి - విశ్వనాథ - దేవులపల్లి - బసవరాజు - పింగళి - కాటూరి - దువ్వూరి - పుట్టపర్తి - శ్రీశ్రీ - ప్రసిద్ధ ఆధునిక కవులు - భావ అభ్యుదయ - దిగంబర.
5. తెలుగు వ్యాకరణ, ఛందస్సు అధ్యయనం :  
 వ్యాకరణం - బాల వ్యాకరణం (సంజ్ఞ, సంధి, క్రియా, తత్సమ, ఆచ్ఛిక ప్రకరణాలు)  
 ప్రౌఢ వ్యాకరణ (సంజ్ఞ, సంధి, కారక, శబ్ద వాక్య పరిచ్ఛేదాలు)  
 ఛందస్సు - వృత్తాలు, జాతులు, ఉపజాతులు  
 (ఉత్పలమాల, చంపకమాల, శార్దూలం, మత్తేభం, ద్విపద, తరువోజ, సీసం, కందం, స్రగ్ధర, పంచచామరం)

అలంకారాలు - అర్థాలంకారాలు, శబ్దాలంకారాలు

తెలుగు భాషా చరిత్ర పరిణామం - (ప్రాబ్లున్నయ యుగం నుండి నేటి వరకు)- ద్రావిడ భాషా

కుటుంబాలలో తెలుగు స్థానం - భౌగోళిక విభజన - మాండలికాలు.

7. భాషా విజ్ఞాన అధ్యయనం - భాషా శాస్త్రం, అర్థ విపరిణామం - ఆధునిక కాలం : శాసన భాష నుండి సాహిత్య భాష వరకు (వ్యావహారిక భాషా ఉద్యమం వంటివి)
8. తెలుగు సాహిత్య పరిణామం - (ప్రాబ్లున్నయ యుగం నుండి నేటి వరకు)
9. సౌందర్య, సాహిత్య విమర్శ అధ్యయనం (ప్రాక్, పశ్చిమ) ఆధునిక తెలుగు సాహిత్య విమర్శ.
10. సంస్కృత వ్యాకరణం, కావ్యాలు - సంస్కృత వ్యాకరణం ప్రాథమిక విజ్ఞానం, సామాన్య ప్రామాణిక గద్య, పద్య పాఠ్యాంశాలు - హితోపదేశం, కాళిదాసుని కృతులు, సంస్కృత పంచకావ్యాల పరిచయం.

### 3. URDU

The Syllabus covers all important topics related to Urdu Language and Literature. It deals with the Origin & Development of Urdu Language, Deccan Urdu Literature. Evolution & Development of different Forms of Literature, both in Prose and Poetry with reference to the works of prominent writers and poets, Literature Movements and Criticism.

The Syllabus is detailed as follows :

#### 1. **ORIGIN & DEVELOPMENT OF URDU LANGUAGE**

Three different periods of Indo-Aryan Language. Maghribi Hindi Aur Uski Boliyan, Khadi Boli Ka Irteqa. Urdu ke Aaghaz Ke Barey Mein Mukhtalif Nazariyat.

#### 2. **DECCANIYAT :**

- a) Bahmani Daur : Fakhruddin Nizami (Kadamrao Padamrao).
- b) Adilshahi Daur : Nusrati (Gulshan-e-Ishq)
- c) Qutubshahi Daur : Mohammed Quli Qutub Shah (Deewas-e- Mohammed Quli QutubShah), Mulla Wajhi (Sabras & Qutub Mushtari), Ghawwasi (Saiful Mulook- o- Badeeuj Jamaal), Ibne Nishati (Phool Ban)

#### 3. **DEVELOPMENT OF DIFFERENT FORMS OF LITERATURE :**

##### a) **POETRY :**

- i. **GHAZAL** : (Tareef, Tareekh aur Tanqeed) The following Poets: Mir, Dard, Atish, Ghalib, Momin, Iqbal, Hasrat, Fani, Jigar, Firaq, Nasir Kazmi.
- ii. **QASEEDA**: (Tareef, Tareekh aur Tanqeed) The following poets : Sauda and Zauq.
- iii. **MARSIYA**: (Tareef, Tareekh aur Tanqeed). The following poets: Mir Anees and Mirza Daber.
- iv. **RUBAYEE**: (Tareef, Tareekh aur Tanqeed) The following Poets: Anees, Akbar, Amjad and Josh.
- v. **MASNAVI**: (Tareef, Tareekh aur Tanqeed) Masnavi Sehrul Bayaan (Mir Hasan), Gulzar-e-Naseem (Daya Shanker Naseem), Zehr-e-Ishq (Nawab Mirza Shauq).
- vi. **NAZM** : (Tareef, Tareekh aur Tanqeed) (Paband Nazm, Nazm-e-Murra, Azad Nazm, Sonnet, Triolet, Haiku and Mahiya) ; Nazeer, Hali, Akbar, Chakbast, Iqbal, Josh, Akhtarul Imaan, Sardar Jafari, Noon Meem Rashid, Meeraji, Farhat Kaifi and Aziz Tamannayee.

##### b) **PROSE :**

- i. **DASTAN** : (Tareef, Tareekh aur Tanqeed) : Bagh-o-Bahar, Fasana-e-Ajayeb.
- ii. **NOVEL** : (Tareef, Tareekh aur Tanqeed) Fasana-e-Azad (Ratan Nath Sharshar) Taubatun Nusoo (Deputy Nazeer Ahamed) Umrao Jan Ada (Mirza Hadi Ruswa) Gowdan (Prem Chand) Ek Chadar Maili si (Rajender Singh Bedi), Tedhi Lakeer (Ismath Chugtayee), Aiwane Ghazal (Jeelani Bano).
- iii. **AFSANA** : (Tareef, Tareekh aur Tanqeed) Premchand (Najaat), Manto (Tobatek Singh), Krishen Chander (Mahalakshmi ka Pul), Quratul Ayen Hyder (Nazaara Darmiyani Hai).
- iv. **DRAMA** : (Tareef, Tareekh aur Tanqeed) : Amaanat (Indra Sabha). Agha Hashr Kashmiri (Said-e-Hawas), Imtiyaz Ali Taj (Anarkali), Habeeb Tanweer (Agra Bazaar), Mohammed Hasan (Zahaak).
- v. **INSHAIYA** : (Tareef, Tareekh aur Tanqeed) Khaja Hasan Nizami (Sipara-e-Dil), Rasheed Ahmed Siddiqui (Ashufta Bayani Meri) Patras Bukhari (Mazameen-e-Patras).

- vi. **KHUTOOT** : (Tareef, Tareekh aur Tanqeed) Ghalib (Urdu-e-Mualla), Moulana Azad (Ghubar-e-Khatir).
- vii. **SAWANEH NIGARI** : (Tareef, Tareekh aur Tanqeed) : Yadgaar-e-Ghalib, Nazeer Ahmed Ki Kahani Kuch Unki Kuch Meri Zabani.
4. **LITERARY CRITICISM** : (Tareef aur Tareekh)
- Tazkeron Mein Tanqeedi Nuqoosh : Nikatush-Shoara, Gulshan-e-Bekhar, Aab-e-Hayat.
  - Hali ke Tanqeedi Nazariyat : Muqaddama-e-Sher-o-Shairi.
  - Mukhtalif Tanqeedi Dabistaan (Unki Tareef aur Tareekh) : Taassurati Tanqeed, Jamaliyati Tanqeed, Nafsiyati Tanqeed, Marxi Tanqeed aur Saakhtiyati Tanqeed.
  - Mumtaz Naqideen : Hali, Shibli, Niyaz Fatehpuri, Waheeduddin Salim, Firaq, Ehtesham Hussain, Kalimuddin Ahmed, Aale-Ahmed Suroor, Mughni Tabassum.
5. **DIFFERENT LITERARY MOVEMENTS** : (Their Contribution)  
Fort William College, Delhi College, St. George College, Dabistane Dilli Dabistane Lucknow, Aligarh Tahreek, Jamia Osmania and Darut Tarjuma, Taraqqi Pasand Tahreek, Halqa-e-Arbaab-e-Zauq, Jadeediyat.
6. **URDU JOURNALISM, TRANSLATION & MASS – MEDIA, Print and Electronic.**

#### 4. SANSKRIT

50% of questions will be set in Sanskrit and the remaining 50% questions will be set in ENGLISH.

In writing Sanskrit Devanagari should be used.

- General introduction to Vedic literature Four Samhitas, Brahmanas, Aranyakas, Upanishads and Vedangas.
- The Ramayana and Mahabharata - The age of their composition, Social and Political conditions revealed-Their influence on later literature.
- Study of the following poets, their works and their age Bhasa-Kalidasa-Bharavi-Naga-Sri Harsha-Bhavabuthi-harsha-Vardhana-Visakhatatta-Bhattanarayana-Dandin Banabhatta, Sudraka.
- History of classical sanskrit literature-the origin and development of different types of literary compositions - Mahakavya - Laghukavya -Historical Kavya - Lyric Poetry Diadactic poetry - Fable - Drama (Basic knowledge of Dasarupakas) - Gadya kavya.
- Alankaras - Simple definitions and examples of, without varieties upama – rupaka utpreksha - Atisayokti - Sandeha - Bhrantiman - Samaskoti - Aprastutaprasamsa Dipaka - Tulya Yogita - Arathantharanyasa Drushtanta – Kavyalingam Ananvyalankara - Swabhavokti.
- Grammar - Ajanta Sadharana Sabdas in all genders - Halanta Sadharana Sabdas in all genders - Sarvanama sabdas in all genderspati - Mati - Atman - Rajan - ap.
- Conjugations - I, IV, VI and X conjugations in (1) Lat (present tense) (2) Lit (Past perfect), (3) Lrit (Second future), Lot (imperative mood) (5) Lang (past perfect), (6) Vidhiling (potential mood).
- Samasas - Tatpurusha - Karmadharaya - Dvandva - Ekasesh - Dvigu - Bahu vrihi Ayyavibhava.
- Sandhi's :  
a) Ach-sandhi-Guna-Vridhi-Savarnadirgha-Prakrutibhava-Purvarupa-Pararupa Ayavayava-Yanadesa.  
b) Halsandhi-Schutva-Shtutva-Jastva-Anunasiktva-Chartva-Anuswara.  
c) Visargasandhi.
- Philology: Origin of the language - Classification of languages into various groups - Indo European group - Satam and Kentum - languages - Phonetic changes and their causes - Samantic changes and their causes.
- Chandas-Vrattas (I) Vamsastham (ii) Indra Vajra (iii) Upendra Vajra (iv) Bhujanga Prayatam (v) Manda Kranta (vi) Sardulavikriditam (vii) Sikharini (viii) Sragdhara (ix) Vasantafilakam (x) Anustup.

