भारत का राजपत्र

The Gazette of India

EXTRAORDINARY

PUBLISHED BY AUTHORITY

NEW DELHI, THURSDAY, FEBRUARY [illegible]

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MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, the 22nd February, 2017

RULES

No. [illegible].—The Rules for a competitive examination to be held by the Union Public Service Commission in 2017 for the purpose of filling vacancies in the Indian Forest Service are published for general information.

1. Indian Forest Service Examination will be a two tier examination – a Preliminary screening Examination followed by a main written Examination and interview. For selecting suitable number of candidates for the 2nd stage of the Examination to be named as Indian Forest Service (Main) Examination, all candidates would be required to qualify Civil Services (Preliminary) Examination (hereinafter called the Preliminary Examination).

2. The number of vacancies to be filled on the result of the examination will be specified in the notice issued by the Commission. Reservation will be made for candidates belonging to the Scheduled Castes, the Scheduled Tribes, Other Backward Classes and Physically Handicapped Category in respect of vacancies as may be fixed by the Government.

3. Every candidate appearing at the Examination, who is otherwise eligible, shall be permitted six attempts at the examination:

Provided that this restriction on the number of attempts will not apply in the case of Scheduled Caste and Scheduled Tribe candidates who are otherwise eligible.

Provided further that the number of attempts permissible to candidates belonging to Other Backward Classes, who are otherwise eligible, shall be nine.

Provided further that a physically handicapped will get as many attempts as are available to other non-physically handicapped candidates of his or her community, subject to the condition that a physically handicapped candidate belonging to the General Category shall be eligible for nine attempts. The relaxation will be available to the physically handicapped candidates who are eligible to avail of reservation applicable to such candidates.

Note I:- A candidate shall be deemed to have made an attempt at the examination if he/she actually appears in any one or more papers.

Note II:- If a candidate actually appears in any one paper in the Preliminary Examination, as a candidate for the Indian Forest Service (Main) Examination, he/she shall be deemed to have made an attempt at the examination.

Note III:- Notwithstanding the disqualification/cancellation of candidature the fact of appearance of the candidate at the examination will count as an attempt.

4. The examination will be conducted by the Union Public Service Commission in the manner prescribed in Appendix I to these rules.

The dates on which and the places at which the examination will be held shall be fixed by the Commission.

5. A candidate must be either :—

(a) a citizen of India, or

(b) a subject of Nepal, or

(c) a subject of Bhutan, or

(d) a Tibetan refugee who came over to India before the 1st January, 1962 with the intention of permanently settling in India, or

(e) a person of Indian origin who has migrated from Pakistan, Burma, Sri Lanka, East African countries of Kenya, Uganda, the United Republic of Tanzania, Zambia, Malawi, Zaire, Ethiopia and Vietnam with the intention of permanently settling in India.

Provided that a candidate belonging to categories (b), (c), (d) and (e) above shall be a person in whose favour a certificate of eligibility has been issued by the Government of India.

A candidate in whose case a certificate of eligibility is necessary may be admitted to the examination but the offer of appointment may be given only after the necessary eligibility certificate has been issued to him/her by the Government of India.

6. (a) A candidate must have attained the age of 21 years and must not have attained the age of 32 years on 1st August, 2017 i.e., he/she must have been born not earlier than 2nd August, 1985 and not later than 1st August, 1996.

(b) The upper age-limit prescribed above will be relaxable :—

(i) upto a maximum of five years if a candidate belongs to a Scheduled Caste or a Scheduled Tribe.

(ii) upto a maximum of three years in the case of candidates belonging to Other Backward Classes who are eligible to avail of reservation applicable to such candidates.

(iii) upto a maximum of five years if a candidate had ordinarily been domiciled in the State of Jammu & Kashmir during the period from the 1st January, 1980 to the 31st day of December, 1989.

(iv) upto a maximum of three years in the case of Defence Services personnel disabled in operations during hostilities with any foreign country or in a disturbed area and released as a consequence thereof;

(v) upto a maximum of five years in the case of ex-servicemen including Commissioned Officers and ECOs/SSCOs who have rendered at least five years Military Service as on 1st August, 2017 and have been released (i) on completion of assignment (including those, whose assignment is due to be completed within one year from 1st August, 2017) otherwise than by way of dismissal or discharge on account of the misconduct or inefficiency or (ii) on account of physical disability attributable to Military Service, or (iii) on invalidment;

(vi) upto a maximum of five years in the case of ECOs/SSCOs who have completed an initial period of assignment of five years of Military Service as on 1st August, 2017 and whose assignment has been extended beyond five years and in whose case the Ministry of Defence issues a certificate that they can apply for civil employment and they will be released on three months notice on selection from the date of receipt of offer of appointment;

(vii) upto a maximum of 10 years in the case of blind, deaf-mute and Orthopaedically handicapped persons.

NOTE I—Candidates belonging to the Scheduled Castes and the Scheduled Tribes and the Other Backward Classes who are also covered under any other clauses of rule 5(b) above, viz. those coming under the category of Ex-servicemen, persons domiciled in the State of J&K, blind, deaf-mute and Orthopaedically handicapped etc. will be eligible for grant of cumulative age relaxation under both the categories.

NOTE II—The term ex-servicemen will apply to the persons who are defined as ex-servicemen in the Ex-servicemen (Re-employment in Civil Services and Posts) Rules, 1979 as amended from time to time.

NOTE III—The age concession under rule 5(b)(v) and (vi) will not be admissible to Ex-Servicemen and Commissioned Officers including ECOs/ SSCOs, who are released at own request.

NOTE IV—Notwithstanding the provision of age relaxation under rule 5 (b) (vii) above, a physically disabled candidate will be considered to be eligible for appointment only if he/she (after such physical examination as the Government or appointing authority, as the case may be, may prescribe) is found to satisfy the requirements of physical and medical standards for the concerned Services/ Posts to be allocated to the physically disabled candidates by the Government.

SAVE AS PROVIDED ABOVE THE AGE LIMITS PRESCRIBED CAN IN NO CASE BE RELAXED.

The date of birth accepted by the Commission is that entered in the Matriculation or Secondary School Leaving Certificate or in a certificate recognised by an Indian University as equivalent to Matriculation or in an extract from a Register of Matriculates maintained by a University, which extract must be certified by the proper authority of the University or in the Higher Secondary or an equivalent examination certificate. These certificates are required to be submitted at the time of applying for the Indian Forest Service (Main) Examination.

No other document relating to age like horoscopes, affidavits, birth extracts from Municipal Corporation, service records and the like will be accepted.

The expression Matriculation/Higher Secondary Examination Certificate in this part of the instruction includes the alternative certificates mentioned above.

NOTE 1 : Candidates should note that only the date of birth as recorded in the Matriculation/ Secondary Examination Certificate or an equivalent certificate on the date of submission of application will be accepted by the Commission and no subsequent request for its change will be considered or granted.

NOTE 2 : Candidates should also note that once a date of birth has been claimed by them and entered in the records of the Commission for the purpose of admission to an Examination, no change will be allowed subsequently (or at any other examination of the Commission) on any grounds whatsoever.

7. A candidate must hold a Bachelor's degree with at least one of the subjects namely Animal Husbandry & Veterinary Science, Botany, Chemistry, Geology, Mathematics, Physics, Statistics and Zoology or Bachelor's degree in Agriculture, Forestry or in Engineering of any University incorporated by an Act of the Central or State Legislature in India or other educational institutions established by an Act of Parliament or declared to be deemed as a University under Section 3 of the University Grants Commission Act, 1956 or possess an equivalent qualification.

NOTE 1 : Candidates who have appeared at an examination the passing of which would render them educationally qualified for the Commission's examination but have not been informed of the results as also the candidates who intend to appear at such a qualifying examination will also be eligible for admission to the Preliminary Examination.

All candidates who are declared qualified by the Commission for taking the Indian Forest Service (Main) Examination will be required to produce proof of passing the requisite examination along with their application for the Main Examination failing which such candidates will not be admitted to the Main Examination.

NOTE II : In addition, the candidates who possess qualification equivalent to those specified in Rule 7 will be required to produce a certificate from University incorporated by an Act of the Central or State Legislature in India or other educational institution established by an Act of Parliament or declared to be deemed as a University under Section 3 of the University Grant Commission Act, 1956 clarifying that the degree is at par with the

Bachelor's degree specified in Rule 7 along with their applications for the Main Examination failing which such candidates will not be admitted to the Main Examination.

NOTE III :- In exceptional cases the Union Public Service Commission may treat a candidate who does not any of the foregoing qualifications, as a qualified candidate provided that he/she has passed examinations conducted by the other institutions the standard of which in the opinion of the Commission justifies his/her admission of the examination.

8. Candidates must pay the fee prescribed in the Commission's Notice.

9. All candidates in Government Service, whether in a permanent or in temporary capacity or as work-charged employees other than casual or daily rated employees or those serving under Public Enterprises will be required to submit an undertaking that they have informed in writing to their Head of Office/Department that they have applied for the examination.

Candidates should note that in case a communication is received from their employer by the Commission withholding permission to the candidates applying for/appearing at the examination, their application will be liable to be rejected/candidature will be liable to be cancelled.

10. The decision of the Commission as to the acceptance of the application of a candidate and his/her eligibility or otherwise for admission to the examination shall be final.

The candidates applying for the examination should ensure that they fulfil all the eligibility conditions for admission to the examination. Their admission at all the stages of examination for which they are admitted by the Commission viz. Preliminary Examination, Main (Written) Examination and Interview Test will be purely provisional subject to their satisfying the prescribed eligibility conditions. If on verification at any time before or after the Preliminary Examination, Main (Written) Examination and Interview Test, it is found that they do not fulfil any of eligibility conditions; their candidature for the examination will be cancelled by the Commission.

11. No candidate will be admitted to the examination unless he/she holds a certificate of admission from the Commission. No request for withdrawal of candidature received from a candidate after he/she has submitted his/her application will be entertained under any circumstances.

12. A candidate who is or has been declared by the Commission to be guilty of :—

(i) obtaining support for his/her candidature by the following means, namely :—

(a) offering illegal gratification to; or

(b) applying pressure on; or

(c) blackmailing or threatening to blackmail any person connected with the conduct of examination; or

(ii) impersonating; or

(iii) procuring impersonation by any person; or

(iv) submitting fabricated document or documents which have been tampered with; or

(v) making statements which are incorrect or false or suppressing material information; or

(vi) resorting to the following means in connection with his/her candidature for the examination, namely :—

(a) obtaining copy of question paper through improper means;

(b) finding out the particulars of the persons connected with secret work relating to the examination;

(c) influencing the examiners; or

(vii) using unfair means during the examination; or

(viii) writing obscene matter or drawing obscene sketches in the scripts; or

(ix) misbehaving in the examination hall including tearing of the scripts, provoking fellow examinees to boycott examination, creating a disorderly scene and the like; or

(x) harassing or doing bodily harm to the staff employed by the Commission for the conduct of their examinations; or

(xi) being in possession of or using any mobile phone, pager or any electronic equipment or device or any other equipment capable of being used as a communication device during the examination; or

(xii) violating any of the instructions issued to candidates along with their admission certificates permitting them to take the examination; or

(xiii) attempting to commit or as the case may be abetting the commission of all or any of the acts specified in the foregoing clauses;

may in addition to rendering himself/herself liable to criminal prosecution, be liable :—

(a) to be disqualified by the Commission from the examination for which he/she is a candidate; and/or

(b) to be debarred either permanently or for a specified period :—

(i) by the Commission from any examination or selection held by them;

(ii) by the Central Government from any employment under them; and

(c) if he/she is already in service under Government to disciplinary action under the appropriate rules.

Provided that no penalty under this rule shall be imposed except after—

giving the candidate an opportunity of making such representation in writing as he/she may wish to make in that behalf; and taking the representation, if any, submitted by the candidate within the period allowed to him/her into consideration.

13. Candidates who obtain such minimum qualifying marks in the General Studies Paper-I of Preliminary Examination as may be fixed by the Commission at their discretion and a minimum of 33% marks in General Studies Paper-II of Civil Services (Preliminary) Examination shall be admitted to the Indian Forest Service (Main) Examination. The candidates who obtain such minimum qualifying marks in the Main Examination (Written) as may be fixed by the Commission at their discretion shall be invited by them for an interview for personality test.

The minimum qualifying marks as determined above, may be relaxed at the discretion of the Commission, in favour of Physically Handicapped candidates, in order to fill up the vacancies reserved for them, if any.

Provided that candidates belonging to the Scheduled Castes or Scheduled Tribes or Other Backward Classes may be invited for an interview for a personality test by the Commission by applying relaxed standards in the General Studies Paper-I of the Preliminary Examination as well as Main Examination (Written) if the Commission is of the opinion that sufficient number of candidates from these communities are not likely to be invited for interview for a personality test on the basis of the general standard in order to fill up vacancies reserved for them.

14. (i) After the interview, the candidates will be arranged by the Commission in the order of merit as disclosed by the aggregate marks finally awarded to each candidate in the Main Examination. Thereafter, the Commission shall for the purpose of recommending candidates against unreserved vacancies, fix a qualifying mark (hereinafter referred to as general qualifying standard) with reference to the number of unreserved vacancies to be filled up on the basis of the Main Examination.

(ii) The candidates belonging to any of the Scheduled Castes, the Scheduled Tribes or Other Backward Classes may to the extent of the number of vacancies reserved for the Scheduled Castes, the Scheduled Tribes and the Other Backward Classes be recommended by the Commission by a relaxed standard, subject to the fitness of these candidates for selection to the Service.

Provided that the candidates belonging to the Scheduled Castes, the Scheduled Tribes and the Other Backward Classes who have been recommended by the Commission without resorting to any relaxations/ concessions in the eligibility or selection criteria, at any stage of the examination, shall not be adjusted against the vacancies reserved for the Scheduled Castes, the Scheduled Tribes and the Other Backward Classes.

15. The form and manner of communication of the result of the examination to individual candidates shall be decided by the Commission in their discretion and the Commission will not enter into correspondence with them regarding the result.

16. Success in the examination confers no right to appointment unless Government are satisfied after such enquiry as may be considered necessary that the candidate having regard to his/her character and antecedents, is suitable in all respects for appointment to the Service.

17. (i) A candidate who qualifies on the results of the written part of the Examination shall be required to indicate in the Detailed Application Form his/her choices in the order of preference from amongst the various State Cadres including his/her "Home State" in case he/she is appointed to the Indian Forest Service.

(ii) The cadre allotment to candidates appointed to Indian Forest Service will be governed by the policy of cadre allotment in force at the time of allotment of cadre. Due consideration will be given at the time of making allocation on the results of the Examination to the preferences expressed by a candidate for various cadres at the time of his/her application.

18. A candidate must be in good mental and bodily health and free from any physical defect likely to interfere with the discharge of his/her duties as an officer of the service. A candidate, who after such medical examination as Government or the appointing authority, as the case may be, may prescribe, is found not to satisfy these requirements will not be appointed. All the candidates recommended by the Commission on the basis of Written Examination and Personality Test will be required to undergo medical examination and walking test as per details given in the Appendix-III to these rules. No fee shall be payable to the Medical Board by the candidate for the medical examination except in the case of appeal.

Provided further that Government may constitute a special Medical Board with experts in the area for conducting the medical examination of physically disabled candidates.

NOTE—In order to prevent disappointment, candidates are advised to have themselves examined by a civil surgeon before applying for admission to the examination. Particulars of the nature of the medical test to which candidates will be subjected before appointment and of the standard required is given in Appendix-III to these rules. For the disabled ex-Defence Services personnel, the standards will be relaxed consistent with requirements of the Service.

Attention is particularly invited to the condition of medical fitness in requiring a walking test of 25 kilometres in 4 hours in the case of male candidates and 14 kilometres in 4 hours for female candidates.

19. The eligibility for availing reservation against the vacancies reserved for the physically disabled persons shall be the same as prescribed in "The Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995.

Provided further that the physically disabled candidates shall also be required to meet special eligibility criteria in terms of physical requirements/functional classification (abilities/ disabilities) consistent with requirements of the identified service/post as may be prescribed by its cadre controlling authority.

The physical requirement and functional classification can, for example, be one or more of the following:

CODE		PHYSICAL REQUIREMENTS
MF	1.	Work performed by manipulation by fingers
PP	2.	Work performed by pulling and pushing
L	3.	Work performed by lifting
KC	4.	Work performed by kneeling and crouching
BN	5.	Work performed by bending
S	6.	Work performed by sitting (on bench or chair)
ST	7.	Work performed by standing
W	8.	Work performed by walking
SE	9.	Work performed by seeing
H	10.	Work performed by hearing/speaking
RW	11.	Work performed by reading and writing
C	12.	Communication
CODE		FUNCTIONAL CLASSIFICATION
BL	1.	Both legs affected but not arms
BA	2.	Both arms affected in a. impaired reach b. weakness of grip c. ataxic
BLA	3.	Both legs and both arms affected
OL	4.	One leg affected (R or L) a. impaired reach b. weakness of grip c. ataxic
OA	5.	One arm affected (R or L) a. impaired reach b. weakness of grip c. ataxic
OAL	6.	One arm and one leg affected
MW	7.	Muscular weakness
B	8.	Blind
LV	9.	Low Vision
H	10.	Hearing

Note : The above lists is subject to revision.

20. A candidate will be eligible to get the benefit of community reservation only in case the particular caste to which the candidate belongs is included in the list of reserved communities issued by the Central Government. If a candidate indicates in his/her Application Form for Indian Forest Service Examination that he/she belongs to General Category but subsequently writes to the Commission to change his/her category to a reserved one, such request shall not be entertained by the Commission.

While the above principle will be followed in general, there may be a few cases where there was a little gap (say 2-3 months) between the issuance of a Government notification enlisting a particular community in the list of any of the reserved communities and the date of submission of the application by the candidate. In such cases the request of change of community from general to reserved may be considered by the Commission on merit. In case of a candidate unfortunately becoming physically disabled during the course of examination, the candidate should produce valid documents to enable the Commission to take a decision in the matter on merit. In case of a candidate unfortunately becoming physically disabled during the course of the examination process, the candidate should produce valid documents showing him/her acquiring a disability to the extent of 40% or more as defined under the PwD Act, 1995 to enable him to get the benefits of the reservation provided he/she otherwise remains eligible for the Indian Forest Service as per Rule 19 above.

21. Candidates seeking reservation/relaxation benefits available for SC/ST/OBC/EWS/PwBD/Ex-servicemen must ensure that they are entitled to such reservation/ relaxation as per eligibility prescribed in the Rules/Notice. They should also be in possession of all the requisite certificates in the prescribed format in support of their claim as stipulated in the Rules/ Notice for such benefits, and these certificates should be dated earlier than the due date (closing date) of the application for Civil Services (Preliminary) Examination.

22. No Person—

(a) who has entered into or contracted a marriage with a person having a spouse living, or

(b) who having a spouse living has entered into or contracted a marriage with any person shall be eligible for appointment to Service:

Provided that the Central Government may, if satisfied that such marriage is permissible under the personal law applicable to such person and the other party to the marriage and there are other grounds for so doing, exempt any person from the operation of this rule.