## 5. ORIYA

ORIYA

## ଓଡ଼ିଆ ପାଠ୍ୟକ୍ରମ

'କ' ବିଭାଗ

(ଓଡ଼ିଆ ଭାଷା ସମ୍ବନ୍ଧୀୟ)

ପ୍ରତ୍ୟେକ ବିଭାଗରୁ ପାଞ୍ଚଗୋଟି ପ୍ରଶ୍ନ ଦିଆଯିବ ।

- \* ଓଡ଼ିଆ ଭାଷାର ଉତ୍ପତ୍ତି ଓ କ୍ରମ ବିକାଶ
- \* ଓଡ଼ିଆ ଭାଷାର ଉପରେ ଇଂରେଜୀ, ଯାବନିକ ଓ ଦ୍ରାବିଡ଼ ଭାଷାର ପ୍ରଭାବ
- \* କୃଦନ୍ତୁ ଓ ତତ୍ତ୍ୱ
- \* କାରକ ଓ ବିଭକ୍ତି
- \* ସମାସ ଓ ସମୋଚ୍ଚାରିତ ଶବ୍ଦ
- \* ସହି
- \* ଓଡ଼ିଆ ଶବ୍ଦ ଭଣ୍ଡାର
- \* ଧ୍ୱନି ପରିଚର୍ଚ୍ଚନ କାରଣ
- \* ଓଡ଼ିଆ ସ୍ୱଭାଷଣ

'ଖ' ବିଭାଗ

(ଓଡ଼ିଆ ସାହିତ୍ୟ ସମ୍ବନ୍ଧୀୟ)

[\*] ବିଭିନ୍ନ ପ୍ରତ୍ୟେକ ବିଭାଗରୁ ଦଶଗୋଟି ପ୍ରଶ୍ନ ଦିଆଯିବ ।

- \* ବର୍ଯ୍ୟା ଗୀତିକା
- \* ସାରଳା ସାହିତ୍ୟ
- \* ଓଡ଼ିଆ ପୁରାଣ ଓ ସବୁ ସାହିତ୍ୟ
- \* ଓଡ଼ିଆ ରୀତି ସାହିତ୍ୟ
- \* ଚଉତିଶା, କୋଇଲି ଓ ଓଡ଼ିଆ ପଦାବଳୀ ସାହିତ୍ୟ
- \* ଜନକିଶ ଶତକ ଓଡ଼ିଆ ସାହିତ୍ୟ (ଗଦ୍ୟ ସାହିତ୍ୟ, ପଦ୍ୟ ସାହିତ୍ୟ ଓ ସାହିତ୍ୟ ପଦ୍ଧତି )
- \* ସତ୍ୟବାଦୀ ସାହିତ୍ୟ
- \* ସବୁଜ ସାହିତ୍ୟ ଓ ପ୍ରଗତିଶୀଳ ଓଡ଼ିଆ ସାହିତ୍ୟ
- \* ସ୍ୱାଧୀନତା ପରବର୍ତ୍ତୀ ଓଡ଼ିଆ ଗଦ୍ୟ ସାହିତ୍ୟ (ଗଳ୍ପ, ଉପନ୍ୟାସ, ପ୍ରବନ୍ଧ )
- \* ସ୍ୱାଧୀନତା ପରବର୍ତ୍ତୀ ଓଡ଼ିଆ କବିତା

## 6. MATHEMATICS

### **I. Real Analysis**

Finite, countable and uncountable sets – Real Number system  $\mathbb{R}$  – infimum and supremum of a subset of  $\mathbb{R}$  – Bolzano – Weierstrass theorem.  
 Sequences, convergence, limit superior and limit inferior of sequences, sub sequences, Heine Borel Theorem.  
 Infinite series – Tests of convergence.  
 Continuity and uniform continuity of real valued functions of real variable.  
 Monotonic functions and functions of bounded variation.  
 Differentiability and mean value theorems.  
 Riemann integrability.  
 Sequences and Series of functions.

### **II. Metric Spaces**

Metric spaces – completeness, compactness and connectedness – continuity and uniform continuity of functions from one metric space into another.  
 Topological spaces – base and subbase – continuous function.

### **III. Elementary Number**

Primes and composite numbers – Fundamental Theorem of arithmetic – divisibility congruences – Fermat's theorem – Wilson's Theorem – Euler's  $\phi$  - function.

### **IV. Group Theory**

Groups, subgroups, normal subgroups – quotient groups – homomorphisms and isomorphism theorems – permutation groups, cyclic groups, Cayley's theorem. Sylow's theorems and their applications.

### **V. Ring Theory**

Rings, integral domains, fields – subrings and ideals – Quotient rings – homomorphisms – Prime ideals and maximal ideals – polynomial rings – Irreducibility of polynomials – Euclidean domains and principal ideal domains.

### **VI. Vector Spaces**

Vector Spaces, Subspaces – Linear dependence and independence of vectors – basis and dimension – Quotient spaces – Inner product spaces – Orthonormal basis – Gram – Schmidt process.

### **VII. Matrix Theory**

Linear transformations – Rank and nullity – change of bases.  
 Matrix of a linear transformation – singular and non-singular matrices – Inverse of matrix – Eigenvalues and eigenvectors of matrix and of linear transformation – Cayley Hamilton's theorem.

### **VIII. Complex Analysis**

Algebra of complex numbers – the complex plane – Complex functions and their Analyticity – Cauchy-Riemann equations – Mobius transformations.  
 Power Series.  
 Complex Integration – Cauchy's theorem – Morera's Theorem – Cauchy's integral formula – Liouville's theorem – Maximum modulus principle – Schwarz's lemma – Taylor's series – Laurents series.  
 Calculus of residues and evaluation of integrals.

### **IX. Ordinary Differential Equation**

Ordinary Differential Equation (ODE) of first order and first degree – Different methods of solving them – Exact Differential equations and integrating factors.  
 ODE of first order and higher degree – equations solvable for  $p$ ,  $x$  and  $y$  – Clairaut's equations – Singular Solutions.  
 Linear differential equations with constant coefficients and variable coefficients – variation of parameters.

### **X. Partial Differential Equations**

Formation of differential equations (PDE) – Lagrange and Charpit methods for solving first order – PDE's – Cauchy problem for first order PDE's Classification of second order PDE's – General solution of higher order PDE's with constant coefficients.

## 7. PHYSICS

### PART-A

#### **I. Mathematical Methods of Physics**

Dimensional analysis. Vector algebra and vector calculus. Linear algebra, matrices, Cayley-Hamilton Theorem. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem.

Data interpretation and analysis. Precision and accuracy. Error analysis, propagation of errors. Least squares fitting, Linear and non-linear curve fitting and Chi-Square Test.

#### **II. Classical Mechanics**

Newton's laws. Dynamical systems, Phase space dynamics, stability analysis. Central force motions. Two body Collisions – scattering in laboratory and Centre of mass frames. Rigid body dynamics-moment of inertia tensor. Non-inertial frames and pseudoforces. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Periodic motion: small oscillations, normal modes. Special theory of relativity-Lorentz transformations, relativistic kinematics and mass-energy equivalence.

#### **III. Electromagnetic Theory**

Electrostatics : Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics : Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields. Charged particles in inhomogeneous fields.

#### **IV. Quantum Mechanics**

Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator, etc.). Tunneling through a barrier. Wave-function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors. Motion in a central potential : orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Hydrogen atom. Stern-Gerlach experiment. Time-independent perturbation theory and applications. Variational method. Time dependent perturbation theory and Fermi's golden rule, selection rules. Identical particles, Pauli exclusion principle, spin-statistics connection.

#### **V. Thermodynamics and Statistical Physics**

Laws of thermodynamics and their significance. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, micro-and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law.

#### **VI. Electronics**

Semiconductors devices (diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices), device structure, device characteristics, frequency dependence and applications. Opto-electronic devices (solar cells, photo-detectors, LEDs). Operational amplifiers and their applications. Digital techniques and applications (Logic circuits, registers, counters and comparators). A/D and D/A converters. Microprocessor microcontroller basics. Fundamentals of communication electronics, modulation techniques.

#### **VII. Atomic & Molecular Physics**

Quantum states of an electron in an atom. Electron spin. Spectrum of helium and alkali atom. Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. Electron spin resonance. Nuclear magnetic resonance, chemical shift. Frank-



Condon principle. Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Lasers : spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, population inversion, rate equation. Modes of resonators and coherence length.

#### **VIII. Condensed Matter Physics**

Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids : metals, insulators and semiconductors. Superconductivity : type-I and type-II superconductors. Josephson junctions. Superfluidity. Defects and dislocations. Ordered phases of matter : translational and orientational order, kinds of liquid crystalline order. Quasi crystals.

#### **IX. Nuclear and Particle Physics**

Basic nuclear properties ; size, shape and charge distribution, spin and parity. Binding energy, semi-empirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single-particle shell model, its validity and limitations. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism, compound nuclei and direct reactions.

### **PART-B**

#### **I. Mathematical Methods of Physics**

Green's function. Partial differential equations (Laplace, wave and heat equations in two and three dimensions). Elements of computational techniques : root of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, Solution of first order differential equation using Runge-Kutta method. Finite difference methods. Tensors. Introductory group theory.

#### **II. Classical Mechanics**

Basic concepts of dynamical systems, Poisson brackets and canonical transformations. Symmetry, invariance and Noether's theorem. Hamilton-Jacobi theory.

#### **III. Electromagnetic Theory**

Dispersion relations in plasma. Lorentz invariance of Maxwell's equation. Transmission lines and wave guides. Radiation- from moving charges and dipoles and retarded potentials.

#### **IV. Quantum Mechanics**

Spin-orbit coupling, fine structure. WKB approximation. Elementary theory of scattering : phase shifts, partial waves, Born approximation. Relativistic quantum mechanics : Klein-Gordon and Dirac equations. Semi-classical theory of radiation.

#### **V. Thermodynamics and Statistical Physics**

First- and second-order phase transitions. Diamagnetism, paramagnetism, and ferromagnetism. Ising model. Bose-Einstein condensation. Diffusion equation. Random walk and Brownian motion. Introduction to nonequilibrium processes.

#### **VI. Condensed Matter Physics**

Electron spin resonance, Nuclear magnetic resonance, chemical shift and applications. X-ray diffraction technique, scanning electron microscopy and transmission electron microscopy.

#### **VII. Nuclear and Particle Physics**

Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Quark model, baryons and mesons. C, P, and T invariance. Application of symmetry arguments to particle reactions. Parity non-conservation in weak interaction. Relativistic kinematics.

## 8. CHEMISTRY

### INORGANIC CHEMISTRY

1. Atomic structure and chemical bonding – structure and bonding in homo and hetero nuclear molecules. Applications of VSEPR, Valence Bond and Molecular orbital theories in explaining the structures of simple molecules.
2. Transition elements and coordination compounds – physical and chemical characteristics of transition elements – Bonding theories – crystal field theory – crystal field splitting patterns in various geometries. Calculation of CFSE – Jahn-Teller effect – Application of MO theory to octahedral and square planar complexes – Electronic spectra of complexes – Russell Saunders coupling – term symbols – spectra of octahedral and tetrahedral complexes – charge transfer spectra – magnetic properties of complex compounds.
3. Metal - ligand equilibria in solution – step wise and overall stability constants – factors affecting the stability of metal complexes – Pearson's theory of hard and soft acids and bases (HSAB) – Chelate effect.
4. Reaction mechanisms in complexes – Inert and labile complexes – Ligand substitution reactions of octahedral complexes – Acid hydrolysis, base hydrolysis – conjugate base mechanism – Anation reactions – substitution reactions of square planar complexes – Trans effect – Electron transfer reactions – Inner and outer sphere mechanisms.
5. Metal complexes - EAN rule – structure and bonding of metal carbonyls of Mn, Fe, Co and Ni – Metal nitrosyls – structure and bonding.
6. Cages and ring compounds – preparation, structure and reactions of boranes and carboranes – Boron-nitrogen and Sulfur-nitrogen cyclic compounds.
7. Metal clusters – factors favoring M-M bonds – Structure and bonding in  $\text{Re}_2\text{Cl}_8^{2-}$ ,  $\text{Mo}_6\text{Cl}_8^{4+}$ ,  $\text{Nb}_6\text{X}_{12}^{2+}$ ,  $\text{Re}_3\text{Cl}_9$  and  $\text{Re}_3\text{Cl}_{12}^{3-}$ .
8. Bio-inorganic chemistry – metal complexes as oxygen carriers – hemoglobin and myoglobin – oxygen transport – non heme proteins – hemerythrin and hemocyanin.
9. Analytical chemistry – chromatography – general principles involved in separations by paper, thin layer and column chromatography – GC and HPLC.

### Physical Chemistry

#### 1. Thermodynamics

Brief review of concepts of I and II laws of thermodynamics. Concept of entropy. Entropy as a state function. Calculation of entropy changes in various processes. Entropy changes in an ideal gas. Entropy changes on mixing of ideal gases. Entropy as a function of V and T. Entropy as a function of P and T. Entropy change in isolated systems- Clausius inequality. Entropy change as criterion for spontaneity and equilibrium.

Third law of thermodynamics. Evaluation of absolute entropies from heat capacity data for solids, liquids and gases. Standard entropies and entropy changes of chemical reactions. Helmholtz and Gibbs free energies (A and G). A and G as a criteria for equilibrium and spontaneity. Physical significance of A and G. Driving force for chemical reactions- relative signs of  $\Delta H$  and  $\Delta S$ .

Thermodynamic relations. Gibbs equations. Maxwell relations. Temperature dependence of G. Gibbs- Helmholtz equation. Pressure dependence of G.

Chemical potential: Gibbs equations for non-equilibrium systems. Material equilibrium. Phase equilibrium. Clapeyron equation and Clausius-Clapeyron equation .

Conditions for equilibrium in a closed system. Chemical potential of ideal gases. Ideal-gas reaction equilibrium-derivation of equilibrium constant. Temperature dependence of equilibrium constant-the van't Hoff equation.

Solutions: Specifying the Solution composition. Partial molar properties-significance. Relation between solution volume and partial molar volume. Measurement of partial molar volumes- slope and intercept methods. The chemical potential. Variation of chemical potential with T and P. Gibbs-Duhem equation-derivation and significance. Ideal solutions. Thermodynamic properties of ideal solutions. Mixing quantities. Vapour pressure-Raoult's law. Thermodynamic properties of ideally dilute solutions. Vapour pressure- Henry's law.

Nonideal systems. Concept of fugacity, fugacity coefficient. Determination of fugacity. Non ideal solutions. Activities and activity coefficients. Standard-state conventions for non ideal solutions. Determination of activity coefficients from vapour pressure measurements. Activity coefficients of nonvolatile solutes using Gibbs-Duhem equation.

Multicomponent phase equilibrium: Vapour pressure lowering, freezing point depression and boiling point elevation

## 2. Statistical Thermodynamics

Concepts of distribution and probability. Estimation of probability and the most probable distribution. Systems composed of noninteracting particles. Derivation of Boltzmann distribution law.

The molecular partition function. Systems composed of interacting particles. The concept of ensemble and canonical ensemble. Canonical partition function and its relation to molecular partition function. The factorization of molecular partition function – translational, rotational, vibrational and electronic partition functions. Derivation of expressions for translational, rotational (diatomic) and vibrational partition functions. Relationship between partition functions and thermodynamic functions.

The relationship between partition functions and thermodynamic functions. Specific heats of solids – Einstein equation of heat capacity of solids – derivation. Explanation of heat capacity at very low and very high temperatures – Dulong and Petits Law. Debye theory.

The entropy of a monoatomic ideal gas. The Sackur-Tetrode equation- derivation. Mean translational and vibrational energies.

## 3. Electrochemistry

**Electrochemical Cells :** Derivation of Nernst equation – problems. Chemical and concentration cells (with and without transference). Liquid junction potential – derivation of the expression for LJP – its determination and elimination. Applications of EMF measurements: Solubility product, potentiometric titrations, determination of transport numbers, equilibrium constant measurements.

Decomposition potential and its significance. Electrode polarization – its causes and elimination. Concentration overpotential.

Concept of activity and activity coefficients in electrolytic solutions. The mean ionic activity coefficient. Debye-Huckel theory of electrolytic solutions. Debye-Huckel limiting law (derivation not required). Calculation of mean ionic activity coefficient. Limitations of Debye-Huckel theory. Extended Debye-Huckel law.

Theory of electrolytic conductance. Derivation of Debye-Huckel-Onsager equation – its validity and limitations.

Concept of ion association – Bjerrum theory of ion association (elementary treatment) - ion association constant – Debye-Huckel-Bjerrum equation.

## 4. QUANTUM CHEMISTRY

Black body radiation-Planck's concept of quantization-Planck's equation, average energy of an oscillator (derivation not required). Wave particle duality and uncertain principle-significance of these for microscopic entities. Emergence of quantum mechanics. Wave mechanics and Schroedinger wave equation.

Operators-operator algebra. Commutation of operators, linear operators. Complex functions. Hermitian operators. Operators  $\nabla$  and  $\nabla^2$ . Eigenfunctions and eigenvalues. Degeneracy. Linear combination of eigenfunctions of an operator. Well behaved functions. Normalized and orthogonal functions.

**Postulates of quantum mechanics.** Physical interpretation of wave function. Observables and operators. Measurability of operators. Average values of observables. The time dependent Schrodinger equation. Separation of variables and the time-independent Schrodinger equation..

**Theorems of quantum mechanics.** Real nature of the eigen values of a Hermitian operator-significance. Orthogonal nature of the eigen values of a Hermitian operator-significance of orthogonality. Expansion of a function in terms of eigenvalues. Eigen functions of commuting operators-significance. Simultaneous measurement of properties and the uncertainty principle.

*Particle in a box-* one dimensional and three dimensional. Plots of  $\psi$  and  $\psi^2$ -discussion. Degeneracy of energy levels. Comparison of classical and quantum mechanical particles. Calculations using wave functions of the particle in a box-orthogonality, measurability of energy, position and momentum, average values and probabilities. Application to the spectra of conjugated molecules.

Cartesian, Polar and spherical polar coordinates and their interrelations

*Schrodinger equation for the hydrogen atom-* separation into three equations. Hydrogen like wave functions. Radial and angular functions. Quantum numbers  $n$ ,  $l$  and  $m$  and their importance. The radial distribution functions. Hydrogen like orbitals and their representation. Polar plots, contour plots and boundary diagrams.