23. Candidates are informed that some knowledge of Hindi prior to entry into Service would be of advantage in passing departmental examinations which candidates have to take after entry into Service.

24. Brief particulars relating to the Service to which recruitment is being made through this examination are given in Appendix-II.

[illegible], Inspector General of Forests

APPENDIX I

SECTION I

Plan of Examination

The competitive examination comprises two successive stages :

(i) Civil Services (Preliminary) Examination (Objective Type) for the screening & selection of candidates for Indian Forest Service (Main) Examination; and

(ii) Indian Forest Service (Main) Examination (Written and Interview) for the selection of candidates against the vacancies identified and reported for the Indian Forest Service Examination.

2. The preliminary Examination will consist of two papers of Objective type (multiple choice questions) and carry a maximum of 400 marks in the subjects set out in sub-section (A) of Section-II. This examination is meant to serve as a screening test only; the marks obtained in the Preliminary Examination by the candidates who are declared qualified for admission to the Main Examination will not be counted for determining their final order of merit. The number of candidates to be admitted to the Main Examination will be about twelve to thirteen times the total approximate number of vacancies to be filled in the year through this examination. Only those candidates who are declared by the Commission to have qualified in the Preliminary Examination in the year will be eligible for admission to the Main Examination of that year provided they are otherwise eligible for admission to the Main Examination.

Note I : Since there may be common candidates for Civil Services Examination and the Indian Forest Service Examination, after the common Screening Test done through Civil Services (Preliminary) Examination, separate lists will be prepared for the candidates eligible to appear in the Civil Services (Main) Examination and Indian Forest Service (Main) Examination, based on the criterion of minimum qualifying marks of 33% in General Studies Paper-II of Civil Services (Preliminary) Examination and total qualifying marks of General Studies Paper-I of Civil Services (Preliminary) Examination as determined by the Commission as the number of vacancies to be filled through the Civil Services Examination and Indian Forest Service Examination.

Note II : There will be negative marking for incorrect answers (as detailed below) for all questions except some of the questions where the negative marking will be inbuilt in the form of different marks being awarded to the most appropriate and not so appropriate answer for such questions.

(i) There are four alternatives for the answers to every question. For each question for which a wrong answer has been given by the candidate, one-third of the marks assigned to that question will be deducted as penalty.

(ii) If a candidate gives more than one answer, it will be treated as a wrong answer even if one of the given answers happens to be correct and there will be same penalty as above for that question.

(iii) If a question is left blank i.e. no answer is given by the candidate, there will be no penalty for that question."

3. The Main Examination will consist of written examination and an interview test. The written examination will consist of 6 papers of conventional essay type in the subjects set out in sub-section (B) of Section-II. Also see Note (ii) under para 1 of Section II (B).

4. Candidates who obtain such minimum qualifying marks in the written part of the Main Examination as may be fixed by the Commission at their discretion, shall be summoned by them for an interview for a Personality Test (vide sub-section 'C' of Section II). The number of candidates to be summoned for interview will be about twice the number of vacancies to be filled. The interview will carry 300 marks (without minimum qualifying marks).

Marks thus obtained by the candidates in the Main Examination (written part as well as interview) would determine their final ranking.

SECTION II

Scheme and subjects for the Preliminary and Main Examination.

A. PRELIMINARY EXAMINATION :

The Examination shall comprise of two compulsory Papers of 200 marks each.

Note:

(i) Both the question papers will be of the objective type (multiple choice questions).

(ii) The General Studies Paper-II of the Civil Services (Preliminary) Examination will be a qualifying paper with minimum qualifying marks fixed at 33%.

(iii) The question papers will be set both in Hindi and English.

(iv) Details of the syllabi are indicated in Part A of Section III.

(v) Candidates must write the papers in their own hand. In no circumstances will they be allowed the help of a scribe to write the answers for them. However, Low Vision candidates (minimum 40% impairment) will be allowed to write the examination with the help of a scribe. Low Vision candidates will also be allowed an extra time of twenty minutes for each paper @ twenty minutes per hour. Each paper will be of two hours duration.

B. MAIN EXAMINATION:

(a) The written examination consisting of the following papers :—

Paper I—General English	300 Marks
Paper II—General Knowledge	300 Marks

Papers III, IV, V and VI :—Any two subjects to be selected from the list of the optional subjects set out in para 2 below. Each subject will have two papers :— 200 marks for each paper.

Note : Answer scripts of only those candidates who have obtained the minimum marks as decided by the Commission for Paper I (General English) will be evaluated.

(b) Interview for Personality Test (See Part C of Section III of this Appendix) of such candidates as may be called by the Commission :— Maximum Marks : 300

2. List of optional subjects :

(i) Agriculture
(ii) Agricultural Engineering
(iii) Animal Husbandry & Veterinary Science
(iv) Botany
(v) Chemistry
(vi) Chemical Engineering
(vii) Civil Engineering
(viii) Forestry
(ix) Geology
(x) Mathematics
(xi) Mechanical Engineering
(xii) Physics
(xiii) Statistics
(xiv) Zoology

Provided that the candidates will not be allowed to offer the following combination of subjects :

(a) Agriculture and Agricultural Engg.
(b) Agriculture and Animal Husbandry & Veterinary Science
(c) Agriculture and Forestry.
(d) Chemistry and Chemical Engg.
(e) Mathematics and Statistics
(f) Of the Engineering subjects viz. Agricultural Engineering, Chemical Engineering, Civil Engineering and Mechanical Engineering—not more than one subject.

NOTE—The standard and syllabi of the subjects mentioned above are given in Section III.

General :

1. All the question papers for the examination will be of conventional (essay) type.

2. ALL QUESTION PAPERS MUST BE ANSWERED IN ENGLISH. QUESTION PAPERS WILL BE SET IN ENGLISH ONLY.

3. The duration of each of the papers referred to above will be three hours.

4. Candidates must write the papers in their own hand. In no circumstances will they be allowed the help of a scribe to write the answers for them. However, Low vision candidates (minimum 40% impairment) will be allowed to write the examination with the help of a scribe. Low Vision candidates will also be allowed an extra time of twenty minutes for each paper @ twenty minutes per hour. Each paper will be of three hours duration.

Note (3) : The eligibility conditions of a scribe, his/her conduct inside the examination hall and the manner in which and extent to which he/she can help the Low Vision candidate in writing the Indian Forest Service Examination shall be governed by the instructions issued by the UPSC in this regard. Violation of all or any of the said instructions shall entail the cancellation of the candidature of the Low Vision candidate in addition to any other action that the UPSC may take against the scribe.

Note (4) : For purpose of these rules the candidate shall be deemed to be a Low Vision candidate if the percentage of visual impairment is forty per cent (40%) or more. However, the extent of visual impairment should have to be corroborated by a certificate in the prescribed proforma from a Medical Board constituted by the Central/State Government along with their Detailed Application Form.

Note (5) : The concession admissible to Low Vision candidates shall not be admissible to those suffering from myopia.

5. The Commission have discretion to fix qualifying marks in any or all the papers of the examination.

6. If a candidate's handwriting is not easily legible, deduction will be made on this account from the total marks otherwise accruing to him/her.

7. Marks will not be allotted for mere superficial knowledge.

8. Credit will be given for orderly, effective and exact expression combined with due economy of words in all subjects of the examination.

9. In the question papers, wherever required, SI units will be used.

10. Candidates should use only International form of Indian numerals (e.g. 1, 2, 3, 4, 5, 6, etc.) while answering question papers.

11. Candidates will be allowed the use of Scientific (Non-programmable type) calculators at the conventional type examinations of UPSC. Programmable type calculators will however not be allowed and the use of such calculators shall tantamount to resorting to unfair means by the candidates. Loaning and interchanging of calculators in the Examination Hall is not permitted.

C. Personality Test

The candidate will be interviewed by a Board of competent and unbiased observers who will have before them a record of his/her career. The object of the interview is to assess the personal suitability of the candidate for the service. The candidate will be expected to have taken an intelligent interest not only in his/her subjects of academic study but also in events which are happening around him/her both within and outside his/her own state or country, as well as in modern currents of thoughts and in new discoveries which should rouse the curiosity of well educated youth.

2. The technique of the interview is not that of a strict cross examination, but of a natural, though directed and purposive conversation, intended to reveal mental qualities of the candidate. The Board will pay special attention to assessing the intellectual curiosity, critical powers of observation and assimilation, balance of judgement and alertness of mind, initiative, tact, capacity for leadership; the ability for social cohesion, mental and physical energy and powers of practical application, integrity of character; and other qualities such as topographical sense, love for outdoor life and the desire to explore unknown and out of way places.

SECTION-III

SYLLABI FOR THE EXAMINATION

NOTE : Candidates are advised to go through the Syllabus published in this Section for the Preliminary Examination and the Main Examination.

Part A—Preliminary Examination

Paper I - (200 marks) Duration : Two hours

Current events of national and international importance.

History of India and Indian National Movement.

Indian and World Geography-Physical, Social, Economic Geography of India and the World.

Indian Polity and Governance-Constitution, Political System, Panchayati Raj, Public Policy, Rights Issues, etc.

Economic and Social Development-Sustainable Development, Poverty, Inclusion, Demographics, Social Sector Initiatives, etc.

General issues on Environmental ecology, Bio-diversity and Climate Change - that do not require subject specialization.

General Science.

Paper II-(200 marks) Duration : Two hours

Comprehension

Interpersonal skills including communication skills;

Logical reasoning and analytical ability

• Decision making and problem-solving

• General mental ability

Basic numeracy (numbers and their relations, orders of magnitude, etc.) (Class X level), Data interpretation (charts, graphs, tables, data sufficiency etc. — Class X level)

Note 1: Paper II of the Civil Services (Preliminary) Examination will be a qualifying paper with minimum qualifying marks fixed at 33%.

Note 2: The questions will be of multiple choice, objective type.

Note 3: It is mandatory for the candidate to appear in both the Papers of Civil Services (Prelim) Examination for the purpose of evaluation. Therefore a candidate will be disqualified in case he/she does not appear in both the papers of Civil Services (Prelim) Examination.

PART C MAIN EXAMINATION

SCHEDULE

The standard of papers in General English and General Knowledge will be such as may be expected of a Science or Engineering graduate of an Indian University.

The scope of the syllabus for optional subject papers for the examination is broadly of the Honours Degree level i.e. a level higher than the Bachelors Degree and lower than the Masters Degree. In the case of Engineering subjects the level corresponds to the Bachelors Degree.

There will be no practical examination in any of the subjects.

GENERAL ENGLISH

Candidates will be required to write an essay in English. Other questions will be designed to test their understanding of English and workmanlike use of words. Passages will usually be set for summary or precis.

GENERAL KNOWLEDGE

General knowledge including knowledge of current events and of such matters of every day observation and experience in their scientific aspects as may be expected of an educated person who has not made a special study of any scientific subject. The paper will also include questions on Indian Polity including the political system and the Constitution of India, History of India and Geography of a nature which the candidate should be able to answer without special study.

OPTIONAL SUBJECTS

Total number of questions in the question papers of optional subjects will be eight. All questions will carry equal marks. Each paper will be divided into two parts, viz. Part A and Part B each part containing four questions. Out of eight questions, five questions are to be attempted. One question in each part will be compulsory. Candidates will be required to answer three more questions out of the remaining six questions, taking at least one question from each Part. In this way, at least two questions will be attempted from each Part i.e. one compulsory question plus one more.

AGRICULTURE

PAPER-I

Ecology and its relevance to man, natural resources, their sustainable management and conservation. Physical and social environment as factors of crop distribution and production. Climatic elements as factors of crop growth, impact of changing environment on cropping pattern as indicators of environments. Environmental pollution and associated hazards to crops, animals and humans.

Cropping patterns in different agro-climatic zones of the country. Impact of high-yielding and short-duration varieties on shifts in cropping patterns. Concepts of multiple cropping, multistorey, relay and inter-cropping and their importance in relation to food production. Package of practices for production of important cereals, pulses, oil seeds, fibres, sugar, commercial and fodder crops grown during Kharif and Rabi seasons in different regions of the country.

Important features, scope and propagation of various types of forestry plantations such as extension, social forestry, agro-forestry and natural forests.

Weeds, their characteristics, dissemination and association with various crops; their multiplications; cultural, biological, and chemical control of weeds.

Soil-physical, chemical and biological properties. Processes and factors of soil formation. Modern classification of Indian soils, Mineral and organic constituents of soils and their role in maintaining soil productivity. Essential plant nutrients and other beneficial elements in soils and plants. Principles of soil fertility and its evaluation for judicious fertiliser use, integrated nutrient management. Losses of nitrogen in soil, nitrogen-use efficiency in submerged rice soils, nitrogen fixation in soils. Fixation of phosphorus and potassium in soils and the scope for their efficient use. Problem soils and their reclamation methods.

Soil conservation planning on watershed basis. Erosion and run-off management in hilly, foot hills and valley lands; processes and factors affecting them. Dry land agriculture and its problems. Technology for stabilising agriculture production in rainfed agriculture area.

Water-use efficiency in relation to crop production, criteria for scheduling irrigations, ways and means of reducing run-off losses of irrigation water. Drip and sprinkler irrigation. Drainage of water-logged soils, quality of irrigation water, effect of industrial effluents on soil and water pollution.

Farm management, scope, importance and characteristics, farm planning. Optimum resource use and budgeting. Economics of different types of farming systems.

Marketing and pricing of agricultural inputs and outputs, price fluctuations and their cost; role of co-operatives in agricultural economy; types and systems of farming and factors affecting them.

Agricultural extension, its importance and role, methods of evaluation of extension programmes, socio-economic survey and status of big, small and marginal farmers and landless agricultural labourers; farm mechanization and its role in agricultural production and rural employment. Training programmes for extension workers; lab-to-land programmes.

PAPER-II

Cell Theory, cell structure, cell organelles and their function, cell division, nucleic acids—structure and function, gene structure and function. Laws of heredity, their significance in plant breeding. Chromosome structure, chromosomal aberrations, linkage and cross-over, and their significance in recombination breeding. Polyploidy, euploids and aneuploids. Mutation—micro and macro—and their role in crop improvement. Variation, components of variation. Heritability, sterility and incompatibility, classification and their application in crop improvement. Cytoplasmic inheritance, sex-linked, sex-influenced and sex-limited characters.

History of plant breeding. Modes of reproduction, selfing and crossing techniques. Origin and evolution of crop plants, centre of origin, law of homologous series, crop genetic resources—conservation and utilization. Application of principles of plant breeding to the improvement of major field crops. Pure-line selection, pedigree, mass and recurrent selections, combining ability, its significance in plant breeding. Hybrid vigour and its exploitation, backcross method of breeding, breeding for disease and pest resistance, role of interspecific and intergeneric hybridization. Role of biotechnology in plant breeding. Improved varieties, hybrids, composites of various crop plants.

Seed technology, its importance. Different kinds of seeds and their seed production and processing techniques. Role of public and private sectors in seed production, processing and marketing in India.

Physiology and its significance in agriculture. Imbibition, surface tension, diffusion and osmosis. Absorption and translocation of water, transpiration and water economy.

Enzymes and plant pigments; photosynthesis—modern concepts and factors affecting the process, aerobic and non-aerobic respiration; C3, C4 and CAM mechanisms. Carbohydrate, protein and fat metabolism.

Growth and development; photoperiodism and vernalization. Auxins, hormones and other plant regulators and their mechanism of action and importance in agriculture. Physiology of seed development and germination; dormancy.

Climatic requirements and cultivation of major fruits plants, vegetable crops and flower plants; the package of practices and their scientific basis. Handling and marketing problems of fruits and vegetables. Principal methods of preservation of important fruits and vegetable products, processing techniques and equipment. Role of fruits and vegetables in human nutrition. Raising of ornamental plants, and design and layout of lawns and gardens.

Diseases and pests of field vegetables, orchard and plantation crops of India. Causes and classification of plant pests and diseases. Principles of control of plant pests and diseases. Biological control of pests and diseases. Integrated pest and disease management. Epidemiology and forecasting.

Pesticides, their formulations and modes of action. Compatibility with rhizobial inoculants. Microbial toxins.

Storage pests and diseases of cereals and pulses and their control.

Food production and consumption trends in India. National and international food policies. Production, procurement, distribution and processing constraints. Relation of food production to national dietary pattern, major deficiencies of calorie and protein.

AGRICULTURAL ENGINEERING

PAPER-I

Section A

1. Soil and Water Conservation : Scope of soil and water conservation. Mechanics and types of erosion, their causes. Rainfall, runoff and sedimentation relationships and their measurement. Soil erosion control measures—biological and engineering including stream bank protection—vegetative barriers, contour bunds, contour trenches, contour stone walls, contour ditches, terraces, outlets and grassed waterways. Gully control structures—temporary and permanent—design of permanent soil conservation structures such as chute, drop and drop inlet spillways. Design of farm ponds and percolation ponds. Principles of flood control—flood routing. Watershed Management—investigation, planning and implementation—selection of priority areas and water shed work plan, water harvesting and moisture conservation. Land development—levelling, estimation of earth volumes and costing. Wind erosion process—design of shelter belts and wind brakes and their management. Forest (Conservation) Act.

2. Aerial Photography and Remote Sensing : Basic characteristics of photographic images, interpretation keys, equipment for interpretation, imagery interpretation for land use, geology, soil and forestry.

Remote sensing—merits and demerits of conventional and remote sensing approaches. Types of satellite images. Fundamentals of satellite image interpretation. Techniques of visual and digital interpretations for soil, water and land use management. Use of GIS in planning and development of watersheds, forests including forest cover, water resources etc.

Section-B

3. Irrigation and Drainage : Sources of water for irrigation. Planning and design of minor irrigation projects. Techniques of measuring soil moisture—laboratory and in situ. Soil-water-plant relationships. Water requirement of crops. Planning conjunctive use of surface and ground water. Measurement of irrigation water, measuring devices—orifices, weirs and flumes. Methods of irrigation—surface, sprinkler and drip, fertigation. Irrigation efficiencies and their estimation. Design and construction of canals, field channels, underground pipelines, head gates, diversion boxes and structures for road crossing.

Occurrence of ground water, hydraulics of wells, types of wells (tube wells and open wells) and their construction. Well development and testing. Pumps—types, selection and installation. Rehabilitation of sick and failed wells.

Drainage—Causes of water logging and salt problems. Methods of drainage—drainage of irrigated and unirrigated lands, design of surface, sub-surface and vertical drainage systems. Improvement and utilization of poor quality water. Reclamation of saline and alkali soils. Economics of irrigation and drainage systems. Use of waste water for irrigation—standards of waste water for sustained irrigation, feasibility and economics.

4. Agricultural Structures : Site selection, design and construction of farmstead—farm house, cattle shed, dairy barn, poultry shed, hog housing, machinery and implement shed, storage structures for food grains feed and forage. Design and construction of fences and farm roads. Structures for plant environment—green houses, poly houses and shade houses. Common building materials used in construction—timber, brick, stone, tiles, concrete etc. and their properties. Water supply, drainage and sanitation system.