*Many electron systems.* Approximate methods. The variation method-variation theorem and its proof. Trial variation function and variation integral. Examples of variational

calculations. Particle in a box. Construction of trial function by the method of linear combinations. Variation parameters. Secular equations and secular determinant..  
*Bonding in molecules.* Molecular orbital theory-basic ideas. Construction of MOs by LCAO,  $H_2^+$  ion. The variational integral for  $H_2^+$  ion. Detailed calculation of Wave functions and energies for the bonding and antibonding MOs. Physical picture of bonding and antibonding wave functions. Energy diagram. The MO and VB wave functions for  $H_2$  molecule and their comparison

### 5. Chemical Kinetics

Theories of reaction rates : Collision theory, steric factor. Transition state theory. Reaction coordinate, activated complex and the transition state. Thermodynamic formulation of transition state theory. Unimolecular reactions and Lindemann's theory.

Complex reactions- Opposing reactions, parallel reactions and consecutive reactions (all first order type). Chain reactions-general characteristics, steady state treatment. Example-  $H_2-Br_2$  reaction. Derivation of rate law.

Effect of structure on reactivity- Linear free energy relationships. Hammett and Taft equations-substituent ( $\sigma$  and  $\sigma^*$ ) and reaction constant ( $\rho$  and  $\rho^*$ ) with examples.

Factors affecting reaction rates in solution. Diffusion controlled reactions. Influence of dielectric constant and ionic strength on ion-ion, ion-dipole and dipole-dipole reactions. Primary and secondary salt effects. Kinetic isotope effects: Primary and secondary isotope effects. Solvent isotope effects.

**Enzyme catalysis:** Chemical catalysis and enzyme catalysis – distinction – energy considerations and rate accelerations – examples.

Michaelis-Menten mechanisms of enzyme catalyzed reactions involving one and two intermediates. Steady-state approximation. Derivation of kinetic equations. Evaluation of kinetic parameters. Enzyme-substrate complex: Fischer's lock and key and Koshland's induced fit hypotheses. Specificity of enzyme-catalyzed reactions. Discussion of the various types of forces involved in the formation of E-S complex. pH dependence of enzyme-catalyzed reactions – the kinetics and the equations involved.

### 6. Photochemistry

Electronic transitions in molecules. The Franck Condon principle. Electronically excited molecules- singlet and triplet states. Radiative life times of excited states-theoretical treatment. Measured lifetimes. Quantum yield and its determination. Actinometry-ferrioxalate and uranyl oxalate actinometers-problems.

Derivation of fluorescence and phosphorescence quantum yields. E-type delayed fluorescence- evaluation of triplet energy splitting ( $\Delta E_{ST}$ ). Photophysical processes- photophysical kinetics of unimolecular reactions. Calculation of rate constants of various photophysical processes-problems, State diagrams

Photochemical primary processes. Types of photochemical reactions- electron transfer, photodissociation, addition, abstraction, oxidation and isomerization reactions with examples. Effect of light intensity on the rates of photochemical reactions. Photosensitization. Quenching-Stern Volmer equation. Experimental set up of a photochemical reaction. Introduction to fast reactions- Principle of flash photolysis

### 7. Solid state chemistry

Magnetic properties of solids- classification of magnetic materials, Magnetic susceptibility, Langevin diamagnetism, Weiss theory of para magnetism

Electronic properties of metals, insulators and semi conductors: Electronic structure of solids, Band theory, band structure of metals, insulators and semiconductors. Electrons, holes and Excitons. The temperature dependence of conductivity of extrinsic semi conductors. Photo conductivity and photovoltaic effect-p-n junctions.

Superconductivity. Occurrence of superconductivity. Destruction of superconductivity by magnetic fields-Meisner effect. Types of superconductors. Theories of super conductivity- BCS theory.

### ORGANIC CHEMISTRY

1. IUPAC nomenclature of organic molecules including structural, positional, functional, regio- and stereoisomers.
2. Molecular representations: Wedge, Fischer, Newman and Saw-horse formulae, their description and interconversions. Stereoisomers-classification-configuration –R,S-nomenclature- Criteria for Chirality. Axially chiral allenes, spiranes, alkylidene cycloalkanes, chiral biaryls, atropisomerism. Planar chiral ansa compounds and trans-cyclooctene. Helically chiral compounds, Determination of absolute configuration by chemical correlation methods. Determination of configuration in E,Z-nomenclature: Spectral and Chemical methods of configuration determination of E,Z isomers. Determination of configuration in aldoximes and ketoximes.

3. Nature of Bonding in Organic Molecules and Aromaticity, Delocalized chemical bonding-conjugation, cross conjugation, resonance, hyperconjugation, tautomerism, Huckle's rule and the concept of aromaticity, aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, metallocenes-Ferrocene, Azulenes, Fulvenes, Annulenes, anti-aromaticity, pseudo-aromaticity, homo-aromaticity.
4. Reactive intermediates and Molecular rearrangements. Reactive Intermediates: Generation, detection, structure, stability and reactions of carbocations, carbanions, carbenes, nitrenes and free radicals. Molecular rearrangements: Definition and classification. Molecular rearrangements involving 1) electron deficient carbon: Wagner-Meerwein, Pinacol-Pinacolone, Allylic and Wolf rearrangement. 2) electron deficient Nitrogen: Hofmann, Lossen, Curtius, Schmidt and Beckmann rearrangements 3) electron deficient Oxygen: Baeyer-Villiger oxidation. 4) Base catalyzed rearrangements: Benzilic acid, Favourski, Transannular, Sommelet-Hauser and Smiles rearrangement
5. Organic Reaction mechanism-I Electrophilic addition to carbon-carbon double bond: Stereoselective addition to carbon-carbon double bond; *anti* addition- Bromination and epoxidation followed by ring opening. *Syn* addition of OsO<sub>4</sub> and KMnO<sub>4</sub>. Hydroboration. Michael reaction. Elimination reactions E2, E1, E1CB mechanisms. Orientation and stereoselectivity in E2 eliminations. Pyrolytic *syn* elimination and  $\alpha$ -elimination, elimination Vs substitution. Determination of reaction mechanism: Energy profiles of addition and elimination reactions, transition states, product isolation and structure of intermediates, use of isotopes, chemical trapping, crossover experiments.
6. Importance of heterocyclic compounds as drugs. Nomenclature of heterocyclic systems based on ring size, number and nature of hetero atoms. Synthesis and reactivity of pyrrole, furan, thiophene, pyridine, indole, benzofuran, benzothiophene, quinoline, isoquinoline.
7. Alkaloids and terpenoids- Importance of natural products as drugs. Isolation of natural products by steam distillation, solvent extraction and chemical methods. Structure determination and synthesis of papaverine, nicotine and quinine-General methods in the structure determination of terpenes. Isoprene rule, structure determination and synthesis of  $\alpha$ -terpeniol and camphor.
8. Organic Photochemistry, Photochemical energy, Frank-Condon principles, Jablonski diagram, singlet and triplet states, dissipation of photochemical energy, photosensitization, quenching, quantum efficiency and quantum yield. Photochemistry of carbonyl compounds -  $n \rightarrow \pi^*$  and  $\pi \rightarrow \pi^*$  transitions. Norrish type-I and Norrish type-II cleavages. Paterno-Buchi reactions, Photoreduction, photochemistry of enones - hydrogen abstraction, rearrangements of  $\alpha, \beta$ - unsaturated ketones and cyclohexadienones, photochemistry of *p*-benzoquinones. Dienes - photochemistry of 1,3-butadienes, (2+2) additions leading to cage structures, photochemistry of cyclohexadienes, photochemistry of aromatic compounds, excited state of benzene and its 1,2-, 1,4- additions
9. Pericyclic Reactions Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3 butadiene, 1,3,5 hexatriene and allyl system. Classification of pericyclic reactions. Woodward - Hoffmann correlation diagrams. FMO and PMO (Möbius Huckel) approaches. Electrocyclic reactions-Conrotatory and disrotatory.  $4n$ ,  $4n+2$  and allyl systems. Cycloadditions-antarafacial and suprafacial additions,  $4n$  and  $4n+2$  systems, 2+2 addition of ketene, 1,3 dipolar cycloadditions Sigmatropic rearrangements - Suprafacial and antarafacial shifts of H, Sigmatropic shifts involving carbon moieties, 3,3 and 5,5 sigmatropic rearrangements.  
Structure determination of organic compounds by UV IR, NMR and Mass Various electronic transitions, Beer-Lambert's law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl Compounds, dienes, conjugated polyenes, Effect of hydrogen bonding and solvent effects-NMR-Shielding mechanism, mechanism of measurement, chemical shift values, chemical exchange, complex spin-spin interaction, <sup>13</sup>C NMR spectroscopy, chemical shift-Mass spectral fragmentation of organic compounds, common functional groups, molecular-ion peak, metastable peak,

## 9. BOTANY

### CELL AND MOLECULAR BIOLOGY OF PLANTS

**Cell Wall** : Structure and functions, biogenesis, growth.

**Plasma membrane** : Structure, models and functions : Sites for ATPases, Ion carriers, Channels and pumps, Receptors.

**Plasmodesmata** : Structure, Role in movement of molecules and macromolecules, Comparison with gap junctions.

**Chloroplast** : Structure, genome organization, gene expression, RNA editing, nucleo-chloroplastic interactions.

**Mitochondria** : Structure, genome organization, Biogenesis.

**Plant Vacuoles** : Tonoplast membrane, ATPases, transporters, as storage organelle.

**Nucleus** : Structure, nuclear pores, nucleosome organization, DNA structure : A, B and Z forms, replication, damage and repair, transcription, Plant promoters and transcription factors, splicing mRNA transport, nucleolus, rRNA biosynthesis.

**Ribosomes** : Structure, site of protein synthesis, mechanism of translation, initiation, elongation and termination; structure and role of tRNA.

**Protein sorting** : Targeting of proteins to organelles.

**Cell shape and motility** : The cytoskeleton; organization and role of microtubules and microfilaments; motor movements; implications in flagellar and other movements.

**Cell cycle and apoptosis** : Control mechanisms; role of cyclins and cyclin dependent kinases; retinoblastoma and E2F proteins; cytokinesis and cell plate formation; mechanisms of programmed cell death.

**Other cellular organelles** : Structure and functions of microbodies, Golgi apparatus, lysosomes, endoplasmic reticulum.