PAPER-II

Section A

1. Farm Power and Machinery : Agricultural mechanization and its scope. Sources of farm power—animate and electro-mechanical. Thermodynamics, construction and working of internal combustion engines. Fuel ignition, lubrication cooling and governing system of IC engines. Different types of tractors and power tillers. Power transmission, ground drive, power take off (p.t.o.) and control systems. Operation and maintenance of farm machinery for primary and secondary tillage. Traction theory. Sowing, transplanting and inter-culture implements and tools. Plant protection equipment—spraying and dusting. Harvesting, threshing and combining equipment. Machinery for earth moving and land development—methods and cost estimation. Ergonomics of man-machine system. Machinery for horticulture and agro-forestry, feeds and forage. Haulage of agricultural and forest produce.

2. Agro-energy : Energy requirements of agricultural operations and agro-processing. Selection, installation, safety and maintenance of electric motors for agricultural applications. Solar (thermal and photovoltaic), wind and bio-gas energy and their utilization in agriculture. Gasification of biomass for running IC engines and for electric power generation. Energy efficient cooking stoves and alternate cooking fuels. Distribution of electricity for agricultural and agro-industrial applications.

Section-B

3. Agricultural Process Engineering : Post harvest technology of crops and its scope. Engineering properties of agricultural produce and by-products. Unit operations—cleaning, grading, size reduction, densification, concentration, drying/dehydration, evaporation, filtration, freezing and packaging of agricultural produce and by-products. Material handling equipments—belt and screw conveyors, bucket elevators, their capacity and power requirements.

Processing of milk and dairy products—homogenization, cream separation, pasteurization, sterilization, spray and roller drying, butter making, ice-cream, cheese and shrikhand manufacture. Waste and by-product utilization—rice husk, rice bran, sugarcane bagasse, plant residues and coir pith.

4. Instrumentation and computer applications in Agricultural Engineering : Electronic devices and their characteristics—rectifiers, amplifiers, oscillators, multivibrators. Digital circuits—sequential and combinational systems. Application of microprocessors in data acquisition and control of agricultural engineering processes—measurement systems for level, flow, strain, force, torque, power, pressure, vacuum and temperature. Computers—Introduction, input/output devices, central processing unit, memory devices, operating systems, processors, keyboards and printers. Algorithms, flowchart specification, programme translation and problem analysis in Agricultural Engineering. Multimedia and Audio-Visual aids.

ANIMAL HUSBANDRY AND VETERINARY SCIENCE

PAPER-I

1. Animal Nutrition—Energy sources, energy, metabolism and requirements for maintenance and production of milk, meat, eggs and wool. Evaluation of feeds as sources of energy.

1.1 Trends in protein nutrition : Sources of protein metabolism and synthesis, protein quantity and quality in relation to requirements. Energy protein ratios in ration.

1.3 Minerals in animal diet: Sources, functions, requirements and their relationship of the basic mineral nutrients including trace elements.

1.4 Vitamins, Hormones and Growth Stimulating substances: Sources, functions, requirements and inter-relationship with minerals.

1.5 Advances in Ruminant Nutrition—Dairy Cattle: Nutrients and their metabolism with reference to milk production and its composition. Nutrient requirements for calves, heifers, dry and milking cows and buffaloes. Various feeding systems.

1.6 Advances in Non-Ruminant Nutrition—Poultry—Nutrients and their metabolism with reference to poultry, meat and egg production. Nutrients requirements and feed formulation and broilers at different ages.

1.7 Advances in Non-Ruminant Nutrition—Swine—Nutrients and their metabolism with special reference to growth and quality of meat production, Nutrient requirement and feed formulation for baby-growing and finishing pigs.

1.8 Advances in Applied Animal Nutrition—A critical review and evaluation of feeding experiments, digestibility and balance studies. Feeding standards and measures of food energy. Nutrition requirements for growth, maintenance and production. Balanced rations.

2. Animal Physiology:

2.1 Growth and Animal Production—Prenatal and postnatal growth, maturation, growth curves, measures of growth, factors affecting growth, conformation, body composition meat quality.

2.2 Milk Production and Reproduction and Digestion—Current status of hormonal control of mammary development, milk secretion and milk ejection. Male and Female reproductive organs, their components and function. Digestive organs and their functions.

2.3 Environmental Physiology—Physiological relations and their regulation, mechanisms of adaptation, environmental factors and regulatory mechanism involved in animal behaviour, methods of controlling climatic stress.

2.4 Semen quality—Preservation and Artificial Insemination—Components of semen, composition of spermatozoa, chemical and physical properties of ejaculated semen, factors affecting semen in vivo and in vitro. Factors affecting semen production and quality preservation, composition of diluents, sperm concentration, transport of diluted semen. Deep Freezing techniques in cows, sheep and goats, swine and poultry. Detection of oestrus and time of insemination for better conception.

3. Livestock Production and Management:

3.1 Commercial Dairy Farming—Comparison of dairy farming in India with advanced countries. Dairying under mixed farming and as a specialized farming, economic dairy farming. Starting of a dairy farm, Capital and land requirement, organization of the dairy farm. Procurement of goods, opportunities in dairy farming, factors determining the efficiency of dairy animal. Herd recording, budgeting, cost of milk production, pricing policy; Personnel Management. Developing Practical and Economic ration for dairy cattle; supply of greens throughout the year, field and fodder requirements of Dairy Farm. Feeding regimes for day and young stock and bulls, heifers and breeding animals; new trends in feeding young and adult stock; Feeding records.

3.2 Commercial meat, egg and wool production—Development of practical and economic rations for sheep, goats, pigs, rabbits and poultry. Supply of greens, fodder regimens for young and mature stock. New trends in enhancing production and management. Capital and land requirements and socio-economic concept.

3.3 Feeding and management of animals under drought, flood and other natural calamities.

4. Genetics and Animal Breeding:

Mitosis and Meiosis; Mendelian inheritance; deviations to Mendelian genetics; Expression of genes; Linkage and crossing over; Sex determination, sex influenced and sex limited characters; Blood groups and polymorphism; Chromosome aberrations; Gene and its structure; DNA as a genetic material; Genetic code and protein synthesis; Recombinant DNA technology. Mutations, types of mutations, methods for detecting mutations and mutation rate.

4.1 Population Genetics Applied to Animal Breeding:

Quantitative Vs. Qualitative traits; Hardy Weinberg Law; Population Vs. Individual; Gene and genotypic frequency; Forces changing gene frequency; Random drift and small populations; Theory of path coefficient; Inbreeding, methods of estimating inbreeding coefficient, systems of inbreeding; Effective population size; Breeding value, estimation of breeding value, dominance and epistatic deviation; Partitioning of variation; Genotype X environment correlation and genotype X environment interaction; role of multiple measurements; Resemblance between relatives.

4.2 Breeding Systems:

Heritability, repeatability and genetic and phenotypic correlations, their methods of estimation and precision of estimates; Aids to selection and their relative merits; Individual, pedigree, family and within family selection; Progeny testing; Methods of selection; Construction of selection indices and their uses; Comparative evaluation of genetic gains through various selection methods; Indirect selection and correlated response; Inbreeding, upgrading, cross-breeding and synthesis of breeds; Crossing of inbred lines for commercial production; Selection for general and specific combining ability; Breeding for threshold characters.

PAPER-II

1. Health and Hygiene :

1.1 Histology and Histological Techniques :

Stains—Chemical classification of stains used in biological work—Principles of staining tissues—mordants—progressive & regressive stains—differential staining of cytoplasmic and connective tissue elements—Methods of preparation and processing of tissues—celloidin embedding—Freezing microtomy—Microscopy—Bright field microscope and electron microscope. Cytology—structure of cell, organells & inclusions; cell division—cell types—Tissues and their classification—embryonic and adult tissues—Comparative histology of organs—Vascular, Nervous, digestive, respiratory, musculo-skeletal and urogenital systems—Endocrine glands—Integuments—sense organs.

1.2 Embryology :

Embryology of vertebrates with special reference to aves and domestic mammals—gametogenesis—fertilization—germ layers—foetal membranes & placentation—types of placenta in domestic mammals—Teratology—twins & twinning—organogenesis—germ layer derivatives—endodermal, mesodermal and ectodermal derivatives.

1.3 Bovine Anatomy—Regional Anatomy :

Paranasal sinuses of OX—surface anatomy of salivary glands. Regional anatomy of infraorbital, maxillary, mandibuloalveolar, mental & cornual nerve block—Regional anatomy of paravertebral nerves, pudental nerve, median, ulnar & radial nerves—tibial, fibular and digital nerves—Cranial nerves—structures involved in epidural anaesthesia—superficial lymph nodes—surface anatomy of visceral organs of thoracic, abdominal and pelvic cavities—comparative features of locomotor apparatus & their application in the biomechanics of mammalian body.

1.4 Anatomy of Fowl : Musculo-skeletal system—functional anatomy in relation to respiration and flying, digestion and egg production.

1.5 Physiology of blood and its circulation, respiration; excretion. Endocrine glands in health and disease.

1.5.1 Blood constituents :

Properties and functions—blood cell formation—Haemoglobin synthesis and chemistry—plasma proteins production, classification and properties, coagulation of blood; Haemorrhagic disorders—anticoagulants—blood groups—Blood volume—Plasma expanders—Buffer systems in blood. Biochemical tests and their significance in disease diagnosis.

1.5.2 Circulation :

Physiology of heart, cardiac cycle, heart sounds, heart block, electrocardiograms. Work and efficiency of heart—effect of ions on heart function—metabolism of cardiac muscle, nervous and chemical regulation of heart, effect of temperature and stress on heart, blood pressure and hypertension, Osmotic regulation, arterial pulse, vasomotor regulation of circulation, shock. Coronary & pulmonary circulation, Blood-Brain barrier—Cerebrospinal fluid—circulation in birds.

1.5.3 Respiration :

Mechanism of respiration, Transport and exchange of gases—neural control of respiration—Chemoreceptors—hypoxia—respiration in birds.

1.5.4 Excretion :

Structure and function of kidney—formation of urine—methods of studying renal function—renal regulation of acid-base balance: physiological constituents of urine—renal failure—passive venous congestion—Urine secretion in chicken—Sweat glands and their function. Biochemical tests for urinary dysfunction.

1.5.5 Endocrine glands :

Functional disorders their symptoms and diagnosis. Synthesis of hormones, mechanism and control of secretion—hormonal receptors—classification and function.

1.6 General knowledge of pharmacology and therapeutics of drugs :

Cellular level of pharmacodynamics and pharmacokinetics—Drugs acting on fluids and electrolyte balance—Drugs acting on Autonomic nervous system—Modern concepts of anaesthesia and dissociative anaesthetics—Autacoids—Antimicrobials and principles of chemotherapy in microbial infections—Use of hormones in therapeutics—chemotherapy of parasitic infections—Drug and economic concerns in the Edible tissues of animals—chemotherapy of Neoplastic diseases.

1.7 Veterinary Hygiene with reference to water, air and habitation :

Assessment of pollution of water, air and soil—Importance of climate in animal health—effect of environment on animal function and performance—relationship between industrialisation and animal agriculture—animal housing requirements for specific categories of domestic animals viz. pregnant cows & sows, milking cows, broiler birds—stress, strain & productivity in relation to animal habitation.

2. Animal Diseases :

2.1 Pathogenesis, symptoms, postmortem lesions, diagnosis, and control of infectious diseases of cattle, pigs and poultry, horses, sheep and goats.

2.2 Etiology, symptoms, diagnosis, treatment of production diseases of cattle, pig and poultry.
2.3 Deficiency diseases of domestic animals and birds.
2.4 Diagnosis and treatment of non-specific conditions like impaction, Bloat, Diarrhoea, Indigestion, dehydration, stroke, poisoning.
2.5 Diagnosis and treatment of neurological disorders.
2.6 Principles and methods of immunization of animals against specific diseases—herd immunity—disease free zones—'zero' disease concept—chemoprophylaxis.
2.7 Anaesthesia—local, regional and general—preanesthetic medication. Symptoms and surgical interference in fractures and dislocation. Hernia, choking abomasal displacement—Caesarian operations. Rumenotomy—Castrations.
2.8 Disease investigation techniques—Materials for laboratory investigation—Establishment Animal Health Centers—Disease free zone.
3. Veterinary Public Health :
3.1 Zoonoses :

Classification, definition, role of animals and birds in prevalence and transmission of zoonotic diseases—occupational zoonotic diseases.
3.2 Epidemiology :

Principle, definition of epidemiological terms, application of epidemiological measures in the study of diseases and disease control. Epidemiological features of air, water and food borne infections.
3.3 Veterinary Jurisprudence :

Rules and Regulations for improvement of animal quality and prevention of animal diseases—State and central Rules for prevention of animal and animal product borne diseases—S P C A—Veterolegal cases—Certificates—Materials and Methods of collection of samples for veterolegal investigation.
4. Milk and Milk Product Technology :
4.1 Milk Technology :

Organization of rural milk procurement, collection and transport of raw milk.

Quality, testing and grading raw milk. Quality storage grades of whole milk, Skimmed milk and cream. Processing, packaging, storing, distributing, marketing defects and their control and nutritive properties of the following milks: Pasteurized, standardized, toned, double toned, sterilized, homogenized, reconstituted, recombined and flavoured milks. Preparation of cultured milks, cultures and their management, yoghurt, Dahi, Lassi and Srikhand.

Preparation of flavoured and sterilized milks. Legal standards. Sanitation requirement for clean and safe milk and for the milk plant equipment.
4.2 Milk Products Technology :

Selection of raw materials, assembling, production, processing, storing, distributing and marketing milk products such as Butter, Ghee, Khoa, Channa, Cheese, Condensed, evaporated, dried milk and baby food, ice cream and Kulfi; by-products, whey products, butter milk, lactose and casein. Testing, Grading, judging milk products—BIS and Agmark specifications, legal standards, quality control nutritive properties. Packaging, processing and operational control Costs.
5. Meat Hygiene and Technology :
5.1 Meat Hygiene :
5.1.1 Ante mortem care and management of food animals, stunning, slaughter and dressing operations; abattoir requirements and designs; Meat inspection procedures and judgement of carcass meat cuts—grading of carcass meat cuts—duties and functions of Veterinarians in wholesome meat production.
5.1.2 Hygienic methods of handling production of meat—Spoilage of meat and control measures—Post slaughter physicochemical changes in meat and factors that influence them—Quality improvement methods—Adulteration of meat and detection—Regulatory provisions in Meat trade and Industry.
5.2 Meat Technology :
5.2.1 Physical and chemical characteristics of meat—Meat emulsions—Methods of preservation of meat—Curing, canning, irradiation, packaging of meat and meat products, meat products and formulations.
5.3 By-products :

Slaughter house by-products and their utilization—Edible and inedible by-products—Social and economic implications of proper utilization of slaughter house by-products—Organ products for food and pharmaceuticals.
5.4 Poultry Products Technology :

Chemical composition and nutritive value of poultry meat, pre-slaughter care and management. Slaughtering techniques, inspection, preservation of poultry meat and products. Legal and BIS standards.

Structure, composition and nutritive value of eggs. Microbial spoilage. Preservation and maintenance. Marketing of poultry meat, eggs and products.
5.5 Rabbit/Fur Animal farming—Care and management of rabbit meat production. Disposal and utilization of fur and wool and recycling of waste by-products. Grading of wool.
6. Extension :—Basic philosophy, objectives, concept and principles of extension. Different methods adopted to educate farmers under rural conditions. Generation of technology, its transfer and feedback. Problems and constraints in transfer of technology. Animal husbandry programmes for rural development.

BOTANY

PAPER—I

1. Microbiology and Plant Pathology—Viruses, bacteria, and plasmids—structure and reproduction. General account of infection. Phytoimmunology. Applications of microbiology in agriculture, industry, medicine and pollution control in air, soil and water.

Important plant diseases caused by viruses, bacteria, mycoplasma, fungi and nematodes. Modes of infection and dissemination. Molecular basis of infection and disease resistance/defence. Physiology of parasitism and control measures. Fungal toxins.

2. Cryptogams—Algae, fungi, bryophytes, pteridophytes—structure and reproduction from evolutionary viewpoint. Distribution of Cryptogams in India and their economic potential.

3. Phanerogams—Gymnosperms : Concept of Progymnosperms. Classification and distribution of Gymnosperms. Salient features of Cycadales, Ginkgoales, Coniferales and Gnetales, their structure and reproduction. General account of Cycadofilicales, Bennettitales and Cordaitales.

Angiosperms—Systematics, anatomy, embryology, palynology and phylogeny.

Comparative account of various systems of Angiosperm Classification. Study of angiospermic families—Magnoliaceae, Ranunculaceae, Brassicaceae (Cruciferae), Rosaceae, Leguminosae, Euphorbiaceae, Malvaceae, Dipterocarpaceae, Apiaceae (Umbelliferae), Asclepiadaceae, Verbenaceae, Solanaceae, Rubiaceae, Cucurbitaceae, Asteraceae (Compositae), Poaceae (Gramineae), Arecaceae (Palmae), Liliaceae, Musaceae, Orchidaceae.

Stomata and their types. Anomalous secondary growth. Anatomy of C_3 and C_4 plants.

Development of male and female gametophytes, pollination, fertilization. Endosperm—its development and function. Patterns of embryo development. Polyembryony, apomixis. Applications of palynology.

4. Plant Utility and Exploitation—Origin of cultivated plants, Vavilov's centres of origin. Plants as sources for food, fodder, fibres, spices, beverages, drugs, narcotics, insecticides, timber, gums, resins and dyes.

Latex, cellulose, starch and their products. Perfumery. Importance of Ethnobotany in Indian context. Energy plantation. Botanical Gardens and Herbaria.

5. Morphogenesis—Totipotency, polarity, symmetry and differentiation. Cell, tissue, organ and protoplast culture. Somatic hybrids and Cybrids.

PAPER—II

1. Cell Biology—Techniques of Cell Biology. Prokaryotic and eukaryotic cells—structural and ultrastructural details. Structure and function of extracellular matrix or ECM (cell wall) and membranes—cell adhesion, membrane transport and vesicular transport. Structure and function of cell organelles (chloroplasts, mitochondria, ER, ribosomes, endosomes, lysosomes, peroxisomes, hydrogenosome). Nucleus, nucleolus, nuclear pore complex. Chromatin and nucleosome. Cell signalling and cell receptors. Signal transduction (G-proteins, etc.). Mitosis and meiosis; molecular basis of cell cycle. Numerical and structural variations in chromosomes and their significance. Study of polytene, lampbrush and B-chromosomes—structure, behaviour and significance.

2. Genetics, Molecular Biology and Evolution—Development of genetics, and gene versus allele concepts (Pseudoalleles). Quantitative genetics and multiple factors. Linkage and crossing over—methods of gene mapping including molecular maps (idea of mapping function). Sex chromosomes and sex-linked inheritance, sex determination and molecular basis of sex differentiation. Mutation (biochemical and molecular basis). Cytoplasmic inheritance and cytoplasmic genes (including genetics of male sterility). Prions and prion hypothesis.

Structure and synthesis of nucleic acids and proteins. Genetic code and regulation of gene expression. Multigene families. Organic evolution—evidences, mechanism and theories.