**Techniques in cell biology** : Immuno techniques; in situ hybridization, FISH, GISH; confocal microscopy.

### CYTOLOGY, GENETICS AND CYTOGENETICS

**Chromatin organization** : Chromosome structure and Packaging of DNA, molecular organization of centromere and telomere; nucleolus and ribosomal RNA genes ; euchromatin and heterochromatin ; karyotype analysis ; banding patterns ; specialized types of chromosomes ; polytene, lampbrush, B-chromosomes and sex chromosomes ; molecular basis of chromosome pairing.

**Structural and numerical alterations in chromosomes** : Duplication, deficiency, inversion and translocation ; autopolyploids ; allopolyploids ; evolution of major crop plants.

**Genetics of prokaryotes and eukaryotic organelles** : genetic recombination in phage ; genetic transformation, conjugation and transduction in bacteria ; genetics of mitochondria and chloroplasts cytoplasmic male sterility.

**Gene structure and expression** : Genetic fine structure ; cis – trans test ; Benzer's experiment; introns and their significance ; RNA splicing ; regulation of gene expression in prokaryotes and eukaryotes.

**Genetic recombination and genetic mapping** : Recombination ; independent assortment and crossing over ; molecular mechanism of recombination ; role of RecA and RecBCD enzymes ; site-specific recombination ; chromosome mapping, linkage groups, genetic markers, construction molecular maps.

**Mutations** : Spontaneous and induced mutations ; physical and chemical mutagens ;

molecular basis of gene mutations ; transposable elements in prokaryotes and eukaryotes ; mutations induced transposons ; site-directed mutagenesis ; DNA damage and repair mechanisms.

**Plant Breeding** : Principles and methods of plant breeding ; Marker assisted breeding.

**Biostatistics** : Mean, Variance, Standard deviation, Standard error, Student's 't' test, chi-square and ANOVA.

**Molecular cytogenetic** : Nuclear DNA content; C-value paradox; cot curve and its significance; restriction mapping – concept and techniques ; multigene families and their evolution.

### **BIOLOGY AND DIVERSITY OF LOWER PLANTS : CRYPTOGAMS**

**Microbiological techniques** : Pure culture, enrichment and anaerobic culture.

**Importance of microorganisms** : Microbes in medicine, agriculture and environment.

**Microbial growth** : Nutritional requirements of microorganisms and methods to measure growth.

**Microbial Ecology** : Nitrification ; phosphorous solubilization ; nitrogen fixation

**Phycology** : Thallus organization ; cell ultra structure ; reproduction (vegetative, sexual, asexual) ; criteria for classification of algae : pigments, reserve food, flagella ; classification, salient features of Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta ; algal blooms, algal biofertilizers ; algae as food, feed and uses in industry.

**Mycology** : General characters of fungi ; substrate relationship in fungi ; cell ultrastructure ; unicellular and multicellular organization ; cell wall composition ; nutrition (saprobic, biotrophic, symbiotic) ; reproduction (vegetative, asexual, sexual) ; heterothallism ; heterokaryosis parasexuality ; Molecular aspects in classification.

General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina ; fungi in industry, medicine and as food ; fungal diseases in plants and humans ; Mycorrhizae ; fungi as biocontrol agents.

**Bryophyta** : Morphology, structure, reproduction and life history ; distribution ; classification, general account of Marchantiales, Junger maniales, Anthocerotales, Sphagnales, Funariales and Polytrcales ; economic and ecological importance.

**Pteridophyta** : Morphology, anatomy and reproduction ; classification ; evolution of stele ; heterospory and origin of seed habit; general account of fossil pteridophyta ; introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

### **TAXONOMY AND DIVERSITY OF SEED PLANTS**

#### **Introduction and classification of Gymnosperms**

**Structure and reproduction in** Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales.

**The species concept:** Taxonomic hierarchy, species, genus, family and other categories ; principles used in assessing relationship, delimitation of taxa and attribution of rank.

Salient features of the International Code of Botanical nomenclature.

**Taxonomic tools** : Herbarium ; floras ; histological, cytological, phytochemical, serological, biochemical and molecular techniques ; computers and GIS.

**Systems of angiosperm classification** : Phenetic versus phylogenetic systems ; cladistics in taxonomy ; relative merits and demerits of major systems of classification.

**Concepts of phytogeography** : Endemism, hotspots; plant explorations; invasions and introductions.

## **PLANT PHYSIOLOGY AND METABOLISM**

**Energy flow** : Principles of thermodynamics, free energy and chemical potential, redox reactions, structure and functions of ATP.

**Fundamentals of enzymology** : General aspects, allosteric mechanism, regulatory and active sites, isoenzymes, kinetics of enzymatic catalysis, Michaelis – Menton equation and its significance.

**Membrane transport and translocation of water and solutes** : Plant water relations, mechanism of water transport through xylem, passive and active solute transport, membrane transport proteins.

**Signal transduction:** Receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, calcium calmodulin cascade, diversity in protein kinases and phosphatases.

**Photochemistry and photosynthesis** : Photosynthetic pigments and light harvesting complexes, photo oxidation of water, mechanisms of electron and proton transport, carbon assimilation – the Calvin cycle, photorespiration and its significance, the C<sub>4</sub> cycle, the CAM pathway, biosynthesis of starch and sucrose.

**Respiration and lipid metabolism** : Glycolysis, the TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylate cycle, alternative oxidase system, structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipids, structural lipids and storage lipids and their catabolism.

**Nitrogen fixation and metabolism** : Biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation.

**Photobiology** : Photochromes and cryptochromes, photophysiology of light –induce responses, cellular localization.

**Plant growth regulators and elicitors** : Physiological effects and mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, polyamines, jasmonic acid and salicylic acid.

**The flowering process** : Photoperiodism, endogenous clock and its regulation, floral induction and development – genetic and molecular analysis, role of vernalization.

**Stress physiology** : Plant responses to biotic and abiotic stress; mechanisms of biotic and abiotic stress tolerance, HR and SAR, water deficit and drought resistance, salinity stress, metal toxicity, freezing and heat stress, oxidative stress.

**Coping with biotic stress** : Chemical control, Biological control, IPM

## **PLANT DEVELOPMENT AND REPRODUCTION**

**Shoot development** : Organization of the shoot apical meristem (SAM); control of cell division and cell to cell communication; control of tissue differentiation especially xylem and phloem ; secretory ducts and laticifers.

### **Phyllotaxy and leaf differentiation**

**Root development** : Organization of root apical meristem (RAM); cell fates and lineages; vascular tissue differentiation; homeotic mutants in Arabidopsis and Antirrhinum, sex determination.

**Male gametophyte:** Structure of anthers; microsporogenesis, role of tapetum; pollen development and gene expression; male sterility; sperm dimorphism and hybrid seed production; pollen germination, pollen tube growth and guidance ; pollen storage ; pollen allergy, pollen embryos.

**Female gametophyte:** Ovule development; megasporogenesis; organization of the embryo sac, structure of the embryo sac cells.



**Pollination, pollen – pistil interaction and fertilization** : Floral characteristics, pollination mechanisms and vectors; self-incompatibility; double fertilization.

**Seed development and fruit growth**: Endosperm development during early, maturation and desiccation stages; embryogenesis, cell lineages during late embryo development; storage proteins of endosperm and embryo; polyembryony; apomixes; embryo culture; fruit maturation.

**Dormancy**: Seed dormancy; overcoming seed dormancy; bud dormancy.

**Senescence and programmed cell death (PCD)**: Types of cell death, PCD in the life cycle of plants, metabolic changes associated with senescence and its regulation; influence of hormones and environmental factors on senescence.

### **PLANT ECOLOGY**

**Climate, soil and vegetation patterns of the world**: Life zones; major biomes and major vegetation and soil types of the world.

**Vegetation organization**: Concepts of community and continuum ; analysis of communities (analytical and synthetic characters)

**Ecological succession**: Hydrosere and xerosere.

**Ecosystem organization**: Structure and functions; primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow Pathways, ecological efficiencies); litter fall and decomposition (mechanism, substrate quality land climatic factors); global biogeochemical cycles of C,N,P and S; mineral cycles (pathways, processes, budgets) in terrestrial and aquatic ecosystems.

**Biological diversity**: Concept and levels; role of biodiversity in ecosystem functions and stability ; speciation and extinction; IUCN categories of threat; distribution and global patterns, terrestrial biodiversity hot spots; inventory.

**Air, water and soil pollution**: Kinds, sources, quality parameters; effects on plants ecosystems.

**Climate change**: Green house gases (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, CFCs: sources, trends and role); ozone layer and ozone hole ; consequences of climate change (CO<sub>2</sub> fertilization, global warming, sea level rise, UV radiation).

**Ecosystem stability** : Concept (resistance and resilience); ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems ; ecology of plant invasion ; environmental impact assessment ; ecosystem restoration.

**Ecological management** : Concepts; sustainable development; sustainability indicators.

### **PLANT RESOURCE UTILIZATION AND CONSERVATION**

#### **Plant Biodiversity and sustainable development**

**Origin, evolution, botany, cultivation and uses of** (i) Food forage and fodder crops (ii) fibre crops (iii) medicinal and aromatic plants and (iv) vegetable oil-yielding crops. Ethnobotany

**Important fire-wood and timber – yielding plants and non-wood forest products (NWFPs)** such as bamboos, rattans, raw materials for paper-making, gums, tannins, dyes, resins and fruits.

**Green revolution** : Benefits and adverse consequences.

**Plants used as avenue trees** for shade, pollution control and aesthetics.

Principles of conservation; extinctions; environmental status of plants based on International Union for Conservation of Nature.

**Strategies for conservation – in situ conservation** : International efforts and Indian initiatives ; protected areas in India – sanctuaries, national parks, biosphere reserves, wetlands,

mangroves and coral reefs for conservation of wild biodiversity.