Role of RNA in origin and evolution.

3. Plant Breeding, Biotechnology and Biostatistics—Methods of plant breeding—introduction, selection and hybridization (pedigree, backcross, mass selection, bulk method). Male sterility and heterosis breeding. Use of apomixis in plant breeding. Micropropagation and genetic engineering—methods of transfer of genes and transgenic crops; development and use of molecular markers in plant breeding.

Standard deviation and coefficient of variation (CV). Tests of significance (Z-test, t-test and chi-square tests). Probability and distributions (normal, binomial and Poisson distributions). Correlation and regression.

4. Physiology and Biochemistry—Water relations, mineral nutrition and ion transport, mineral deficiencies. Photosynthesis—photochemical reactions, photophosphorylation and carbon pathways including C_2 pathway (photorespiration), C_3, C_4 and CAM pathways. Respiration (anaerobic and aerobic, including fermentation)—electron transport chain and oxidative phosphorylation. Chemiosmotic theory and ATP synthesis. Nitrogen fixation and nitrogen metabolism. Enzymes, coenzymes, energy transfer and energy conservation. Importance of secondary metabolites. Pigments as photoreceptors (plastidial pigments and phytochrome). Photoperiodism and flowering, vernalization, senescence. Growth substances—their chemical nature, role and applications in agri-horticulture, growth indices, growth

movements; Stress physiology (heat, water, salinity, metal); Fruit and seed physiology. Dormancy, storage and germination of seed. Fruit ripening—its molecular basis and manipulation.

5. Ecology and Plant Geography: Ecological factors; Concepts and dynamics of community; Plant succession. Concepts of biosphere; Ecosystems and their conservation; Pollution and its control (including phytoremediation);

Forest types of India—Afforestation, deforestation and social forestry; Endangered plants, endemism and Red Data Books. Biodiversity. Convention of Biological Diversity, Sovereign Rights and Intellectual Property Rights. Biogeochemical cycles. Global warming.

CHEMISTRY

PAPER - I

1. Atomic structure:

Quantum theory, Heisenberg's uncertainty principle, Schrodinger wave equation (time independent). Interpretation of wave function, particle in one-dimensional box, quantum numbers, hydrogen atom wave functions. Shapes of s, p and d orbitals.

2. Chemical bonding:

Ionic bond, characteristics of ionic compounds, factors affecting stability of ionic compounds, lattice energy, Born-Haber cycle; covalent bond and its general characteristics, polarities of bonds in molecules and their dipole moments. Valence bond theory, concept of resonance and resonance energy. Molecular orbital theory (LCAO method); bonding in homonuclear molecules: H_2^+, H_2 to Ne_2, NO, CO, HF, CN, CN^-, BeH_2 and CO_2. Comparison of valence bond and molecular orbital theories, bond order, bond strength and bond length.

3. Solid state:

Forms of solids, law of constancy of interfacial angles, crystal systems and crystal classes (crystallographic groups). Designation of crystal faces, lattice structures and unit cell. Laws of rational indices. Bragg's law. X-ray diffraction by crystals. Close packing, radius ratio rules, calculation of some limiting radius ratio values. Structures of NaCl, ZnS, CsCl, CaF_2, CdI_2 and rutile. Imperfections in crystals, stoichiometric and nonstoichiometric defects, impurity defects, semiconductors. Elementary study of liquid crystals.

4. The gaseous state:

Equation of state for real gases, intermolecular interactions, liquefaction of gases and critical phenomena, Maxwell's distribution of speeds, intermolecular collisions, collisions on the wall and effusion.

5. Thermodynamics and statistical thermodynamics:

Thermodynamic systems, states and processes, work, heat and internal energy; first law of thermodynamics, work done on the systems and heat absorbed in different types of processes; calorimetry, energy and enthalpy changes in various processes and their temperature dependence.

Second law of thermodynamics; entropy as a state function, entropy changes in various processes, entropy—reversibility and irreversibility, Free energy functions; criteria for equilibrium, relation between equilibrium constant and thermodynamic quantities; Nernst heat theorem and third law of thermodynamics.

Micro and macro states; canonical ensemble and canonical partition function; electronic, rotational and vibrational partition functions and thermodynamic quantities; chemical equilibrium in ideal gas reactions.

6. Phase equilibria and solutions:

Phase equilibria in pure substances; Clausius-Clapeyron equation; phase diagram for a pure substance; phase equilibria in binary systems, partially miscible liquids—upper and lower critical solution temperatures; partial molar quantities, their significance and determination; excess thermodynamic functions and their determination.

7. Electrochemistry:

Debye-Huckel theory of strong electrolytes and Debye-Huckel limiting Law for various equilibrium and transport properties.

Galvanic cells, concentration cells; electrochemical series, measurement of e.m.f. of cells and its applications; fuel cells and batteries. Processes at electrodes; double layer at the interface; rate of charge transfer, current density; overpotential; electroanalytical techniques—voltametry, polarography, amperometry, cyclic-voltametry, ion selective electrodes and their use.

8. Chemical kinetics:

Concentration dependence of rate of reaction; differential and integral rate equations for zeroth, first, second and fractional order reactions. Rate equations involving reverse, parallel, consecutive and chain reactions; effect of temperature and pressure on rate constant. Study of fast reactions by stop-flow and relaxation methods. Collisions and transition state theories.

9. Photochemistry:

Absorption of light; decay of excited state by different routes; photochemical reactions between hydrogen and halogens and their quantum yields.

10. Surface phenomena and catalysis :

Adsorption from gases and solutions on solid adsorbents; adsorption isotherms—Langmuir and B.E.T. isotherms; determination of surface area, characteristics and mechanism of reaction on heterogeneous catalysts.

11. Bio-inorganic chemistry :

Metal ions in biological systems and their role in ion-transport across the membranes (molecular mechanism), ionophores, photosynthesis—PSI, PSII; nitrogen fixation, oxygen-uptake proteins, cytochromes and ferredoxins.

12. Coordination chemistry :

(a) Electronic configurations; introduction to theories of bonding in transition metal complexes. Valence bond theory, crystal field theory and its modifications; applications of theories in the explanation of magnetism and electronic spectra of metal complexes.

(b) Isomerism in coordination compounds. IUPAC nomenclature of coordination compounds; stereochemistry of complexes with 4 and 6 coordination numbers; chelate effect and polynuclear complexes; trans effect and its theories; kinetics of substitution reactions in square-planar complexes; thermodynamic and kinetic stability of complexes.

(c) Synthesis and structures of metal carbonyls; carboxylate anions, carbonyl hydrides and metal nitrosyl compounds.

(d) Complexes with aromatic systems, synthesis, structure and bonding in metal olefin complexes, alkyne complexes and cyclopentadienyl complexes; coordinative unsaturation, oxidative addition reactions, insertion reactions, fluxional molecules and their characterization; compounds with metal-metal bonds and metal atom clusters.

13. General chemistry of 'f' block elements :

Lanthanides and actinides; separation, oxidation states, magnetic and spectral properties; lanthanide contraction.

14. Non-Aqueous Solvents :

Reactions in liquid NH_3, HF, SO_2 and H_2SO_4. Failure of solvent system concept, coordination model of non-aqueous solvents. Some highly acidic media, fluorosulphuric acid and super acids.

PAPER-II

1. Delocalized covalent bonding :—Aromaticity, anti-aromaticity; annulenes, azulenes, tropolones, fulvenes, sydnones.

2 (a) Reaction mechanisms :—General methods (both kinetic and non-kinetic) of study of mechanisms or organic reactions illustrated by examples—use of isotopes, cross-over experiment, intermediate trapping, stereochemistry; energy diagrams of simple organic reactions—transition states and intermediates; energy of activation; thermodynamic control and kinetic control of reactions.

(b) Reactive intermediates :—Generation, geometry, stability and reactions of carbonium and carbonium ions, carbanions, free radicals, carbenes, benzynes and nitrenes.

(c) Substitution reactions :—S_N1, S_N2, S_Ni, S_N1', S_N2', S_Ni' and $S_{RN}1$ mechanisms; neighbouring group participation; electrophilic and nucleophilic reactions of aromatic compounds including simple heterocyclic compounds—pyrrole, furan, thiophene, indole.

(d) Elimination reactions :—E1, E2 and E1cb mechanisms; orientation in E2 reactions—Saytzeff and Hoffmann; pyrolytic syn elimination—acetate pyrolysis, Chugaev and Cope eliminations.

(e) Addition reactions :—Electrophilic addition to C=C and C≡C; nucleophilic addition to C=O, C≡N, conjugated olefins and carbonyls.

(f) Rearrangements :—Pinacol-pinacolone, Hoffmann, Beckmann, Baeyer—Villiger, Favorskii, Fries, Claisen, Cope, Stevens and Wagner—Meerwein rearrangements.

3. Pericyclic reactions :—Classification and examples; Woodward—Hoffmann rules—electrocyclic reactions, cycloaddition reactions [2+2 and 4+2] and sigmatropic shifts [1, 3; 3, 3 and 1, 5], FMO approach.

4. Chemistry and mechanism of reactions :—Aldol condensation (including directed aldol condensation), Claisen condensation, Dieckmann, Perkin, Knoevenagel, Wittig, Clemmensen, Wolff—Kishner, Cannizzaro and von Richter reactions; Stobbe, benzoin and acyloin condensations; Fischer indole synthesis, Skraup synthesis, Bischler—Napieralski, Sandmeyer, Reimer—Tiemann and Reformatsky reactions.

5. Polymeric Systems :

(a) Physical chemistry of polymers :—Polymer solutions and their thermodynamic properties; number and weight average molecular weights of Polymers. Determination of molecular weights by sedimentation, light scattering, osmotic pressure, viscosity, end group analysis methods.

(b) Preparation and properties of polymers :—Organic polymers—polyethylene, polystyrene, polyvinyl chloride, Teflon, nylon, terylene, synthetic and natural rubber. Inorganic polymers—phosphonitrilic halides, borazines, silicones and silicates.

(c) Biopolymers :—Basic bonding in proteins, DNA and RNA.

6. Synthetic uses of reagents :—OsO_4, HIO_4, CrO_3, $Pb(OAc)_4$, SeO_2, NBS, B_2H_6, Na-Liquid NH_3, $LiAlH_4$, $NaBH_4$, n-BuLi, MCPBA.

7. Photochemistry :—Photochemical reactions of simple organic compounds, excited and ground states, singlet and triplet states, Norrish—Type I and Type II reactions.

8. Principles of spectroscopy and applications in structure elucidation :

(a) Rotational spectra :—Diatomic molecules; isotopic substitution and rotational constants.

(b) Vibrational spectra :—Diatomic molecules, linear triatomic molecules, specific frequencies of functional groups in polyatomic molecules.

(c) Electronic spectra :—Singlet and triplet states, $n \to \pi^*$ and $\pi \to \pi^*$ transitions; application to conjugated double bonds and conjugated carbonyls—Woodward-Fieser rules.

(d) Nuclear magnetic resonance :—Isochronous and anisochronous protons; chemical shift and coupling constants. Application of ^1H NMR to simple organic molecules.

(e) Mass spectra :—Parent peak, base peak, daughter peak, metastable peak, fragmentation of simple organic molecules;

α-cleavage, McLafferty rearrangement.

(f) Electron spin resonance :—Inorganic complexes and free radicals.

CHEMICAL ENGINEERING

Paper I

Section A

(a) Fluid and particle Dynamics

Viscosity of fluids. Laminar and turbulent flows. Equation of continuity and Navier—Stokes equation— Bernoulli's Theorem. Flow meters. Fluid drag and pressure drop due to friction, reynolds Number and friction factor—effect of pipe roughness. Economic pipe diameter. Pumps, valves, ejectors jet ejectors, compressors, blowers and fans. Agitation and mixing of liquids. Mixing of solids and pastes. Crushing and Grinding—principles and equipment. Rittinger's and Bond's laws. Filtration and filtration equipment. Fluid-particle mechanics—free and hindered settling. Fluidization and minimum fluidization velocity, concepts of compressible and incompressible flow. Transport of Solids.

(b) Mass Transfer

Molecular diffusion coefficients, first and second law of diffusion, mass transfer coefficients, film and penetration theories of mass transfer. Distillation, simple distillation, relative volatility, fractional distillation, plate and packed columns for distillation. Calculation of theoretical number of plates. Liquid-liquid equilibria. Extraction—theory and practice; Design of gas absorption columns. Drying. Humidification, dehumidification. Crystallization. Design of equipment.

(c) Heat Transfer

Conduction, thermal conductivity, extended surface heat transfer.

Convection—free and forced. Heat transfer coefficients—Nusselt Number. LMTD and effectiveness. NTU methods for the design of double pipe and shell & tube heat exchangers. Analogy between heat and momentum transfer. Boiling and condensation heat transfer. Single and multiple—effect evaporators. Radiation—Stefan—Boltzmann Law, emissivity and absorptivity. Calculation of heat load of a furnace. Solar heater.

Section B

(d) Novel Separation Processes

Equilibrium separation processes—ion exchange, osmosis, electro-dialysis, reverse osmosis, ultra-filtration and other membrane processes. Molecular distillation. Super critical fluid extraction.

(e) Process Equipment Design

Factors affecting vessel design criteria—Cost considerations. Design of storage vessels—vertical, horizontal, spherical, underground tanks for atmospheric and higher pressure. Design of vessels flat and dished heads. Design of supports. Materials of construction—characteristics and selection.

(f) Process Dynamics and Control

Measuring instruments for process variables like level, pressure, flow, temperature pH and concentration with indication in visual/pneumatic/ analog/digital signal forms. Control variable, manipulative variable and load variables. Linear control—Laplace transforms. PID controllers. Block diagram representation. Transient and frequency response, stability of closed loop systems. Advanced control strategies. Computer based process control.

Paper II

Section A

(a) Material and Energy Balance

Material and energy balance calculations in processes with recycle/bypass/purge. Combustion of solid, liquid and gaseous fuels, stoichiometric relationships and excess air requirements. Adiabatic flame temperature.

(b) Chemical Engineering Thermodynamics

Laws of thermodynamics. PVT relationship for pure components and mixtures. Energy functions and inter-relationships—Maxwell's relations. Fugacity, activity and chemical potential. Vapour-liquid equilibria for ideal/non-ideal,

single and multi-component systems. Criteria for chemical reaction equilibrium, equilibrium constant and equilibrium conversions. Thermodynamic cycles—refrigeration and power.

(v) Chemical Reaction Engineering:

Batch reactors—kinetics of homogeneous reactions and interpretation of kinetic data. Ideal flow reactors—CSTR, plug flow reactors and their performance equations. Temperature effects and runaway reactions. Heterogeneous reactions—catalytic and non-catalytic and gas-solid and gas-liquid reactions. Intrinsic kinetics and global rate concepts. Importance of interphase and intraparticle mass transfer on performance. Effectiveness factor. Isothermal and non-isothermal reactors and reactor stability.

Section B

(i) Chemical Technology:

Natural organic products—Wood and wood-based chemicals, pulp and paper. Agro industries—Sugar. Edible oils extraction (including rice bran and seeds). Soaps and detergents. Essential oils. Biomass gasification (including biogas). Coal and coal chemicals. Petroleum and natural gas—Petroleum refining (atmospheric distillation/cracking/reforming)—Petrochemical industries—Polyethylenes (LDPE/HDPE/LLDPE), Polyvinyl chloride, Polystyrene. Ammonia manufacture. Cement and lime industries. Paints and varnishes. Glass ceramics. Fermentation—alcohol and antibiotics.

(ii) Environmental Engineering and Safety:

Ecology and Environment. Sources of pollutants in air and water. Green house effect, ozone layer depletion, acid rain. Micrometeorology and dispersion of pollutants in environment. Measurement techniques of pollutant levels and their control strategies. Solid wastes, their hazards and their disposal techniques. Design and performance analysis of pollution control equipment. Fire and explosion hazard rating—HAZOP and HAZAN. Emergency planning, disaster management. Environmental legislations—water, air and environment protection Acts. Forest (Conservation) Act.

(iii) Process Engineering Economics:

Fixed and working capital requirement for a process industry and estimation methods. Cost estimation and comparison of alternatives. Net present value by discounted cash flow. Pay back analysis. IRR. Depreciation. Taxes and insurance. Break-even point analysis. Project scheduling—PERT and CPM. Profit and loss account, balance sheet and financial statement. Plant location and plant layout including piping.

CIVIL ENGINEERING

PAPER-I

Part-A : Engineering mechanics, strength of materials and structural analysis.

ENGINEERING MECHANICS :

Units and Dimensions, SI Units, Vectors, Concept of Force, Concept of particle and rigid body. Concurrent, Non Concurrent and parallel forces in a plane, moment of force and Varignon's theorem, free body diagram, conditions of equilibrium, Principle of virtual work, equivalent force system.

First and Second Moment of area, Mass moment of Inertia.

Static Friction, Inclined Plane and bearings.

Kinematics and Kinetics:

Kinematics in Cartesian and Polar Co-ordinates, motion under uniform and non-uniform acceleration, motion under gravity. Kinetics of particle : Momentum and Energy principles, D'Alembert's Principle, Collision of elastic bodies, rotation of rigid bodies, simple harmonic motion, Flywheel.

STRENGTH OF MATERIALS :

Simple Stress and Strain, Elastic constants, axially loaded compression members, Shear force and bending moment, theory of simple bending, Shear Stress distribution across cross sections, Beams of uniform strength, Leaf spring, Strain Energy in direct stress, bending & shear.

Deflection of beams : Macaulay's method, Mohr's moment area method, Conjugate beam method, unit load method. Torsion of Shafts, Transmission of power, close coiled helical springs, Elastic stability of columns, Euler's, Rankine's and Secant formulae. Principal Stresses and Strains in two dimensions, Mohr's Circle, Theories of Elastic Failure, Thin and Thick cylinder : Stresses due to internal and external pressure—Lame's equations.

STRUCTURAL ANALYSIS :

Castigliano's theorems I and II, unit load method, method of consistent deformation applied to beams and pin jointed trusses. Slope-deflection, moment distribution, Kani's method of analysis and column analogy method applied to indeterminate beams and rigid frames.

Rolling loads and Influences lines : Influences lines for Shear Force and Bending moment at a section of a beam. Criteria for maximum shear force and Bending Moment in beams traversed by a system of moving loads. Influences lines for simply supported plane pin jointed trusses.

Arches : Three hinged, two hinged and fixed arches, rib shortening and temperature effects, influence lines in arches.
Matrix methods of analysis : Force method and displacement method of analysis of indeterminate beams and rigid frames.
Plastic Analysis of beams and frames: Theory of plastic bending, plastic analysis, statical method, Mechanism method.
Unsymmetrical bending : Moment of inertia, product of inertia, position of Neutral Axis and Principal axes, calculation of bending stresses.

Part-B : DESIGN OF STRUCTURES : STEEL, CONCRETE AND MASONRY STRUCTURES.