**Strategies for conservation – ex situ conservation :** Principles and practices; botanical gardens, field gene banks, seed banks, in vitro repositories, cryobanks; general account of the activities of Botanical Survey of India (BSI), National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Council of Scientific and Industrial Research (CSIR) and the Department of Biotechnology (DBT) for conservation, non-formal conservation efforts.

### **BIOTECHNOLOGY AND GENETIC ENGINEERING OF PLANTS AND MICROBES**

**Plant Biotechnology –** Principles, scope and applications.

**Plant cell and tissue culture :** General introduction, scope, cellular differentiation, and totipotency.

**Organogenesis and adventives embryogenesis :** Morphogenesis; somatic embryogenesis.

**Somatic hybridization :** Protoplast isolation, fusion and culture.

**Applications of plant tissue culture :** Clonal propagation, artificial seed, production of hybrids and soma clones, production of secondary metabolites / natural products, cryopreservation and germplasm storage.

**Recombinant DNA technology :** Gene cloning principles and techniques, genomic / c DNA libraries, vectors, DNA synthesis and sequencing, polymerase chain reaction, DNA fingerprinting and DNA markers.

**Genetic engineering of plants :** Transgenic plants, Methods of gene transfer – *Agrobacterium* – mediated and microprojectile, chloroplast transformation, intellectual property rights, ecological risks and ethical concerns.

**Microbial genetic manipulation :** Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes.

**Genomics and proteomics :** High throughput sequencing, genome projects, bioinformatics, functional genomics, microarrays.

## **10. ZOOLOGY**

### **General Concepts :**

1. Levels of structural organization : Unicellular, colonial and multicellular forms. Prokaryotic and Eukaryotic cells. Levels of organization of tissues, organs & systems.
2. Acoelomata, Pseudocoelomata, Coelomata, Proterostomia and Deuterostomia.
3. Concepts of species and hierarchical taxa, biological nomenclature, classical methods of taxonomy of animals.

### **Non-Chordata :**

1. General characteristics and classification of invertebrates up to class level.
2. Protozoa: Locomotion, Nutrition and Reproduction in protozoa, Protozoan diseases of man.
3. Porifera: Canal system in porifera, skeleton in porifera, Reproduction in sponges.
4. Coelenterata : Polymorphism, Metagenesis, coral formation, Etenophora.
5. Hemlinths: Common Helminthic parasites of Man – *Taenia solium*, *Schistosoma sp.*, *Ascaris*, *Ancylostoma*, *Oxyuris*, *Loa*, *Trichinella*, *Strongyloides* – their life cycles. Parasitism and parasitic adaptations.
6. Annelida: Excretory system, Coelom formation, coelom and coelomoducts.
7. Arthropoda: Mouthparts of Insects, useful and harmful insects, Metamorphosis in insects. Apiculture and sericulture in India, crustacean larvae.
8. Mollusca: Respiration, Torsion and De-torsion, pearl formation and Pearl industry.
9. Echinodermata: Echinoderm larvae, Water vascular system.

**CHORDATA :**

1. General Characters and classification of chordates upto class, Origin of Chordates, phylogeny and affinities of Hemichordata, Retrogressive metamorphosis.
2. Vertebrate integument and derivatives, Comparative account of Digestive, Respiratory, Circulatory, Excretory and Reproductive systems of Vertebrates.
3. Pisciculture in India, Common edible fishes of Andhra Pradesh.
4. Origin and evolution of Amphibia, Paedogenesis, Neotony.
5. Important Snakes of India, Dinosaurs.
6. Flight adaptations and Migration in birds. Archeopteryx, Poultry in India.
7. Adaptive radiation and Dentition in Mammals.

**CELL BIOLOGY :**

1. Prokaryotic and Eukaryotic cell, Plasma Membrane-Ultrastructure, Permeability, intercellular communication, Endocytosis, Exocytosis, Phagocytosis, Active transport, membrane pumps.
2. Structure & function of Intracellular organelles – Nucleus, Mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, Cell wall, Cytoskeleton and its role in motility.
3. Organization of genes and chromosomes - Operon, unique and repetitive DNA, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons.
4. Cell division and cell cycle - Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.
5. DNA replication, repair and recombination - Unit of replication, replication origin and replication fork, Recombinant technology, Transgenic and cloned animals, DNA damage and repair mechanisms.
6. Protein synthesis - initiation, elongation and termination of Genetic code.
7. Regulation of gene expression - Lac operon, Lambda operon.

**GENETICS :**

1. Mendel's law of inheritance - Critical review and Linkage.
2. Gene mapping methods : Linkage-complete and Incomplete linkage; Linkage maps, Recombination, mapping with molecular markers, somatic cell hybrids.
3. Crossing over : Types (Somatic or mitotic crossing over and Germinal or meiotic crossing over), theories about the mechanism of crossing over, tetrad analysis, and cytological detection of crossing over.
4. Mutations : Types (Spontaneous and Induced), causes and detection, mutant types (lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants), Molecular basis of mutations.
5. Chromosomal aberrations (deletion, duplication, inversion and translocation, ploidy and their genetic implications); Autosomal abnormalities (Down's syndrome, Trisomy 13, -18); Sex anomalies (Turner's syndrome, Klinefelter's syndrome, Hermaphroditism).
6. Human genetics : Human karyotyping, Genetic disorders due to mutant genes (Huntington's chorea), Inborn errors of metabolism-Pheynylketonuria, alkaptonuria, Sickle cell anemia.

**SYSTEM AND CELL PHYSIOLOGY :**

1. Blood and circulation - Blood corpuscles, haemopoiesis, plasma function, blood groups, haemoglobin, haemostasis.
2. Cardiovascular System : Neurogenic, myogenic hearts, cardiac cycle, heart as a pump, neural and chemical regulation of all above.
3. Respiratory system - Transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.
4. Nervous system - Neurons, action potential, Conduction of nerve impulse, synapse, Neurotransmitters.
5. Muscle : Ultraa structure and mechanism of muscle contraction.
6. Sense organs – Eye, Ear.

7. Excretory system - Comparative physiology of excretion, urine formation, micturition.
8. Osmoregulation – Osmoregulation in fishes, Hormonal control of osmoregulation.
9. Digestive system - Digestion, absorption, assimilation and egestion.
10. Endocrinology and reproduction - Endocrine glands, basic mechanism of hormone action, hormones and diseases, reproduction in mammals.
11. Chemical bonds (Covalent, Hydrogen and Ionic bonds, Van der waals interactions).
12. Outline classification of organic compounds (carbohydrates, proteins and lipids).
13. Order of protein structure, primary, secondary, tertiary and quaternary; Ramachandran plot.
14. Glycolysis, TCA cycle and their Biomedical importance. Pentose phosphate pathway, Gluconeogenesis. Redox Potentials, Mitochondrial electron transport system, Oxidative phosphorylation.

#### **EVOLUTION :**

1. Origin of life - Modern concepts, theories of Evolution.
2. Isolation, Speciation, Natural Selection.
3. Hardy weinberg' Law.
4. Population Genetics (Gene pool, Gene frequency), Genetic drift and convergent evolution, Adaptive radiation.
5. Evolution of Man.
6. Zoogeographical realms of the world.

#### **DEVELOPMENTAL BIOLOGY :**

1. Speamatogenesis, oogenesis.
2. Fertilization, cleavage, gastrulation formation of germ layers, parthenogenesis.
3. Embryogenesis in vertebrates.
4. Formation and function of foetal membranes.
5. Types of Placenta.
6. Regualtion, genetic control of development.
7. Development of Frog and chick.

#### **HISTOLOGY :**

1. Histology of Mammalian tissues and organs - Epithelial, connective, blood, bone, cartilage, skin, stomach, intestine, liver, pancreas, kidney, Testis and Ovary.

#### **ECOLOGY :**

1. Concept of Ecosystem.
2. Biogeochemical cycles (Carbon, Nitrogen and Phosphorous).
3. Influence of environmental factors on animals, energy flow in Ecosystem, food chains, food web and trophic levels.
4. Community and population ecology. Ecological succession.
5. Environmental pollution-Air, water, land, noise, radioactive, thermal and visual, effects of pollution on ecosystem, prevention of pollution.
6. Wildlife in India-conservation, Chipko movement.
7. Biodiversity-Economic significance, conservation, hot spots of India.

#### **IMMUNOLOGY :**

1. Cells of the immune system : Lymphoid cells, Mononuclear cells, granulocytic cells, Mast cells.
2. Organs of the immune system - primary and secondary lymphoid organs, lymphatic system.
3. Antigens: Antigenic determinants or epitopes, immunogenicity, Haptens.
4. Innate (Non-specific immunity): Anatomical barriers, phagocytosis, NK cells, interferon.
5. Humoral immunity: Immunoglobulins (fine structure of immunoglobulins and immunoglobulin classes); the complement system, Classical and alternate pathway, inflammation.
6. Cell mediated immunity : Mechanism of cell mediated immunity; Brief account on Antigen presentation, Major histocompatibility complex.
7. Antigen-Antibody interactions : Affinity, Avidity, Cross-reactivity, precipitation reactions, and Agglutination reactions and ELISA.
8. Brief account on immunological Hypersensitivity disorders :
  - a) Tolerance and Autoimmunity
  - b) Transplantation.
  - c) Immunodeficiency diseases - HIV.
  - d) Immunization (Active and passive immunity).