STRUCTURAL STEEL DESIGN:
Structural Steel : Factors of safety and load factors. Riveted, bolted and welded joints and connections. Design of tension and compression members, beams of built up section, riveted and welded plate girders, gantry girders, stanchions with battens and lacings, slab and gusseted column bases.
Design of highway and railway bridges : Through and deck type plate girder, Warren girder, Pratt truss.
DESIGN OF CONCRETE AND MASONRY STRUCTURES:
Concept of mix design. Reinforced Concrete : Working Stress and Limit State method of design–Recommendations of I.S. codes, design of one way and two way slabs, staircase slabs, simple and continuous beams of rectangular, T and L sections, compression members under direct load with or without eccentricity, Isolated and combined footings.
Cantilever and Counter fort type retaining walls.
Water tanks : Design requirements for Rectangular and circular tanks resting on ground.
Prestressed concrete : Methods and systems of prestressing, anchorages, Analysis and design of sections for flexure based on working stress, loss of prestress.
Design of brick masonry as per I.S. Codes.
Design of masonry retaining walls.

Part-C : FLUID MECHANICS, OPEN CHANNEL FLOW AND HYDRAULIC MACHINES

FLUID MECHANICS:
Fluid properties and their role in fluid motion, fluid statics including forces acting on plane and curve surfaces.
Kinematics and Dynamics of Fluid flow : Velocity and accelerations, stream lines, equation of continuity, irrotational and rotational flow, velocity potential and stream functions, flow net, methods of drawing flow net, sources and sinks, flow separation, free and forced vortices.
Control volume equation, continuity, momentum, energy and moment of momentum equations from control volume equation, Navier-Stokes equation, Euler's equation of motion, application to fluid flow problems, pipe flow, plane, curved, stationary and moving vanes, sluice gates, weirs, orifice meters and Venturi meters.
Dimensional Analysis and Similitude : Buckingham's Pi-theorem, dimensionless parameters, similitude theory, model laws, undistorted and distorted models.
Laminar Flow : Laminar flow between parallel, stationary and moving plates, flow through tube.
Boundary layer : Laminar and turbulent boundary layer on a flat plate, laminar sub layer, smooth and rough boundaries, drag and lift.
Turbulent flow through pipes : Characteristics of turbulent flow, velocity distribution and variation of pipe friction factor, hydraulic grade line and total energy line, siphons, expansions and contractions in pipes, pipe networks, water hammer in pipes and surge tanks.
Open channel flow : Uniform and non-uniform flows, momentum and energy correction factors, specific energy and specific force, critical depth, resistance equations and variation of roughness coefficient, rapidly varied flow, flow in contractions, flow at sudden drop, hydraulic jump and its applications, surges and waves, gradually varied flow, classification of surface profiles, control section, step method of integration of varied flow equation, moving surges and hydraulic bore.
HYDRAULIC MACHINES AND HYDROPOWER:
Centrifugal pumps—Types, characteristics, Net Positive Suction Height (NPSH), specific speed. Pumps in parallel.
Reciprocating pumps, Airvessels, Hydraulic ram, efficiency parameters, Rotary and positive displacement pumps, diaphragm and jet pumps.
Hydraulic turbines, types classification, Choice of turbines, performance parameters, controls, characteristics, specific speed.
Principles of hydropower development. Types, layouts and Component works, Surge tanks, Forebay and intake. Flow duration curves and dependable flow. Storage and pondage. Pumped storage plants. Special features of mini, micro-hydel plants.

Part-C : GEOTECHNICAL ENGINEERING

Types of soil, phase relationships, consistency limits, particle size distribution, classification of soil, structure and clay mineralogy.

Capillary water and structural water, effective stress and pore water pressure, Darcy's Law, factors affecting permeability, determination of permeability, permeability of stratified soil deposits.

Seepage pressure, quicksand condition, compressibility and consolidation, Terzaghi's theory of one dimensional consolidation, consolidation test.

Compaction of soil, field control of compaction. Total stress and effective stress parameters, pore pressure coefficients.

Shear strength of soils, Mohr Coulomb failure theory, Shear tests.

Earth pressure at rest, active and passive pressures, Rankine's theory, Coulomb's wedge theory, earth pressure on retaining wall, sheetpile walls, Braced excavation.

Bearing capacity, Terzaghi and other important theories, net and gross bearing pressure.

Immediate and consolidation settlement.

Stability of slope, Total Stress and Effective Stress methods, Conventional methods of slices, stability number.

Subsurface exploration, methods of boring, sampling, penetration tests, pressure meter tests.

Essential features of foundation, types of foundation, design criteria, choice of type of foundation, stress distribution in soils, Boussinessq's theory, Newmark's chart, pressure bulb, contact pressure, applicability of different bearing capacity theories, evaluation of bearing capacity from field tests, allowable bearing capacity, Settlement analysis, allowable settlement.

Proportioning of footing, isolated and combined footings, rafts, buoyancy rafts, Pile foundation, types of piles, pile capacity, static and dynamic analysis, design of pile groups, pile load test, settlement of piles, lateral capacity. Foundation for Bridges. Ground improvement techniques-preloading, sand drains, stone column, grouting, soil stabilisation.

PAPER-II

Part-A : CONSTRUCTION TECHNOLOGY, EQUIPMENT, PLANNING AND MANAGEMENT

1. CONSTRUCTION TECHNOLOGY :

ENGINEERING MATERIALS :

Physical properties of construction materials : Stones, Bricks and Tiles; Lime, Cement and Surkhi Mortars; Lime Concrete and Cement concrete, Properties of freshly mixed and hardened concrete, flooring tiles, use of ferro-cement, fibre-reinforced and polymer concrete, high strength concrete and light weight concrete. Timber : Properties and uses; defects in timber; seasoning and preservation of timber. Plastics, rubber and damp-proofing materials, termite proofing, Materials for Low cost housing.

CONSTRUCTION :

Building components and their functions; Brick masonry : Bonds, jointing. Stone masonry. Design of Brick masonry walls as per I.S. codes, factors of safety, serviceability and strength requirements; plastering, pointing. Types of Floors & Roofs. Ventilators, Repairs in buildings.

Functional planning of building : Building orientation, circulation, grouping of areas, privacy concept and design of energy efficient building; provisions of National Building Code.

Building estimates and specifications; cost of works; valuation.

2. CONSTRUCTION EQUIPMENT :

Standard and special types of equipment, Preventive maintenance and repair, factors affecting the selection of equipment, economical life, time and motion study, capital and maintenance cost.

Concreting equipments : Weigh batcher, mixer, vibrator, batching plant, Concrete pump.

Earth-work equipments : Power shovel, hoe, bulldozer, dumper, trailers and tractors, rollers, sheep foot roller.

3. CONSTRUCTION, PLANNING AND MANAGEMENT :

Construction activity, schedules, job layout, bar charts, organization of contracting firms, project control and supervision. Cost reduction measures.

Network analysis : CPM and PERT analysis, Float Times, crashing of activities, contraction of network for cost optimization, updating, Cost analysis and resource allocation.

Elements of Engineering Economics, methods of appraisal, present worth, annual cost, benefit-cost, incremental analysis. Economy of scale and size. Choosing between alternatives including levels of investments. Project profitability.

Part-B : SURVEY AND TRANSPORTATION ENGINEERING

Survey : Common methods of distance and angle measurements, plane table survey, levelling, traverse survey, triangulation survey, corrections and adjustments, contouring, topographical map. Surveying instruments for above purposes. Tacheometry. Circular and transition curves. Principles of photogrammetry.

Railways : Permanent way, sleepers, rail fastenings, ballast, points and crossings, design of turn outs, stations and yards, turntables, signals and inter-locking, level-crossing. Construction and maintenance of permanent ways : Superelevation, creep of rail, ruling gradient, track resistance, tractive effort, relaying of track.

Highway Engineering : Principles of highway planning, Highway alignments. Geometrical design : Cross section, camber, superelevation, horizontal and vertical curves. Classification of roads : low cost roads, flexible pavements, rigid pavements. Design of pavements and their construction, evaluation of pavement failure and strengthening.

Drainage of roads : Surface and sub-surface drainage.

Traffic Engineering : Forecasting techniques, origin and destination survey, highway capacity. Channelized and unchannelized intersections, rotary design elements, markings, signs, signals, street lighting; Traffic surveys. Principle of highway financing.

PART-C : HYDROLOGY, WATER RESOURCES AND ENGINEERING

Hydrology : Hydrological cycle, precipitation, evaporation, transpiration, depression storage, infiltration, overland flow, hydrograph, flood frequency analysis, flood estimation, flood routing through a reservoir, channel flow routing-Muskingam method.

Ground water flow : Specific yield, storage coefficient, coefficient of permeability, confined and unconfined aquifers, aquitards, radial flow into a well under confined and unconfined conditions, tube wells, pumping and recuperation tests, ground water potential.

Water Resources Engineering : Ground and surface water resources, single and multipurpose projects, storage capacity of reservoirs, reservoir losses, reservoir sedimentation, economics of water resources projects.

Irrigation Engineering : Water requirements of crops : consumptive use, quality of water for irrigation, duty and delta, irrigation methods and their efficiencies.

Canals : Distribution systems for canal irrigation, canal capacity, canal losses, alignment of main and distributory canals, most efficient section, lined canals, their design, regime theory, critical shear stress, bed load, local and suspended load transport, cost analysis of lined and unlined canals, drainage behind lining.

Water logging : causes and control, drainage system design, salinity.

Canal structures : Design of cross regulators, head regulators, canal falls, aqueducts, metering flumes and canal outlets.

Diversion head work : Principles and design of weirs on permeable and impermeable foundation, Khosla's theory, energy dissipation, stilling basin, sediment excluders.

Storage works : Types of dams, design, principles of rigid gravity and earth dams, stability analysis, foundation treatment, joints and galleries, control of seepage.

Spillways : Spillway types, crest gates, energy dissipation.

River training : Objectives of river training, methods of river training.

PART-D : ENVIRONMENTAL ENGINEERING

Water Supply : Estimation of surface and subsurface water resources, predicting demand for water, impurities of water and their significance, physical, chemical and bacteriological analysis, waterborne diseases, standards for potable water.

Intake of water : Pumping and gravity schemes. Water treatment : principles of coagulation, flocculation and sedimentation; slow-, rapid-, pressure-, filters; chlorination, softening, removal of taste, odour and salinity.

Water storage and distribution : Storage and balancing reservoirs : types, location and capacity. Distribution system : layout, hydraulics of pipe lines, pipe fittings, valves including check and pressure reducing valves, meters, analysis of distribution systems, leak detection, maintenance of distribution systems, pumping stations and their operations.

Sewerage systems : Domestic and industrial wastes, storm sewage—separate and combined systems, flow through sewers, design of sewers, sewer appurtenances, manholes, inlets, junctions, siphon. Plumbing in public buildings.

Sewage characterisation : BOD, COD, solids, dissolved oxygen, nitrogen and TOC. Standards of disposal in normal water course and on land.

Sewage treatment : Working principles, units, chambers, sedimentation tank, trickling filters, oxidation ponds, activated sludge process, septic tank, disposal of sludge, recycling of waste water.

Solid waste : Collection and disposal in rural and urban contexts, management of long-term ill-effects.

Environmental pollution : Sustainable development. Radioactive wastes and disposal. Environmental impact assessment for thermal power plants, mines, river valley projects. Air pollution. Pollution control acts.

FORESTRY

PAPER-I

Section-A

1. Silviculture—General :

General Silvicultural Principles—ecological and physiological factors influencing vegetation, natural and artificial regeneration of forests; methods of propagation, grafting techniques; site factors; nursery and planting techniques—nursery beds, polybags and maintenance, water budgeting, grading and hardening of seedlings; special approaches, establishment and tending.

2. Silviculture-Systems :

Clear felling, uniform shelter wood selection, coppice and conversion systems. Management of silviculture systems of temperate, subtropical, humid tropical, dry tropical and coastal tropical forests with special reference to plantation silviculture, choice of species, establishment and management of stands, enrichment methods, technical constraints, intensive mechanised methods, aerial seeding, thinning.

3. Silviculture-Mangrove and Cold Desert :

Mangrove—habitat and characteristics, mangrove plantation—establishment and rehabilitation of degraded mangrove formations; silvicultural systems for mangrove; protection of habitats against natural disasters. Cold desert—characteristics, identification and management of species.

4. Silviculture of Trees :

Traditional and recent advances in tropical silvicultural research and practices. Silviculture of some of the economically important species in India such as *Acacia catechu, Acacia nilotica, Acacia auriculiformis, Albizia lebbeck, Albizia procera, Anthocephalus cadamba, Anogeissus latifolia, Azadirachta indica, Bamboo spp., Butea monosperma, Cassia siamea, Casuarina equisetifolia, Cedrus deodara, Chukrasia tabularis, Dalbergia sissoo, Dipterocarpus spp., Emblica officinalis, Eucalyptus spp., Gmelina arborea, Hardwickia binata, Lagerstroemia lanceolata, Pinus roxburghii, Populus spp., Pterocarpus marsupium, Prosopis juliflora, Santalum album, Semecarpus anacardium, Shorea robusta, Salmalia malabaricum, Tectona grandis, Terminalia tomentosa, Tamarindus indica.*

Section-B

1. Agroforestry, Social Forestry, Joint Forest Management and Tribology :

Agroforestry—scope and necessity; role in the life of people and domestic animals and in integrated land use, planning especially related to (i) soil and water conservation; (ii) water recharge; (iii) nutrient availability to crops; (iv) nature and eco-system preservation including ecological balances through pest-predator relationships and (v) providing opportunities for enhancing bio-diversity, medicinal and other flora and fauna. Agroforestry systems under different agro-ecological zones; selection of species and role of multipurpose trees and NTFPs, techniques, Food, fodder and fuel security. Research and Extension needs.

Social/Urban Forestry—objectives, scope and necessity; peoples participation.

JFM—principles, objectives, methodology, scope, benefits and role of NGOs.

Tribology—Tribal scene in India; tribes, concept of races, principles of social grouping, stages of tribal economy, education, cultural tradition, customs, ethics and participation in forestry programmes.

2. Forest Soils, Soil Conservation and Watershed Management :

Forests soils—classification, factors affecting soil formation; physical, chemical and biological properties.

Soil Conservation—definition, causes for erosion; types—wind and water erosion; conservation and management of eroded soils/areas, wind breaks, shelter belts; sand dunes; reclamation of saline and alkaline soils, water logged and other waste lands. Role of forests in conserving soils, maintenance and build up of soil organic matter, provision of loppings for green leaf manuring; forest leaf litter and composting; role of micro-organisms in ameliorating soils; N and C cycles, VAM.

Watershed Management—concepts of watersheds; role of mini-forests and forest trees in overall resource management, forest hydrology, watershed development in respect of torrent control, river channel stabilization, avalanche and landslide controls, rehabilitation of degraded areas; hilly and mountain areas; watershed management and environmental functions of forests; water-harvesting and conservation; ground water recharge and watershed management; role of integrating forest trees, horticultural crops, field crops, grass and fodders.

3. Environmental Conservation and Biodiversity :

Environment—components and importance, principles of conservation, impact of deforestation; forest fires and various human activities like mining, construction and developmental projects, population growth on environment.

Pollution—types, global warming, green house effects, ozone layer depletion, acid rain, impact and control measures, environmental monitoring; concept of sustainable development. Role of trees and forests in environmental conservation; control and prevention of air, water and noise pollution. Environmental policy and legislation in India. Environmental Impact Assessment. Economic assessment of watershed development vis-a-vis ecological and environmental protection.

4. Tree Improvement and Seed Technology :

General concept of tree improvement, methods and techniques, variation and its use, provenance, seed source, exotics; quantitative aspects of forest tree improvement, seed production and seed orchards, progeny tests, use of tree improvement in natural forest and stand improvement, genetic testing programming, selection and breeding for resistance to diseases, insects, and adverse environment; the genetic base, forest genetic resources and gene conservation "in situ" and "ex situ". Cost benefit ratio, economic evaluation.

PAPER-II

Section A

1. Forest Management and Management Systems :

Objective and principles; techniques; stand structure and dynamics, sustained yield relation; rotation, normal forest, growing stock; regulation of yield; management of forest plantations, commercial forests, forest cover monitoring. Approaches viz., (i) site-specific planning, (ii) strategic planning, (iii) approval, sanction and expenditure, (iv) Monitoring, (v) Reporting and governance. Details of steps involved such as formation of Village Forest Committees, Joint Forest Participatory Management.

2. Forest Working Plan :

Forest planning, evaluation and monitoring tools and approaches for integrated planning; multipurpose development of forest resources and forest industries development; working plans and working schemes, their role in nature conservation, biodiversity and other dimensions; preparation and control. Divisional Working Plans, Annual Plan of Operations.

3. Forest Mensuration and Remote Sensing :

Methods of measuring—diameter, girth, height and volume of trees; form-factor; volume estimation of stand, current annual increment; mean annual increment. Sampling methods and sample plots. Yield calculation; yield and stand tables, forest cover monitoring through remote sensing; Geographic Information Systems for management and modelling.

4. Surveying and Forest Engineering :

Forest surveying—different methods of surveying, maps and map reading. Basic principles of forest engineering. Building materials and construction. Roads and Bridges; General principles, objects, types, simple design and construction of timber bridges.

Section B

1. Forest Ecology and Ethnobotany :

Forest ecology—biotic and abiotic components, forest eco-systems; forest community concepts; vegetation concepts, ecological succession and climax, primary productivity, nutrient cycling and water relations; physiology in stress environments (drought, water logging, salinity and alkalinity). Forest types in India, identification of species, composition and associations; dendrology, taxonomic classification, principles and establishment of herbaria and arboreta. Conservation of forest ecosystems. Clonal parks.

Role of Ethnobotany in Indian Systems of Medicine; Ayurveda and Unani—Introduction, nomenclature, habitat, distribution and botanical features of medicinal and aromatic plants. Factors affecting action and toxicity of drug plants and their chemical constituents.

2. Forest Resources and Utilization :

Environmentally sound forest harvesting practices; logging and extraction techniques and principles, transportation systems, storage and sale; Non-Timber Forest Products (NTFPs)—definition and scope; gums, resins, oleoresins, fibres, oil seeds, nuts, rubber, canes, bamboos, medicinal plants, charcoal, lac and shellac, Katha and Bidi leaves, collection, processing and disposal.

Need and importance of wood seasoning and preservation; general principles of seasoning, air and kiln seasoning, solar dehumidification, steam heating and electrical kilns. Composite wood; adhesives—manufacture, properties, uses, plywood manufacture—properties, uses. Fibre boards—manufacture, properties, uses, particle boards—manufacture, properties, uses. Present status of composite wood industry in India and future expansion plans. Pulp-paper and rayon; present position of supply of raw material to industry, wood substitution, utilization of plantation wood; problems and possibilities.

Anatomical structure of wood, defects and abnormalities of wood, timber identification—general principles.

3. Forest Protection & Wildlife Biology :

Injuries to forest—abiotic and biotic destructive agencies. Insect-pests and disease, effects of air pollution on forests and forest die back. Susceptibility of forests to damage, nature of damage, cause, prevention, protective measures and benefits due to chemical and biological control. General forest protection against fire, equipment and methods, controlled use of fire, economic and environmental costs; timber salvage operations after natural disasters. Role of afforestation and forest regeneration in absorption of CO_2. Rotational and controlled grazing, different methods of control against grazing and browsing animals; effect of wild animals on forest regeneration, human impacts; encroachment, poaching, grazing, live fencing, theft, shifting cultivation and control.

4. Forest Economics and Legislation :

Forest economics—fundamental principles, cost-benefit analysis; estimation of demand and supply; analysis of trends in the national and international market and changes in production and consumption patterns; assessment and projection of market structures; role of private sector and co-operatives; role of corporate financing. Socio-economic analysis of forest productivity and attitudes; valuation of forest goods and services.

Legislation—History of forest development; Indian Forest Policy of 1894, 1952 and 1988; National Forest Policy, 1988 of People's involvement, Joint Forest Management, Involvement of women; Forestry Policies and issues related to land use, timber and non-timber products, sustainable forest management; industrialization policies; institutional and structural changes. Decentralization and Forestry Public Administration. Forest laws, necessity; general principles, Indian Forest Act, 1927; Forest Conservation Act, 1980; Wildlife Protection Act, 1972 and their amendments; application of Indian Penal Code to Forestry. Scope and objectives of Forest Inventory.

GEOLOGY
PAPER-I
Section-A

(i) General Geology :

The Solar System, meteorites, origin and interior of the earth. Radioactivity and age of earth; Volcanoes—causes and products, volcanic belts. Earthquakes—causes, effects, earthquake belts, seismicity of India, intensity and magnitude, seismographs. Island arcs, deep sea trenches and mid-ocean ridges. Continental drift—evidences and mechanics; seafloor spreading, plate tectonics. Isostasy, orogeny and epeirogeny. Continents and oceans.

(ii) Geomorphology and Remote Sensing :

Basic concepts of geomorphology. Weathering and mass wasting. Landforms, slopes and drainage. Geomorphic cycles and their interpretation. Morphology and its relation to structures and lithology. Applications of geomorphology in mineral prospecting, civil engineering, hydrology and environmental studies. Geomorphology of Indian subcontinent.

Aerial photographs and their interpretation—merits and limitations. The Electromagnetic spectrum. Orbiting satellites and sensor systems. Indian Remote Sensing Satellites. Satellite data products. Applications of remote sensing in geology. The Geographic Information System and its applications. Global Positioning System.

(iii) Structural Geology :

Principles of geologic mapping and map reading, projection diagrams, stress and strain ellipsoid and stress-strain relationships of elastic, plastic and viscous materials. Strain markers in deformed rocks. Behaviour of minerals and rocks under deformation conditions. Folds and faults—classification and mechanics. Structural analysis of folds, foliations, lineations, joints and faults, unconformities. Superposed deformation. Time-relationship between crystallization and deformation. Introduction to petrofabrics.

Section-B

(i) Paleontology :

Species—definition and nomenclature. Megafossils and Microfossils. Modes of preservation of fossils. Different kinds of microfossils. Application of microfossils in correlation, petroleum exploration, paleoclimatic and paleoceanographic studies. Morphology, geological history and evolutionary trend in Cephalopoda, Trilobita, Brachiopoda, Echinoidea and Anthozoa. Stratigraphic utility of Ammonoidea, Trilobita and Graptoloidea. Evolutionary trend in Hominidae, Equidae and Proboscidae. Siwalik fauna. Gondwana flora and fauna and its importance.

(ii) Stratigraphy and Geology of India :

Classification of stratigraphic sequences : lithostratigraphic, biostratigraphic, chrono-stratigraphic and magnetostratigraphic and their interrelationships. Distribution and classification of Precambrian rocks of India. Study of stratigraphic distribution and lithology of Phanerozoic rocks of India with reference to fauna, flora and economic importance. Major boundary problems—Cambrian/Precambrian, Permian/Triassic, Cretaceous/Tertiary and Pliocene/Pleistocene. Study of climatic conditions, paleogeography and igneous activity in the Indian subcontinent in the geological past. Tectonic framework of India. Evolution of the Himalayas.

(iii) Hydrogeology and Engineering Geology :

Hydrologic cycle and genetic classification of water. Movement of subsurface water. Springs. Porosity, permeability, hydraulic conductivity, transmissivity and storage coefficient, classification of aquifers. Water-bearing characteristics of rocks. Groundwater chemistry. Salt water intrusion. Types of wells. Drainage basin morphometry. Exploration for groundwater. Groundwater recharge. Problems and management of groundwater. Rainwater harvesting. Engineering properties of rocks. Geological investigations for dams, tunnels and bridges. Rock as construction material. Alkali-aggregate reaction. Landslides—causes, prevention and rehabilitation. Earthquake-resistant structures.

PAPER-II
Section-A

(i) Mineralogy :

Classification of crystals into systems and classes of symmetry. International system of crystallographic notation. Use of projection diagrams to represent crystal symmetry. Crystal defects. Elements of X-ray crystallography.

Petrological microscope and accessories. Optical properties of common rock forming minerals. Pleochroism, extinction angle, double refraction, birefringence, twinning and dispersion in minerals.

Physical and chemical characters of rock forming silicate mineral groups; structural classification of silicates; common minerals of igneous and metamorphic rocks; minerals of the carbonate, phosphate, sulphide and halide groups.

(ii) Igneous and Metamorphic Petrology:

Generation and crystallisation of magmas. Crystallisation of albite-anorthite, diopside-anorthite and diopside-wollastonite-silica systems. Bowen's reaction principle; Magmatic differentiation and assimilation. Petrogenetic significance of the textures and structures of igneous rocks. Petrography and petrogenesis of granite, syenite, diorite, basic and ultrabasic groups; charnockite, anorthosite and alkaline rocks. Carbonatites. Deccan volcanic province.

Types and agents of metamorphism. Metamorphic grades and zones; Phase rule. Facies of regional and contact metamorphism; ACF and AKF diagrams; Textures and structures of metamorphic rocks. Metamorphism of arenaceous, argillaceous and basic rocks; Minerals assemblages. Retrograde metamorphism; Metasomatism and granitisation, migmatites. Granulite terrains of India.

(iii) Sedimentology:

Sedimentary rocks : Processes of formation, diagenesis and lithification; Clastic and non-clastic rocks-their classification, petrography and depositional environment; Sedimentary facies and provenance. Sedimentary structures and their significance. Heavy minerals and their significance. Sedimentary basins of India.

Section-B

(iv) Economic Geology :

Ore, ore minerals and gangue, tenor of ore. Classification of ore deposits; Process of formation of mineral deposits; Controls of ore localization; Ore textures and structures; Metallogenic epochs and provinces; Geology of the important Indian deposits of aluminium, chromium, copper, gold, iron, lead, zinc, manganese, titanium, uranium and thorium and industrial minerals; Deposits of coal and petroleum in India; National Mineral Policy; Conservation and utilization of mineral resources. Marine mineral resources and Law of Sea.

(v) Mining Geology :

Methods of prospecting—geological, geophysical, geochemical and geobotanical; Techniques of sampling. Estimation of reserves of ore; Methods of exploration and mining metallic ores, industrial minerals and marine mineral resources; Mineral beneficiation and ore dressing.

(vi) Geochemistry and Environmental Geology :

Cosmic abundance of elements. Composition of the planets and meteorites. Structure and composition of earth and distribution of elements. Trace elements. Elements of crystal chemistry—types of chemical bonds, coordination number. Isomorphism and polymorphism. Elementary thermodynamics.

Natural hazards—floods, landslides, coastal erosion, earthquakes and volcanic activity and mitigation. Environmental impact of urbanization, open cast mining, industrial and radioactive waste disposal, use of fertilizers, dumping of mine waste and fly-ash. Pollution of ground and surface water, marine pollution. Environment protection—legislative measures in India.

MATHEMATICS

PAPER-I

Section-A

Linear Algebra:

Vector spaces, linear dependence and independence, subspaces, bases, dimensions. Finite dimensional vector spaces.

Matrices, Cayley-Hamilton theorem, eigenvalues and eigenvectors, matrix of linear transformation, row and column reduction, Echelon form, equivalence, congruence and similarity, reduction to canonical form, rank, orthogonal, symmetrical, skew symmetrical, unitary, hermitian, skew-hermitian forms—their eigenvalues. Orthogonal and unitary reduction of quadratic and hermitian forms, positive definite quadratic forms.

Calculus :

Real numbers, limits, continuity, differentiability, mean-value theorems, Taylor's theorem with remainders, indeterminate forms, maxima and minima, asymptotes. Functions of several variables : continuity, differentiability, partial derivatives, maxima and minima, Lagrange's method of multipliers, Jacobian. Riemann's definition of definite integrals, indefinite integrals, infinite and improper integrals, beta and gamma functions. Double and triple integrals (evaluation techniques only). Areas, surface and volumes, centre of gravity.

Analytic Geometry :

Cartesian and polar coordinates in two and three dimensions, second degree equations in two and three dimensions, reduction to canonical forms, straight lines, shortest distance between two skew lines, plane, sphere, cone, cylinder, paraboloid, ellipsoid, hyperboloid of one and two sheets and their properties.

Section B

Ordinary Differential Equations :

Formulation of differential equations, order and degree, equations of first order and first degree, integrating factor, equations of first order but not of first degree, Clairaut's equation, singular solution. Higher order linear equations with constant coefficients, complementary function and particular integral, general solution, Euler-Cauchy equation.

Second order linear equations with variable coefficients, determination of complete solution when one solution is known, method of variation of parameters.

Dynamics, Statics and Hydrostatics :

Degree of freedom and constraints, rectilinear motion, simple harmonic motion, motion in a plane, projectiles, constrained motion, work and energy, conservation of energy, motion under impulsive forces, Kepler's laws, orbits under central forces, motion of varying mass, motion under resistance.

Equilibrium of a system of particles, work and potential energy, friction, common catenary, principle of virtual work, stability of equilibrium, equilibrium of forces in three dimensions.

Pressure of heavy fluids, equilibrium of fluids under given system of forces, Bernoulli's equation, centre of pressure. Thrust on curved surfaces, equilibrium of floating bodies, stability of equilibrium, metacentre, pressure of gases.

Vector Analysis :

Scalar and vector fields, triple products, differentiation of vector function of a scalar variable, gradient, divergence and curl in cartesian, cylindrical and spherical coordinates and their physical interpretations, higher order derivatives, vector identities and vector equations.

Application to Geometry : Curves in space, curvature and torsion, Serret-Frenet's formulae, Gauss and Stokes' theorems, Green's identities.

PAPER-II

Section A

Algebra :

Groups, subgroups, normal subgroups, homomorphism of groups, quotient groups, basic isomorphism theorems, Sylow's group, permutation groups, Cayley theorem. Rings and ideals, principal ideal domains, unique factorization domains and Euclidean domains. Field extensions, finite fields.

Real Analysis :

Real number system, ordered sets, bounds, ordered field, real number system as an ordered field with least upper bound property, Cauchy sequence, completeness. Continuity and uniform continuity of functions, properties of continuous functions on compact sets. Riemann integral, improper integrals, absolute and conditional convergence of series of real and complex terms, rearrangement of series. Uniform convergence, continuity, differentiability and integrability for sequences and series of functions. Differentiation of functions of several variables, change in the order of partial derivatives, implicit function theorem, maxima and minima. Multiple integrals.

Complex Analysis :

Analytic function, Cauchy-Riemann equations, Cauchy's theorem, Cauchy's integral formula, power series, Taylor's series, Laurent's Series, Singularities, Cauchy's residue theorem, contour integration. Conformal mapping, bilinear transformations.

Linear Programming :

Linear programming problems, basic solution, basic feasible solution and optimal solution, graphical method and Simplex method of solutions. Duality. Transportation and assignment problems. Travelling salesman problems.

Section B

Partial Differential Equations :

Curves and surfaces in three dimensions, formulation of partial differential equations, solutions of equations of type dx/P=dy/Q=dz/R ; orthogonal trajectories, Pfaffian differential equations; partial differential equations of the first order, solution by Cauchy's method of characteristics; Charpit's method of solutions, linear partial differential equations of the second order with constant coefficients, equations of vibrating string, heat equation, Laplace equation.

Numerical Analysis and Computer Programming :

Numerical methods : solution of algebraic and transcendental equations of one variable by bisection, Regula-Falsi and Newton-Raphson methods, solution of system of linear equations by Gaussian elimination and Gauss-Jordan (direct) methods, Gauss-Seidel (iterative) method. Newton's (Forward and Backward) and Lagrange's method of interpolation.

Numerical integration : Simpson's one-third rule, trapezoidal rule, Gaussian quadrature formula.

Numerical solution of ordinary differential equations : Euler and Runge Kutta-methods.

Computer Programming : Storage of numbers in Computers, Bits, bytes and words, binary system, arithmetic and logical operations on numbers. Bitwise operations. AND, OR, XOR, NOT, and shift/rotate operators. Octal and Hexadecimal Systems. Conversion to and from decimal Systems.

Representation of unsigned integers, signed integers and reals, double precision reals and long integers.

Algorithms and flow charts for solving numerical analysis problems.

Developing simple programs in BASIC for problems involving techniques covered in the numerical analysis.

Mechanics and Fluid Dynamics :

Generalised coordinates; constraints, holonomic and non-holonomic systems. D'Alembert's principle and Lagrange's equations; Hamilton equations; moment of inertia; motion of rigid bodies in two dimensions.

Equation of continuity; Euler's equation of motion for inviscid flow; stream-lines, path of a particle; potential flow; two-dimensional and axisymmetric motion; sources and sinks, vortex motion; flow past a cylinder and a sphere, method of images. Navier-Stokes equation for a viscous fluid.

MECHANICAL ENGINEERING

PAPER—I

1. Theory of Machines :

Kinematic and dynamic analysis of planar mechanisms. Cams. Gears and gear trains. Flywheels. Governors. Balancing of rigid rotors. Balancing of single and multicylinder engines. Linear vibration analysis of mechanical systems (single degree and two degrees of freedom). Critical speeds and whirling of shafts. Automatic Controls. Belt and chain drives. Hydrodynamic bearings.

2. Mechanics of Solids :

Stress and strain in two dimensions. Principal stresses and strains. Mohr's construction, linear elastic materials, isotropy and anisotropy. Stress-strain relations, uniaxial loading, thermal stresses. Beams : Bending moment and shear force diagrams. Bending stresses and deflection of beams. Shear stress distribution. Torsion of shafts, helical springs. Combined stresses. Thick and thin-walled pressure vessels. Struts and columns. Strain energy concepts and theories of failure. Rotating discs. Shrink fits.

3. Engineering Materials :

Basic concepts on structure of solids. Crystalline materials. Defects in crystalline materials. Alloys and binary phase diagrams. Structure and properties of common engineering materials. Heat treatment of steels. Plastics, Ceramics and composite materials. Common applications of various materials.

4. Manufacturing Science :

Merchant's force analysis. Taylor's tool life equation, machinability and machining economics. Rigid, small and flexible automation. NC, CNC. Recent machining methods—EDM, ECM and ultrasonics. Application of lasers and plasmas. Analysis of forming processes. High energy rate forming. Jigs, fixtures, tools and gauges. Inspection of length, position, profile and surface finish.

5. Manufacturing Management :

Production, Planning and Control. Forecasting—Moving average, exponential smoothing. Operations scheduling; assembly line balancing. Product development. Breakeven analysis. Capacity planning. PERT and CPM. Control Operations : Inventory control—ABC analysis, EOQ model. Materials requirement planning. Job design, Job standards, Work measurement, Quality Management—Quality analysis and control. Statistical quality control. Operations Research : Linear Programming—Graphical and Simplex methods. Transportation and assignment models. Single server queuing model.

Value Engineering : Value analysis for cost/value. Total quality management and forecasting techniques. Project management.

6. Elements of Computation :

Computer Organization, Flow charting. Features of Common Computer Languages—FORTRAN, d Base III, Lotus 1-2-3, C and elementary programming.

PAPER—II

1. Thermodynamics :

Basic concept. Open and closed systems. Applications of Thermodynamic laws. Gas equations. Clapeyron equation, availability, irreversibility and Tds relations.

2. I.C. Engines, Fuels and Combustion :

Spark ignition and compression, ignition engines. Four stroke engine and Two stroke engines. Mechanical, thermal and volumetric efficiencies. Heat balance.

Combustion process in S.I. and C.I. engines, preignition detonation in S.I. engine, Diesel knock in C.I. engine. Choice of engine fuels. Octane and Cetane ratings. Alternate fuels. Carburation and fuel injection. Engine emissions and control. Solid, liquid and gaseous fuels, stoichiometric air requirements and excess air factor. Fuel gas analysis, higher and lower calorific values and their measurements.

2. Heat Transfer, Refrigeration and Air Conditioning:

One and two dimensional heat conduction, heat transfer from extended surfaces, heat transfer by forced and free convection, heat exchangers. Fundamentals of diffusive and convective mass transfer, Radiation laws, heat exchange between black and non-black surfaces, Network analysis. Heat pump refrigeration cycles and systems, Condensers, evaporators and expansion devices and controls. Properties and choice of refrigerant, Refrigeration Systems and components, Psychrometrics, Comfort indices, cooling load calculations, solar refrigeration.

3. Turbo-Machines and Power Plants:

Continuity, momentum and Energy Equations, Adiabatic and Isentropic flow, Fanno lines, Rayleigh lines. Theory and design of axial flow turbines and compressors, Flow through turbo-machine blade, cascades, centrifugal compressor. Dimensional Analysis and modelling. Selection of site for steam, hydro, nuclear and stand-by power plants, Selection base and peak load power plants, Modern High pressure, High duty boilers, Draft and dust removal equipment, Fuel and cooling water systems, heat balance, station and plant heat rates, operation and maintenance of various power plants, preventive maintenance, economics of power generation.

PHYSICS
PAPER—I
SECTION-A

1. Classical Mechanics

(a) Particle Dynamics

Centre of mass and laboratory coordinates, conservation of linear and angular momentum. The rocket equation. Rutherford scattering, Galilean transformation, inertial and non-inertial frames, rotating frames, centrifugal and Coriolis forces, Foucault pendulum.

(b) System of Particles

Constraints, degrees of freedom, generalised coordinates and momenta. Lagrange's equation and applications to linear harmonic oscillator, simple pendulum and central force problems. Cyclic coordinates, Hamiltonian, Lagrange's equation from Hamilton's principle.

(c) Rigid Body Dynamics

Eulerian angles, inertia tensor, principal moments of inertia. Euler's equation of motion of a rigid body, force-free motion of a rigid body. Gyroscope.

2. Special Relativity, Waves & Geometrical Optics

(a) Special Relativity

Michelson-Morley experiment and its implications. Lorentz transformations-length contraction, time dilation, addition of velocities, aberration and Doppler effect, mass-energy relation, simple applications to a decay process. Minkowski diagram, four dimensional momentum vector. Covariance of equations of physics.

(b) Waves

Simple harmonic motion, damped oscillation, forced oscillation and resonance. Beats. Stationary waves in a string. Pulses and wave packets. Phase and group velocities. Reflection and refraction from Huygens' principle.