## 11.ECONOMICS

1. **Microeconomic Analysis**  
Demand analysis – Marshallian, Hicksian and Revealed preference approaches; axiomatic approach Theory of Production and Costs Pricing and output under different forms of market structure; collusive and non-collusive oligopolies. Factor Pricing analysis. Elements of General Equilibrium analysis and new welfare economics.
2. **Macroeconomic Analysis**  
National income accounting – basic concepts. methods of estimation. Determination of output and employment – Classical approach, Keynesian approach. Real balance effect – Patinkin and Pigou. Theories of inflation. Phillips Curve analysis. Business cycles – Models of Samuelson, Hicks and Kaldor. IS-LM Analysis - Relative roles of monetary and fiscal policies. Mundell-Fleming open economy model. Rational expectations; new classical / tenets.
3. **Development and Growth**  
Development and Growth – Role of institutions.  
Theories of growth and development – Models of growth of Joan Robinson and Kaldor; Technical Progress – Hicks, Harrod and learning by doing, production function approach to the determinants of growth ; Endogenous growth : role of education, research and knowledge – explanation of cross country differentials in economic development and growth.  
Theories of development – Classical, Marx, Schumpeter and structural analysis of development – Imperfect market paradigm, Lewis model of development, Ranis-Fei model, Dependency theory of development.  
Factors in economic development – natural resources, population, capital, human resource development – Measurement of development – Conventional, HDI and Quality of Life indices.  
Trade and development – trade as engine of growth, two-gap analysis, Prebisch, Singer and Myrdal views; gains from trade and LDCs.
4. **Money and Banking**  
Definition and functions of money; empirical definition of money – monetary aggregates; monetarism; demand for money – Fisher, Cambridge, Keynesian, Friedman, Baumol and Tobin; supply of money – determinants; money multiplier. Role and functions of Central bank; NBFIs; instruments of monetary control; stabilization polices; monetary and interest rate targetting.  
Social responsibility of banks; banking sector reforms, Basel I and II; deregulation, competition and efficiency; NPAs. Specialized financial and investment institutions.
5. **Public Finance**  
Role of government in a mixed economy – allocation, distribution and stabilization. Private, public and merit goods. Theories of Social choice. Theories of taxation, types, incidence and effects. Theories of public expenditure – effects on savings, investment and growth Burden of public debt; Wagner and Peacock – Wiseman hypotheses. Union Finance – Trends in Revenue and Expenditure of the Government of India. State Finance – Trends in Revenue and Expenditure of the State Governments. Public Debt – Effects and Burden and Management of public debt. Government Budget – Forms of Budgeting, Zero based budgeting, Different Budget deficits. Fiscal Federalism – Horizontal and vertical imbalances; methods of fiscal adjustment.
6. **International Trade and Finance**  
Theories of International Trade : Empirical verification and relevance. International Trade under Imperfect competition. Terms of Trade and Economic Growth – Secular Deterioration of Terms of Trade Hypothesis – a critical review. Equilibrium / disequilibrium in Balance of Payment – Traditional, Absorption and monetary approaches to adjustment in Balance of Payments. Impact of Tariffs on Partial and general equilibrium analysis; Political economy of Non-Tariff Barriers. Theory of regionalism at Global level – Trade blocks – SAARC and ASEAN. Trade Policy and Reforms in India. Optimum currency areas – Euro - ERM
7. **Indian Economy :**  
Basic features of Indian economy; growth and structural changes – composition and trends in National Income.  
Demography – Demographic features; demographic transition and demographic dividend; rural urban migration and rural urban divide.  
Planning : Objectives and strategies of planning; and achievements of programmes for

poverty alleviation and regional imbalances.

Agriculture : Land reforms and New Green Revolution – Role of technology; regional disparities in Indian agriculture; Pricing Policy; Food subsidy and Public distribution system.

Industry : Industrial growth and Productivity – New industrial policy; Privatisation, Disinvestment – FDI and role of MNCs. SMEs and industrial development.

Public Finance : Composition and growth of public expenditure and debt; Fiscal reforms and rationalization of subsidies; Centre – State financial relations.

WTO and its impact on Indian economy; Energy and Environment: Energy Security; Environmental Policy of Government of India, Rationale of Social Forestry.

## 8. **QUANTITATIVE METHODS :**

### a. **Statistical Methods**

Measures of Central tendency, dispersion, skewness and kurtosis

Fundamentals of probability – Binomial, Poisson and Normal distributions. Simple correlation and regression analysis

Statistical inferences – Applications, sampling distributions ( t, Chi-square and F tests),

Sampling of attributes, testing of hypothesis Index numbers and time series analysis

Sampling and census methods, types of sampling and errors.

### b. **Econometric Methods :**

#### i) Single Equation Linear Model :

Assumption and properties of OLS

Multiple Regression Model – Estimation and Interpretation

Multi-collinearity, auto-correlation and heteroscedasticity – Causes, detection, consequences and remedy.

Dummy variables, distributed lags – need, limitations and interpretation

Applications in economics.

#### ii) Simultaneous Equation Models :

Structural and reduced forms, Endogenous and exogenous variables, Identification problems and conditions.

Single equation methods of estimations – two stage least squares, indirect least squares, and least variance ratio.

### c. **Time Series Models**

Auto-regressive (AR), moving average (MA) and mixed processes (ARMA, ARIMA)

Concepts of unit root, integration and cointegration, random walks.

### d. **Mathematical Methods**

#### i) Principles of optimization : maxima and minima of functions of a single variable.

ii) Basic concepts of Game Theory – Two-person, Zero-sum Game, Pure and Mixed strategy, Saddle point solution, Linear programming and input output analysis.

## 12. CIVICS

### **Common Syllabus: Public Policy and Research Methodology**

#### **I. (A) Public Policy**

a) Nature, Scope and Importance of Public Policy, Public Policy as a Policy Science.

b) Theories / Models : Systems, Structural – Functional Incremental, Elite, Group, Rational Comprehensive.

c) Public Policy Making: Legislature, Executive Judiciary, Bureaucracy, Political Parties, Pressure Groups, NGOs

d) Policy Evaluation & Impact: Constraints.

#### **I. (B) Research Methodology**

a) Methods of Enquiry: Traditional and Scientific Methods, Objectivity in Social Science Research

b) Types of Research Design

c) Hypothesis

- d) Methods of Data Collection: Library, Interview, Observation
- e) Data Processing, Report Writing.

## **II. Public Administration**

- a) Definition, Meaning, Nature, Scope and Importance of Public Administration
- b) Evolution of Public Administration Theories: Classical, Human Relations and System Approach
- c) Union Government: President, Prime Minister and Council of Ministers, Parliament, Judiciary
- d) State Government: Governor, Chief Minister and Council of Ministers, State Legislative, Judiciary (High Court and Subordinate Court)
- e) Local Government: Panchayati Raj Institutions, Gram Panchayat, Mandal Parishad, Zilla Parishad
- f) Impact of 73<sup>rd</sup> and 74<sup>th</sup> Constitutional Amendments on Panchayati Raj Institutions

## **III. Political Science**

- a) Definition, Meaning, Nature, Scope and Importance of Political Science
- b) State : Essential Elements : Theories of Origin of State
- c) Sphere of State Activity : Laissez Fair, Welfare, Fascist, Anarchist, Socialist, Marxist
- d) Basic Concepts : Law, Liberty, Equality, Justice and Rights
- e) Forms of Government : Unitary, Federal, Presidential and Parliamentary
- f) Theory of Separation of Powers
- g) India's Foreign Policy – Determinants and Features, Non-Alignment and U.N.O.

## **13. HISTORY**

### **Ancient India :**

1. Pre and protohistoric background – Stone ages and Chalcolithic cultures.
2. Harappan Civilization – Extent, major cities, characteristic features, social and economic conditions, script, religious practices, causes for the decline.
3. Iron Age – Aryan migration – Second urbanization.
4. Vedic Age : Importance literature, Political, Social and economic conditions in the early and later vedic age.
5. India in the 6<sup>th</sup> century B.C. : Political, Social and economic conditions, Rise and spread of Jainism and Buddhism.
6. Mauryan Age : Political history of the Mauryans, Ashoka, Mauryan Administration, social and economic conditions, decline of the Mauryan empire.
7. The Satavahanas : Political history, administration, contribution to the culture.
8. Gupta Period : Political history, administration, social and economic conditions, growth of culture, decline of the empire.
9. India in the 7<sup>th</sup> century A.D. : Harsha Vardhana, Pallavas and Chalukyas, Rashtrakutas their political history and their contribution to culture.

### **Medieval India:**

10. India between 650 and 1200 A.D. – Political, social and economic conditions, Chola administration and culture.

11. Age of the Delhi Sultanate : (1206-1526), Political history, Military and Administrative organisation, changes in society and economy, Bhakti movement.
12. The Vijayanagar Empire : Origin, History, Krishnadevaraya, social and economic conditions, contribution to art and architecture, decline.
13. Mughal Age (1556-1707) : Political history, Akbar, Administration, Social and economic conditions, culture, decline of the Mauryan empire, Marattas and Shivaji.

**Modern India (1757-1947) :**

14. Historical forces and factors which led to the establishment of the British power in India – Early resistance to the British power in India – Hyder Ali, Tippu Sultan, causes for their failure.
15. Evolution of British paramountcy in India : Policies of Wellesley and Dalhousie – Economic policies of the British.
16. Socio-religious reform movements – Rajaram Mohan Roy, Dayananda Saraswathi and others – Educational policies of the British and their impact on Indian society.
17. Revolt of 1857: Causes, results, significance.
18. Rise and growth of the Indian National Movement : Birth of the Indian National Congress, the national movement from 1885 to 1905; movement from 1905 to 1920. Role of Tilak and Annie Besant :The movement from 1920 to 1947 ; Emergence of Gandhi; Non-cooperation movement, Salt Satyagraha and the Quit India Movement.

Freedom movement in Andhra Pradesh with special reference to the role of Alluri Sitarama Raju and Tanguturi Prakasam, Revolt against the nizam's rule in Telangana.

**Modern World :**

19. Industrial Revolution – Significance and results.
20. American War of Independence – course, results, significance.
21. French Revolution – course, effects, significance.
22. National liberation movements in Italy and Germany in the 19<sup>th</sup> century – Mazzini, Cavour, Garibaldi, Bismarck.
23. World War-I – Causes and effects.
24. The Russian Revolution of 1917 – Causes, results and importance.
25. The World between the two world wars – Nazism in Germany, Fascism in Italy, Turkey under Mustafa Kamal Pasha.
26. Developments in China 1911-1949 – Nationalist Revolution of 1911 – Communist Revolution of 1948.
27. World War-II – Causes and effects.