(c) Geometrical Optics

Laws of reflection and refraction from Fermat's principle. Matrix method in paraxial optics-thin lens formula, nodal planes, system of two thin lenses, chromatic and spherical aberrations.

3. Physical Optics

(a) Interference

Interference of light-Young's experiment, Newton's rings, interference by thin films, Michelson interferometer. Multiple beam interference and Fabry-Perot interferometer. Holography and simple applications.

(b) Diffraction

Fraunhofer diffraction-single slit, double slit, diffraction grating, resolving power. Fresnel diffraction: - half-period zones and zone plates. Fresnel integrals. Application of Cornu's spiral to the analysis of diffraction at a straight edge and by a long narrow slit. Diffraction by a circular aperture and the Airy pattern.

(c) Polarisation and Modern Optics

Production and detection of linearly and circularly polarised light. Double refraction, quarter wave plate. Optical activity. Principles of fibre optics-attenuation; pulse dispersion in step index and parabolic index fibres; material dispersion, single mode fibres. Lasers-Einstein A and B coefficients. Ruby and He-Ne lasers. Characteristics of laser light-spatial and temporal coherence. Focussing of laser beams. Three-level scheme for laser operation.

SECTION-B

1. Electricity and Magnetism

(a) Electrostatics and Magnetostatics:

Laplace and Poisson equations in electrostatics and their applications. Energy of a system of charges, multipole expansion of scalar potential. Method of images and its applications. Potential and field due to a dipole, force and torque on a dipole in an external field. Dielectrics, polarisation. Solutions to boundary-value problems-conducting and dielectric spheres in a uniform electric field. Magnetic shell, uniformly magnetised sphere. Ferromagnetic materials, hysteresis, energy loss.

(b) Current Electricity:

Kirchhoff's laws and their applications. Biot-Savart law, Ampere's law, Faraday's law, Lenz' law. Self-and mutual-inductances. Mean and r m s values in AC circuits. LR, CR and LCR circuits- series and parallel resonance. Quality factor. Principle of transformer.

2. Electromagnetic Theory & Black Body Radiation

(a) Electromagnetic Theory:

Displacement current and Maxwell's equations. Wave equations in vacuum, Poynting theorem. Vector and scalar potentials. Gauge invariance, Lorentz and Coulomb gauges. Electromagnetic field tensor, covariance of Maxwell's equations. Wave equations in isotropic dielectrics, reflection and refraction at the boundary of two dielectrics. Fresnel's relations. Normal and anomalous dispersion. Rayleigh scattering.

(b) Blackbody Radiation:

Blackbody radiation and Planck radiation law- Stefan-Boltzmann law, Wien displacement law and Rayleigh-Jeans law, Planck mass, Planck length, Planck time, Planck temperature and Planck energy.

3. Thermal and Statistical Physics

(a) Thermodynamics:

Laws of thermodynamics, reversible and irreversible processes, entropy. Isothermal, adiabatic, isobaric, isochoric processes and entropy change. Otto and Diesel engines, Gibbs' phase rule and chemical potential. van der Waals equation of state of a real gas, critical constants. Maxwell-Boltzmann distribution of molecular velocities, transport phenomena, equipartition and virial theorems. Dulong-Petit, Einstein, and Debye's theories of specific heat of solids. Maxwell relations and applications. Clausius-Clapeyron equation. Adiabatic demagnetisation, Joule-Kelvin effect and liquefaction of gases.

(b) Statistical Physics:

Saha ionization formula. Bose-Einstein condensation. Thermodynamic behaviour of an ideal Fermi gas, Chandrasekhar limit, elementary ideas about neutron stars and pulsars. Brownian motion as a random walk, diffusion process. Concept of negative temperatures.

PAPER—II

SECTION-A

1. Quantum Mechanics I

Wave-particle duality. Schroedinger equation and expectation values. Uncertainty principle. Solutions of the one-dimensional Schroedinger equation-free particle (Gaussian wave-packet), particle in a box, particle in a finite well, linear harmonic oscillator. Reflection and transmission by a potential step and by a rectangular barrier. Use of WKB formula for the life-time calculation in the alpha-decay problem.

2. Quantum Mechanics II & Atomic Physics

(a) Quantum Mechanics II:

Particle in a three dimensional box, density of states, free electron theory of metals. The angular momentum problem. The hydrogen atom. The spin half problem and properties of Pauli spin matrices.

(b) Atomic Physics:

Stern-Gerlach experiment, electron spin, fine structure of hydrogen atom. L-S coupling, J-J coupling. Spectroscopic notation of atomic states. Zeeman effect. Franck-Condon principle and applications.

3. Molecular Physics

Elementary theory of rotational, vibrational and electronic spectra of diatomic molecules. Raman effect and molecular structure. Laser Raman spectroscopy. Importance of neutral hydrogen atom, molecular hydrogen and molecular hydrogen ion in astronomy. Fluorescence and Phosphorescence. Elementary theory and applications of NMR. Elementary ideas about Lamb shift and its significance.

SECTION-B

4. Nuclear Physics

Basic nuclear properties-size, binding energy, angular momentum, parity, magnetic moment. Semi-empirical mass formula and applications. Mass parabolas. Ground state of a deuteron, magnetic moment and non-central forces. Meson theory of nuclear forces. Salient features of nuclear forces. Shell model of the nucleus - success and limitations. Violation of parity in beta decay. Gamma decay and internal conversion. Elementary ideas about Mossbauer spectroscopy. Q-value of nuclear reactions. Nuclear fission and fusion, energy production in stars. Nuclear reactors.

3. Particle Physics & Solid State Physics

(a) Particle Physics

Classification of elementary particles and their interactions; Conservation laws; Quark structure of hadrons; Field quanta of electroweak and strong interactions; Elementary ideas about unification of forces; Physics of neutrinos.

(b) Solid State Physics

Cubic crystal structure; Band theory of solids—conductors, insulators and semiconductors; Elements of superconductivity, Meissner effect, Josephson junctions and applications; Elementary ideas about high temperature superconductivity.

4. Electronics

Intrinsic and extrinsic semiconductors-p-n-p and n-p-n transistors; Amplifiers and oscillators; Op-amps; FET, JFET and MOSFET; Digital electronics-Boolean identities; De Morgan's laws, Logic gates and truth tables; Simple logic circuits; Thermistors, solar cells; Fundamentals of microprocessors and digital computers.

STATISTICS

PAPER—I

Probability

Sample space and events, probability measure and probability space, random variable as a measurable function, distribution function of a random variable, discrete and continuous-type random variable, probability mass function, probability density function, vector-valued random variable, marginal and conditional distributions, stochastic independence of events and of random variables, expectation and moments of a random variable, conditional expectation, convergence of a sequence of random variable in distribution, in probability, in p-th mean and almost everywhere, their criteria and inter-relations, Borel-Cantelli lemma, Chebyshev's and Khinchine's weak laws of large numbers, strong law of large numbers and Kolmogorov's theorems, Glivenko-Cantelli theorem, probability generating function, characteristic function, inversion theorem, Laplace transform, related uniqueness and continuity theorems, determination of distribution by its moments. Lindeberg and Levy forms of central limit theorem, standard discrete and continuous probability distributions, their inter-relations and limiting cases, simple properties of finite Markov chains.

Statistical Inference

Consistency, unbiasedness, efficiency, sufficiency, minimal sufficiency, completeness, ancillary statistic, factorization theorem, exponential family of distribution and its properties, uniformly minimum variance unbiased (UMVU) estimation, Rao-Blackwell and Lehmann-Scheffe theorems, Cramer-Rao inequality for single and several-parameter family of distributions, minimum variance bound estimator and its properties, modifications and extensions of Cramer-Rao inequality, Chapman-Robbins inequality, Bhattacharya's bounds, estimation by methods of moments, maximum likelihood, least squares, minimum chi-square and modified minimum chi-square, properties of maximum likelihood and other estimators, idea of asymptotic efficiency, idea of prior and posterior distributions, Bayes estimators.

Non-randomised and randomised tests, critical function, MP tests, Neyman-Pearson lemma, UMP tests, monotone likelihood ratio, generalised Neyman-Pearson lemma, similar and unbiased tests, UMPU tests for single and several-parameter families of distributions, likelihood ratio test and its large sample properties, chi-square goodness of fit test and its asymptotic distribution.

Confidence bounds and its relation with tests, uniformly most accurate (UMA) and UMA unbiased confidence bounds.

Kolmogorov's test for goodness of fit and its consistency, sign test and its optimality, Wilcoxon signed-ranks test and its consistency, Kolmogorov-Smirnov two-sample test, run test, Wilcoxon-Mann-Whitney test and median test, their consistency and asymptotic normality.

Wald's SPRT and its properties, OC and ASN functions, Wald's fundamental identity, sequential estimation.

Linear Inference and Multivariate Analysis

Linear statistical models, theory of least squares and analysis of variance, Gauss-Markoff theory, normal equations, least squares estimates and their precision, test of significance and interval estimates based on least squares theory in one-way, two-way and three-way classified data, regression analysis, linear regression, curvilinear regression and orthogonal polynomials, multiple regression, multiple and partial correlations, regression diagnostics and sensitivity analysis, calibration problems, estimation of variance and covariance components, MINQUE theory, multivariate normal distribution, Mahalanobis' D2 and Hotelling's T2 statistics and their applications and properties, discriminant analysis, canonical correlations, one-way MANOVA, principal component analysis, elements of factor analysis.

Sampling Theory and Design of Experiments

An outline of fixed-population and super-population approaches, distinctive features of finite population sampling, probability sampling designs, simple random sampling with and without replacement, stratified random sampling, systematic sampling and its efficacy for structural populations, cluster sampling, two-stage and multi-stage sampling, ratio and regression methods of estimation involving one or more auxiliary variables, two-phase sampling, probability proportional to size sampling with and without replacement, the Hansen-Hurwitz and the Horvitz-Thompson

estimator, non-negative variance estimation with reference to the Horvitz-Thompson estimator, non-sampling errors, Warner's randomized response technique for sensitive characteristics.

Fixed effects model (two-way classification), random and mixed effects models (two-way classification with equal number of observations per cell), CRD, RBD, LSD and their analyses, incomplete block designs, concepts of orthogonality and balance, BIBD, missing plot technique, factorial designs: 2^n, 3^2 and 3^3, confounding in factorial experiments, split-plot and simple lattice designs.

PAPER-IV

I. Industrial Statistics

Process and product control, general theory of control charts, different types of control charts for variables and attributes, X, R, s, p, np and c charts, cumulative sum chart, V-mask, single, double, multiple and sequential sampling plans for attributes, OC, ASN, AOQ and ATI curves, concepts of producer's and consumer's risks, AQL, LTPD and AOQL, sampling plans for variables, use of Dodge-Romig and Military Standard tables.

Concepts of reliability, maintainability and availability, reliability of series and parallel systems and other simple configurations, renewal density and renewal function, survival models (exponential, Weibull, lognormal, Rayleigh, and bath-tub), different types of redundancy and use of redundancy in reliability improvement, problems in life-testing, censored and truncated experiments for exponential models.

II. Optimization Techniques

Different types of models in Operational Research, their construction and general methods of solution, simulation and Monte-Carlo methods, the structure and formulation of linear programming (LP) problem, simple LP model and its graphical solution, the simplex procedure, the two-phase method and the M-technique with artificial variables, the duality theory of LP and its economic interpretation, sensitivity analysis, transportation and assignment problems, rectangular games, two-person zero-sum games, methods of solution (graphical and algebraic).

Replacement of failing or deteriorating items, group and individual replacement policies, concept of scientific inventory management and analytical structure of inventory problems, simple models with deterministic and stochastic demand with and without lead time, storage models with particular reference to dam type.

Homogeneous discrete-time Markov chains, transition probability matrix, classification of states and ergodic theorems, homogeneous continuous-time Markov chains, Poisson process, elements of queuing theory, M/M/1, M/M/K, G/M/1 and M/G/1 queues.

Solution of statistical problems on computers using well-known statistical software packages like SPSS.

III. Quantitative Economics and Official Statistics

Determination of trend, seasonal and cyclical components, Box-Jenkins method, tests for stationarity of series, ARIMA models and determination of orders of autoregressive and moving average components, forecasting.

Commonly used index numbers- Laspeyre's, Paasche's and Fisher's ideal index numbers, chain-base index number, uses and limitations of index numbers, index number of wholesale prices, consumer price index number, index number of agricultural and industrial production, tests for index numbers like proportionality test, time-reversal test, factor-reversal test, circular test and dimensional invariance test.

General linear model, ordinary least squares and generalized least squares methods of estimation, problem of multicollinearity, consequences and solutions of multicollinearity, autocorrelation and its consequences, heteroscedasticity of disturbances and its testing, tests for independence of disturbances, Zellner's seemingly unrelated regression equation model and its estimation, concept of structure and model for simultaneous equations, problem of identification-rank and order conditions of identifiability, two-stage least squares method of estimation.

Present official statistical system in India relating to population, agriculture, industrial production, trade and prices, methods of collection of official statistics, their reliability and limitation and the principal publications containing such statistics, various official agencies responsible for data collection and their main functions.

IV. Demography and Psychometry

Demographic data from census, registration, NSS and other surveys, and their limitation and uses, definition, construction and uses of vital rates and ratios, measures of fertility, reproduction rates, morbidity rate, standardized death rate, complete and abridged life tables, construction of life tables from vital statistics and census returns, uses of life tables, logistic and other population growth curves, fitting a logistic curve, population projection, stable population theory, uses of stable and quasi-stable population techniques in estimation of demographic parameters, morbidity and its measurement, standard classification by cause of death, health surveys and use of hospital statistics.

Methods of standardisation of scales and tests, Z-scores, standard scores, T-scores, percentile scores, intelligence quotient and its measurement and uses, validity of test scores and its determination, use of factor analysis and path analysis in psychometry.

ZOOLOGY

PAPER-I

Section A

1. Non-chordata and chordata :

(a) Classification and relationship of various phyla up to sub-classes: Acoelomata and Coelomata, Protostomes and Deuterostomes, Bilateria and Radiata; Status of Protista, Parazoa, Onychophora and Hemichordata; Symmetry.

(b) Protozoa : Locomotion, nutrition, reproduction; evolution of sex; general features and life history of Paramecium, Monocystis, Plasmodium and Leishmania.

(c) Porifera : Skeleton, canal system and reproduction.

(d) Cnidaria : Polymorphism, defensive structures and their mechanism; coral reefs and their formation; metagenesis; general features and life history of Obelia and Aurelia.

(e) Platyhelminthes : Parasitic adaptation; general features and life history of Fasciola and Taenia and their relation to man.

(f) Nemathelminthes : General features, life history and parasitic adaptation of Ascaris; nemathelminthes in relation to man.

(g) Annelida : Coelom and metamerism; modes of life in polychaetes; general features and life history of nereis (Neanthes), earthworm (Pheretima) and leech (Hirudinaria).

(h) Arthropoda : Larval forms and parasitism in Crustacea; vision and respiration in arthropods (prawn, cockroach and scorpion); modification of mouth parts in insects (cockroach, mosquito, housefly, honey bee and butterfly); metamorphosis in insects and its hormonal regulation; social organization in insects (termites and honey bees).

(i) Mollusca : Feeding, respiration, locomotion, shell diversity; general features and life history of Lamellidens, Pila and Sepia; torsion and detorsion in gastropods.

(j) Echinodermata : Feeding, respiration, locomotion, larval forms; general features and life history of Asterias.

(k) Protochordata : Origin of chordates; general features and life history of Branchiostoma and Herdmania.

(l) Pisces : Scales, respiration, locomotion, migration.

(m) Amphibia : Origin of tetrapods; parental care, paedomorphosis.

(n) Reptilia : Origin of reptiles; skull types; status of Sphenodon and crocodiles.

(o) Aves : Origin of birds; flight adaptation, migration.

(p) Mammalia : Origin of mammals; dentition; general features of egg-laying mammals, pouched mammals, aquatic mammals and primates; endocrine glands and other hormone producing structures (pituitary, thyroid, parathyroid, adrenal, pancreas, gonads) and their interrelationships.

(q) Comparative functional anatomy of various systems of vertebrates (integument and its derivatives, endoskeleton, locomotory organs, digestive system, respiratory system, circulatory system including heart and aortic arches; urinogenital system, brain and sense organs (eye and ear).

Section B

2. Ecology :

(a) Biosphere : Biogeochemical cycles, green-house effect, ozone layer and its impact; ecological succession, biomes and ecotones.

(b) Population, characteristics, population dynamics, population stabilization.

(c) Conservation of natural resources—mineral mining, fisheries, aquaculture; forestry; grassland; wildlife (Project Tiger); sustainable production in agriculture—integrated pest management.

(d) Environmental biology; pollution; pollution and its impact on biosphere and its prevention.

3. Ethology :

(a) Behaviour : Sensory filtering, responsiveness, sign stimuli, learning, instinct, habituation, conditioning, imprinting.

(b) Role of hormones in drive; role of pheromones in alarm spreading; crypsis, predator detection, predator tactics, social behaviour in insects and primates; courtship (Drosophila, 3-spine stickleback and birds).

(c) Orientation, navigation, homing; biological rhythms; biological clock, tidal, seasonal and circadian rhythms.

(d) Methods of studying animal behaviour.

4. Economic Zoology :

(a) Apiculture, sericulture, lac culture, carp culture, pearl culture, prawn culture.

(b) Major infectious and communicable diseases (small pox, plague, malaria, tuberculosis, cholera and AIDS) their vectors, pathogens and prevention.

(c) Cattle and livestock diseases, their pathogens (helminths) and vectors (ticks, mites, Tabanus, Stomoxys).

(d) Pests of sugar-cane (Pyrilla perpusiella), oil seed (Achaea janata) and rice (Sitophilus oryzae).

10. Biostatistics :

Designing of experiments; null hypothesis; correlation, regression, distribution and measure of central tendency, chi square, student-test, F-test (one-way & two-way F-test).

11. Instrumental methods :

(a) Spectrophotometer, flame photometer, Geiger-Muller counter, scintillation counting.

(b) Electron microscope (TEM, SEM).

PAPER II

Section A

1. Cell Biology :

(a) Structure and function of cell and its organelles (nucleus, plasma membrane, mitochondria, Golgi bodies, endoplasmic reticulum, ribosomes and lysosomes), cell division (mitosis and meiosis), mitotic spindle and mitotic apparatus, chromosome movement.

(b) Watson-Crick model of DNA, replication of DNA, protein synthesis, transcription and transcription factors.

2. Genetics :

(a) Gene structure and functions; genetic code.

(b) Sex chromosomes and sex determination in Drosophila, nematodes and man.

(c) Mendel's laws of inheritance, recombination, linkage, linkage-maps, multiple alleles, cistron concept; genetics of blood groups.

(d) Mutations and mutagenesis : radiation and chemical.

(e) Cloning technology, plasmids and cosmids as vectors, transgenics, transposons, DNA sequence cloning and whole animal cloning (principles and methodology).

(f) Regulation and gene expression in pro- and eukaryotes.

(g) Signal transduction; pedigree-analysis; congenital diseases in man.