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**SCHEME & SYLLABUS OF EXAMINATION OF THE COMPUTER PROFICIENCY TEST (CPT)**

**Scheme for Computer Proficiency Test**

(As per G.O.Ms.No.26, G.A. (Ser.B) Dept., dt: 24.02.2023)

<b>Scheme of the examination (Practical Type)</b>					
Test	Duration (Minutes)	Maximum Marks	Minimum Qualifying Marks		
			SC/ST/PH	B.C's	O.C's
Proficiency in Office Automation with usage of Computers and Associated Software.	60	100	30	35	40

**Syllabus for Computer Proficiency Test**

**PART-A**

- 1. INTRODUCTION TO COMPUTERS:** Introduction to Computers - Components and their classification - Peripheral devices and their purpose. Input Devices - Keyboard, Mouse, Scanner, Lighten, Touch screens, Joystick, Micro phone, Scanner, Digital camera, Bar code reader, Biometric sensor Output Devices: Display devices, Printers, Monitor, Speaker, Plotter, Secondary Storage Devices – Feature- Driven Development (FDD), Magnetic tape, Universal Serial Bus(USB), Pen Drives, Disks - The Role of input Processing / output processing devices - Computing Concepts - Data - Information – Random Access Memory (RAM) – Read-Only Memory(ROM) - Control Unit - Memory Unit – Arithmetic Logic Unit(ALU).
- 2. COMPUTER SOFTWARE TYPES:** System Software, Application Software, Embedded software, Proprietary Software, Open source software (their purpose and characteristics only).
- 3. OPERATING SYSTEM:** Purpose of operating system, Single User and Multi User Operating Systems with Examples.
- 4. WINDOWS OPERATING SYSTEM:** Interfacing Graphical User Interface (GUI), Differences between Criminal Interdiction Unit(CUI) and Graphical User Interface(GUI) - working With Files and Folders - More About Files - Running An Application Through The File Manager - Running an Application Through The Program Manager - Setting up of Printer, Webcam, Scanner and other peripheral devices,
- 5. LINUX/MAC OS (only basic concepts):** Introduction to Linux - Features and advantages of Linux, File handling commands, directory handling commands - User Management - File permissions Media Access Control Address(MAC) OS - Introduction - Advantages of Media Access Control Address(MAC) OS . Basics commands
- 6. INTERNET CONCEPTS (only basic concepts):** Minimum Hardware and Software Requirements for a system to use internet, Communication Protocols and Facilities - Various browsers - What is Internet Protocol(IP) Address - Steps required in connecting system to network - Uploading and Downloading Files from Internet
- 7. ELECTRONIC MAIL (only basic concepts):** Sending and receiving mails, Basic E-Mail Functions, Using your word processor for E-mail, Finding E-Mail Address, Mailing Lists and lists Servers.
- 8. WORLD WIDE WEB (only basic concepts):** WWW advantages of the Web - how to navigate with the Web - Web Searching.

**PART – B**

- 1. OFFICE SUITE:** MSOFFICE or any open source office like Libre Office /Apache Open Office Neo office for Windows/Linux/Media Access Control Address (MAC)OS.
- 2. GETTING STARTED WITH OFFICE:** Introduction to Office Software- Starting and Exiting the Office Applications - Introducing the Office Shortcut Bar - Customizing Office Shortcut Bar.
- 3. FILE OPERATIONS IN THE OFFICE:** Common Office Tools and Techniques - Opening an Application - Creating Files - Entering And Editing Text - Saving Files - Opening Files - Closing a File - Exiting The Application - Managing Your files With The Office Applications.
- 4. TOOLS IN THE OFFICE APPLICATIONS:** Key Combinations - Cut, Copy and Paste - Drag And Drop Editing - Menu Bars And Toolbars - Undo and - Redo - Spell Checking - Auto Correct - Find and Replace - Help And The Office Assistants - Templates and Wizards.
- 5. WORD PROCESSING (MS WORD or its equivalent in Libre office /Apache Open Office / Neo office for Windows/s/Linux/Mac OS):** Starting Word

- Title Bar - Menu Bar - Format Bar - Standard Bar - Ruler - Workspace Area - Scroll Bar - Status Bar - Different Toolbars - Option a Menu Bar - Creating New Document When Word is Running - Opening Pre existing Documents When Word is Running - Designing Your Document - Typing Text - Selection text - Deleting Text - Formatting text and document - copying and moving - Saving Document - Page Setup - Properties of a document - Undo-Redo-Cut-Copy a Document - Pasting a Document - Print Preview - Printing - Select All - Find - Replace - Go To - Four Different View Of A Document - Normal, Web Layout, Print Layout, and Outline Layout- Document Map - Full Screen - Zoom - Objects - Page Break - Header and Footer - Page Number - Auto Format - Auto Text - Inserting Date And Time - Working With Header, Footers- footnotes-Fields-Symbols-Caption Cross Reference-Index-Tabs-Table and Sorting - Working With Graphics - Inserting Pictures - Modifying Pictures - Word Art - Inserting Chart - Inserting Files - Hyper Linking - Bookmark - Using Different Fonts - Paragraph – Bullets Borders and Shading- Columns-Drop Cap-Theme-Change Case Background-Frames-Style-Spelling And Grammar - Set Language - Word Count - Auto Summarize - Auto Correct - Merge Document - Protect Document - Envelopes And Labels - - Templates, Wizards And Sample Documents - drawing Tables - Merge Cell - Spilt Cells - Spilt Table - Table Auto Format - Auto Fit - Sort - Formula - Arrange All-Split- Micro Soft Word Help - Macros - Custom Toolbars - Keyboard Shortcuts - Menus - Mail Merge.

**6. SPREAD SHEET (MS Excel or its equivalent in Libre Office / Apache Open Office / Neo office for Windows/s/Linux/ Mac OS):**

Features Of Excel - Excel worksheet - Selecting Cell - Navigating With The Mouse And Keyboard - Entering And Editing Text - Text Boxes - Text Notes - Checking Spelling - Undoing And Repeating Action - Entering And Editing Formulas - Referencing Cells - Order Of Evolution in Formulas - Copying Entries And Equations To Minimize Typing - More Auto Fill Examples - Creating Custom Fill Lists Protecting And Un Protecting Documents And Cell - Creating A New Worksheet - Excel Formatting Tips And Techniques - Moving cell - Copying Cells - Sorting Cell Data - Insertion Cells Inserting As You Paste - Deleting Parts Of Worksheet - Clearing Parts Of A Worksheet - Excel Page Setup - Changing Column Width And Row Heights - Auto Format - Manual Formatting - Using style - Format Code Alter A Number's Appearance - Format Painter Speeds-Up Format Copying - Changing Font Size And Attributes - Adjusting Alignments - Centering Text Across Column - Using Border Buttons And Commands - Changing Color And Shading - Inserting And Removing Page Breaks - Hiding Rows And Columns - Rearranging Worksheet - Entering Formula - Excel Functions - Inserting Rows And Columns - Saving A Worksheet - Printing A Worksheet - Printing Tips For Large Excel Project - Parts Of A Function - Functions Requiring Add-ins - Function Wizard - Example Of Functions By Category - Organizing Your Data - Excel's Chart Features - Chart Parts And Terminology - Instant charts with The chart wizard - Creating Chart On Separating Worksheets - Resizing And Moving Charts - Adding Chart Notes And Arrows - Editing Charts - Rotating 3-D Charts - Printing Charts - Deleting Charts Setting The Default Chart Type - Creating Trend Lines Data Map - Working With Graphics in Excel - Creating And Pacing Graphic objects - Resizing Graphs - Possible Sources Of Excel Graphics - Creating and Running Macro - Sorting Excel Data - Adding Subtotals To Databases - Customizing Excel - Customizing Workspace – Comma Separated Value (CSV) File format - Using Worksheet As Databases.

**7. PRESENTATION SOFTWARE (MS Power Point or its equivalent in Libre Office/Apache Open office/Neo office for Windows/s/Linux/Mac Os):**

Introduction - Starting Presentation Software - Views in Presentation Software - Slides - Terminology - Color Schemes - Formatting Slides - Creating a Presentation - Using the Auto Content Wizard - Masters- - Using a Template - Creating a Blank Presentation - Working with Text in Power Point - Adding Slides Editing And Working Text - Working in Outlaying view – Spell checking - Finding And Replacing Text - Formatting Text - Aligning Text - Developing Your Presentation - Importing images From The Outside World - The Clipart Gallery - Drawing in Presentation software- Bringing A Presentation to Life - Inserting Objects in Your Presentation - Inserting A Picture - Working With Graphics - Multimedia in Power Point - Animating The Objects, Pictures, Graphics, - Enhancements to the Slide Show Showing Slides Out Of Order Printing Presentation Elements - Finalizing The Presentation - Assigning Transitions And Timings - Setting The Master Slide - Setting Up The Slide Show - Running The Slide Show.

**Assessment Pattern:**

**Part-A:** Test may be designed to assess the candidate by means of MCQs.

**(20 %of Total Marks)**

**Part-B:** A computer based assessment test where they need to:

1. Prepare a model document and organize the same in a formatted manner. This should cover evaluating the typing speed, organizing the document and covering several other aspects such as inserting tables, inserting Images/WordArt, mail merge, etc...).
2. Evaluating typing speed **(25% of Total Marks)**  
(This may be made mandatory for qualifying based on the norms existing)
3. Organizing and inserting different objects **(15% of Total Marks)**
4. Prepare an Excel Sheet to fill with data and format the sheet, merging/splitting cells, formulae for calculation in the cells, conditional formatting, preparation of different graphs based on the data. **(20% of Total Marks)**
5. Prepared a Power Point presentation using the standard layouts available and filling different slides with content (Formatted text, images, tables, transition effects, animation etc.).

**(20%of Total Marks)**

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