(h) Human genome mapping; DNA finger-printing.

3. Evolution :

(a) Origin of life.

(b) Natural selection, role of mutation in evolution, mimicry, variation, isolation, speciation.

(c) Fossils and fossilization; evolution of horse, elephant and man.

(d) Hardy-Weinberg Law; causes of change in gene frequency.

(e) Continental drift and distribution of animals.

4. Systematics :

(a) Zoological nomenclature; international code; cladistics.

Section B

1. Biochemistry :

(a) Structure and role of carbohydrates, fats, fatty acids, proteins, aminoacids, nucleic acids. Saturated and unsaturated fatty acids, cholesterol.

(b) Glycolysis and Krebs cycle, oxidation and reduction, oxidative phosphorylation; energy conservation and release, ATP, cyclic AMP—its structure and role.

(c) Hormone classification (steroid and peptide hormones), biosynthesis and function.

(d) Enzymes : types and mechanisms of action; immunoglobulin and immunity; vitamins and co-enzymes.

(e) Bioenergetics.

2. Physiology (with special reference to mammals) :

(a) Composition and constituents of blood; blood groups and Rh factor in man, coagulation, factors and mechanism of coagulation; acid-base balance, thermo regulation.

(b) Oxygen and carbon dioxide transport; haemoglobin : constituents and role in regulation.

(c) Nutritive requirements; role of salivary glands, liver, pancreas and intestinal glands in digestion and absorption.

(d) Excretory products; nephron and regulation of urine formation; osmoregulation.

(e) Types of muscles, mechanism of contraction of skeletal muscles.

(f) Neuron, nerve impulse—its conduction and synaptic transmission; neurotransmitters.

(g) Vision, hearing and olfaction in man.

(h) Mechanism of hormone action.

(i) Physiology of reproduction, role of hormones and pheromones.

3. Developmental Biology :

(a) Differentiation from gamete to neurula stage; dedifferentiation; metaplasia, induction, morphogenesis and morphogen; fate maps of gastrulae in frog and chick; organogenesis of eye and heart, placentation in mammals.

(b) Role of cytoplasm in and genetic control of development, cell lineage, causation of metamorphosis in frog and insects, paedogenesis and neoteny, growth, degrowth and cell death; ageing; blastogenesis; regeneration; teratogenesis; neoplasia.
(c) Invasiveness of Placenta; in vitro fertilization; embryo transfer, cloning.
(d) Baer's law; evo-devo concept.

APPENDIX II

Brief particulars relating to the Indian Forest Service (vide Rule 24)

(a) Appointment will be made on probation for a period of two years which may be extended. Successful candidates will be required to undergo probation in such place and in such manner and pass such examinations during the period of probation as the Government of India may determine.

(b) If in the opinion of Government, the work or conduct of an officer on probation is unsatisfactory or shows that he/she is unlikely to become efficient, Government may discharge him/her forthwith, or, as the case may be, revert him/her to the permanent post on which he/she holds a lien, or would hold a lien had he/she not been suspended, under the rules applicable to him/her prior to his/her appointment to the service.

(c) On the conclusion of his/her period of probation, Government may confirm the officer in his/her appointment or, if his/her work or conduct has in the opinion of Government been unsatisfactory, Government may either discharge him/her from the service or may extend his/her period of probation for such further period as Government may think fit.

(d) If the power to make appointment in the service is delegated by government to any officer that officer may exercise any of the power of Government under clause (b) and (c) above.

(e) An officer belonging to the Indian Forest Service will be liable to serve anywhere in India as allocated either under Central Government or under State Government.

(f) Scale of pay:

Levels in The Pay Matrix and appointment in these Levels — (i) Pay Matrix: The Level of pay in the Pay Matrix admissible to a member of Service which shall be deemed to have come into force from the 1st day of January, 2016 shall be as follows:-

(A) Junior Scale:	Level 10 in the Pay Matrix
(B) Senior Scales:-	
(i) Senior Time Scale:	Level 11 in the Pay Matrix
(ii) Junior Administrative Grade:	Level 12 in the Pay Matrix
(iii) Selection Grade:	Level 13 in the Pay Matrix
(C) Super Time Scale:-	
(i) Conservator of Forests:	Level 13A in the Pay Matrix
(ii) Chief Conservator of Forests:	Level 14 in the Pay Matrix
(D) Above Super Time Scale:-	
(i) Additional Principal Chief Conservator of Forests (AS):	Level 15 in the Pay Matrix
(ii) HAG+ Scale:	Level 16 in the Pay Matrix
(iii) Apex Scale:	Level 17 in the Pay Matrix

Dearness allowance will be admissible in accordance with the orders issued from time to time.

A probationer will start on the junior time scale and be permitted to count the period spent on probation towards leave, pension or increment in the time scale.

(g) Provident Fund—Officers of the Indian Forest Service are governed by the All India Services (Provident Fund) Rules, 1955, as amended from time to time.

(h) Leave—Officers of the Indian Forest Service are governed by the All India Services (Leave) Rules, 1955, as amended from time to time.

(i) Medical Attendance—Officers of Indian Forest Service are entitled to medical attendance benefits admissible under the All India Services (Medical Attendance) Rules, 1954, as amended from time to time.

(j) Retirement Benefits—Officers of the Indian Forest Service Appointed on the Basis of Competitive Examination are governed by the All India Services (Death-cum-Retirement Benefits) Rules, 1958, as amended from time to time.

APPENDIX III

REGULATIONS RELATING TO THE PHYSICAL EXAMINATION OF CANDIDATES

(Vide Rule 18)

[These regulations are published for the convenience of candidates and to enable them to ascertain the probability of their being of the required physical standard. The regulations are also intended to provide guidelines to the medical examiners. The medical examination shall be conducted in respect of the candidates who have been declared finally successful on the basis of [illegible] examination and shall consist of [illegible] medical examination which the medical board may prescribe for a candidate, including Radiographic Examination of the chest (X-ray test). The Government of India reserve to themselves absolute discretion to reject or accept any candidate after considering the report of the Medical Board.]

1. To be passed as fit for appointment, a candidate must be in good mental and bodily health and free from any physical defect likely to interfere with the efficient performance of the duties of his/her appointment.

2. Walking test: The male candidates (both PH and non-PH) will be required to qualify in walking test of [illegible] kilometres to be completed in 4 hours and female candidates (both PH and non-PH) [illegible] kilometres to be completed in 4 hours. The arrangement for conducting the test will be made by the Director General of Forests, Government of India so as to synchronise with the sitting of the Medical Board.

Provided in case a candidate either fails to complete the walking test within the prescribed time limit or fails to appear in the test, will be given another opportunity to appear in the walking test. In case he/she again fails to appear/pass the test, no further opportunity will be given to him/her to appear in the walking test."

3. (a) In the matter of the correlation of age, height and chest girth of candidates of Indian (including Anglo-Indian) race, it is left to the Medical Board to use whatever correlation figures are considered most suitable as a guide in the examination of the candidates. If there be any disproportion with regard to height, weight and chest girth, the candidate should be hospitalised for investigation and X-ray of the chest taken before the candidate is declared fit or not fit by the Board. However, the X-ray of the chest will be done in respect of only such candidates who are directed to appear before the Medical Board for Part-II of the medical examination.

(b) The minimum standard for height and chest girth without which candidates cannot be accepted are as follows :—

Height	Chest (fully expanded)	Expansion
[illegible] cms.	[illegible] cms.	5 cms. (for men)
150 cms.	79 cms.	5 cms. (for women)

The following minimum height standards may be allowed in the case of candidates belonging to Scheduled Tribes and to races such as Gorkhas, Nepalese, Assamese, Meghalaya, Tribal, Ladakhese, Sikkimese, Bhutanese, Garhwalese, Kumaonis, Nagas and Arunachal Pradesh candidates whose average height is distinctly lower :—

Men	[illegible] cms.
Women	[illegible] cms.

4. The candidate's height will be measured as follows :—

He/She will remove his/her shoes and be placed against the standard with his/her feet together and the weight thrown on the heels and not on the toes or other sides of the feet. He/She will stand erect without rigidity and with the heels, calves, buttocks and shoulders touching the standard. The chin will be depressed to bring the vertex of the head level under the horizontal bar and the height will be recorded in centimetres and parts of a centimetre to halves.

5. The candidate's chest will be measured as follows :—

He/She will be made to stand erect with his/her feet together and to raise his/her arms over his/her head. The tape will be so adjusted around the chest that its upper edge touches the inferior angles of the shoulder blades behind and lies in the same horizontal plane when the tape is taken round the chest. The arms will then be lowered to hang loosely by the side and care will be taken that the shoulders are not thrown upwards or backwards so as to displace the tape. The candidate will then be directed to take a deep inspiration several times and the maximum expansion of the chest will be carefully noted and the minimum and maximum will then be recorded in centimetres [illegible], [illegible] etc. In recording the measurements fraction of less than half centimetre should not be noted.

N.B.—The height and chest of the candidate should be measured twice before coming to a final decision.

6. The candidate will also be weighed and his/her weight recorded in kilograms. Fraction of half a kilogram should not be noted.

7. The candidate's eye-sight will be tested in accordance with the following rules. The results of each test will be recorded :—

(i) General—The candidate's eyes will be submitted to a general examination directed to the detection of any disease or abnormality. The candidate will be rejected if he/she suffers from any squint or morbid conditions of eyes, eyelids or contiguous structures of such a sort as to render or are likely to render him/her unfit for service at a future date.

(ii) Visual Acuity—The examination for determining the acuteness of vision includes two tests, one for distant vision, the other for near vision. Each eye will be examined separately.

There shall be no limit for minimum naked eye acuity but naked eye vision of the candidates shall however, be recorded by the Medical Board or other medical authority in every case, as it will furnish the basic information with regard to the condition of the eye.

The Indian Forest Service is a technical service.

The standards for distant and near vision with or without glasses shall be as follows:—

Distant vision		Near vision	
Better eye (corrected vision)	Worse eye	Better eye (corrected vision)	Worse eye
6/6	6/9	J.1	J.2

Type of correction permitted: Spectacles, Contact Lens, Radial Keratotomy.

NOTE:—

(1) Fundus Examination:—In every case of Myopia Fundus Examination should be carried out and the result recorded. In the event of pathological condition being present which is likely to be progressive and affect efficiency of the candidate, he/she should be declared unfit.

The total amount of Myopia (including the cylinder) shall not exceed −4.00D. Total amount of Hypermetropia (including the cylinder) shall not exceed +4.00D.

Provided that in case a candidate is found unfit on ground of high myopia, the matter shall be referred to a special Board of three ophthalmologists to declare whether this myopia is pathological or not. In case it is not pathological the candidate shall be declared fit, provided he fulfils the visual requirements otherwise.

(2) Colour Vision:—(i) The testing of colour vision shall be essential.

(ii) Colour perception should be graded into a higher and lower grade depending upon the size of the aperture in the lantern as described in the table below:—

		Higher grade colour perception	Lower grade colour perception
1.	Distance between the lamp and candidate	16 ft.	16 ft.
2.	Size of aperture	1.3 mm.	13 mm.
3.	Time of exposure	5 seconds	5 seconds

(iii) Satisfactory colour vision constitutes recognition with ease and without hesitation of signal red, signal green and white colours. The use of Ishihara's plates shown in good light and suitable lantern like Edridge Green's shall be considered quite dependable for testing colour vision. While either of the two tests may ordinarily be considered sufficient, it is essential to carry out the lantern test. In doubtful cases where a candidate fails to qualify when tested by only one of the two tests, both the tests should be employed.

NOTE : For appointment to the Indian Forest Service, Lower Grade of colour vision will be considered sufficient.

(3) Field of vision:—The field of vision shall be tested in respect of all services by the confrontation method. Where such test gives unsatisfactory or doubtful results the field of vision should be determined on the perimeter.

(4) Night Blindness:—Night blindness need not be tested as a routine, but only in special cases. No standard test for the testing of night blindness or dark adaptation is prescribed. The Medical Board should be given the discretion to improvise such rough tests e.g. recording of visual acuity with reduced illumination or by making the candidate recognise various objects in a darkened room after he/she has been there for 20 to 30 minutes. Candidates own statements should not always be relied upon but they should be given due consideration.

(5) Ocular conditions other than visual acuity:—(a) Any organic disease or a progressive refractive error which is likely to result in lowering the visual acuity should be considered as a disqualification.

(b) Trachoma:—Trachoma unless complicated shall not ordinarily be a cause for disqualification.

(c) Squint:—Where the presence of binocular vision is essential squint even if the visual acuity is of the prescribed standard, should be considered as a disqualification.

(d) One eyed persons:—The employment of one eyed individuals is not recommended.

4. Blood Pressure:

The Board will use its discretion regarding Blood Pressure.

A rough method of calculating normal maximum systolic pressure is as follows:—

(i) With young subjects 15-25 years of age, the average is about 100 plus the age.

(ii) With subjects over 25 years of age the general rule of 110 plus half the age seems quite satisfactory.

N.B.—As a general rule any systolic pressure over 140 mm and diastolic over 90 mm should be regarded as suspicious and the candidate should be hospitalised by the Board before giving their final opinion regarding the candidate's fitness or otherwise. The hospitalisation report should indicate whether the rise in blood pressure is of a transient nature due to excitement etc. or whether it is due to any organic disease. In all such cases X-ray and electro-cardiographic

Examination of heart and blood urea diastasis but should also be done as a routine. The final decision as to the fitness or otherwise of a candidate will, however, rest with the Medical Board only.

Method of taking Blood Pressure

The mercury manometer type of instrument should be used as a rule. The measurement should not be taken within fifteen minutes of any exercise or excitement. Provided the patient and particularly his arm is relaxed, he may be either lying or sitting. The arm is supported comfortably at the patient's side in a more or less horizontal position. The arm should be freed from clothes to the shoulder. The cuff completely deflated should be applied with the middle of the rubber over the inner side of the arm and its lower edge an inch or two above the bend of the elbow. The following turns of cloth bandage should spread evenly over the bag to avoid bulging during inflation.

The brachial artery is located by palpitation at the bend of the elbow and the stethoscope is then applied lightly and centrally over it below, but not in contact with the cuff. The cuff is inflated to about 200 mm Hg and then slowly deflated. The level at which the column stands when soft successive sounds are heard represents the Systolic pressure. When more air is allowed to escape the sound will be heard to increase in intensity. The level at which the well-heard clear sound change to soft muffled fading sounds represents the diastolic pressure. The measurement should be taken in a fairly brief period of time as prolonged pressure of the cuff is irritating to the patient and will vitiate the readings. Re-checking, if necessary, should be done only a few minutes after complete deflation of the cuff. Sometimes as the cuff is deflated sounds are heard at a certain level; they may disappear as pressure falls and reappear at a still lower level. This "Silent gap" may cause error in reading.

9. The urine (passed in the presence of the examiner) should be examined and the results recorded. Where a Medical Board finds sugar present in a candidate's urine by the usual chemical test, the Board will proceed with the examination with all its other aspects and will also specially note any signs or symptoms suggestive of diabetes. If except for the glycosuria the Board finds the candidate conforms to the standards of medical fitness required they may pass the candidate "fit" subject to the glycosuria being non-diabetic and the Board will refer the case to a specified specialist in medicine who has hospital and laboratory facilities at his disposal. The Medical Specialist will carry out whatever examination clinical and laboratory tests he considers necessary including a standard blood sugar tolerance test, and will submit his opinion to the medical board upon which the medical board will base its final opinion "fit" or "unfit". The candidate will not be required to appear in person before the Board on the second occasion. To exclude the effects of medication it may be necessary to retain a candidate for several days in hospital under strict supervision.

10. A woman candidate who as a result of tests is found to be pregnant of 12 weeks standing or over should be declared temporarily unfit until the confinement is over. She should be re-examined for fitness certificate six weeks after the date of confinement subject to the production of a medical certificate of fitness from registered medical practitioner.

11. The following additional points should be observed:

(a) That the candidate's hearing in each ear is good and that there is no sign of disease of the ear. In case it is defective the candidate should be got examined by the ear specialist; provided that if the defect in hearing is remediable by operation or by use of hearing aid a candidate cannot be declared unfit on that account provided he/she has no progressive disease in the ear. The following are the guidelines for the medical examination authority in this regard:

(i)	Marked or total deafness in one ear other ear being normal.	Fit for non-technical jobs if the deafness is up to 30 decibels in higher frequency.
(ii)	Perceptive deafness in both ears in which some improvement is possible by a hearing aid.	Fit in respect of both technical and non-technical jobs if the deafness is upto 30 decibels in speech frequencies of 1000 to 4000 Hz.
(iii)	Perforation of tympanic membrane of central or marginal type.	(i) One ear normal other ear perforation of tympanic membrane present: Temporarily unfit. Under improved condition of ear surgery a candidate with marginal or other perforation in both ears should be given a chance by declaring him temporarily unfit and then he may be considered under 4 (ii) below. (ii) Marginal or attic perforation in both ears: unfit. (iii) Central perforation in both ears: Temporarily unfit.
(iv)	Ears with mastoid cavity sub normal hearing on one side/on	(i) Either ear normal hearing other ear Mastoid cavity Fit for both technical/ non-technical jobs.

	both sides	(i) Residual deafness of both sides: unfit for technical jobs (ii) For non-technical jobs: if hearing impairment is 30 Decibles in either ear with or without hearing aid
(5)	Persistently discharging ear operated/un-operated	Temporarily unfit for both technical and non-technical jobs.
(6)	Chronic inflammatory/allergic condition of nose with or without bony deformities of nasal septum.	(i) A decision will be taken as per circumstances individual cases. (ii) If deviated nasal septum is present with symptoms—Temporarily unfit.
(7)	Chronic inflammatory conditions of tonsils and/or Larynx.	(i) Chronic inflammatory conditions of tonsils and/or Larynx—Fit. (ii) Hoarseness of voice of severe degree if present then—Temporarily unfit.
(8)	Benign or locally malignant tumours of ENT.	(i) Benign Tumours—Temporarily unfit. (ii) Malignant Tumour—Unfit.
(9)	Otosclerosis	If the hearing is within 30 decibels after operation or with the help of hearing aid—Fit.
(10)	Congenital defects of ear, nose or throat.	(i) If not interfering with function—Fit. (ii) Stuttering of severe degree—Unfit.
(11)	Nasal Poly	Temporarily unfit.

(d) that his/her speech is without impediment;

(e) that his/her teeth are in good order and that he/she is provided with dentures where necessary for effective mastication (well filled teeth will be considered as sound);

(f) that the chest is well formed and his/her chest expansion sufficient; and that his/her heart and lungs are sound;

(g) that there is no evidence of any abdominal disease;

(h) that he/she is not ruptured;

(i) that he/she does not suffer from hydrocele, a severe degree of varicose veins or piles;

(j) that his/her limbs, hands and feet are well formed and developed and that there is free and perfect motion of all his joints;

(k) that he/she is not suffering from any inveterate skin disease;

(l) that there is no congenital malformation or defect;

(m) that he/she does not bear traces of acute or chronic disease pointing to an impaired constitution;

(n) that he/she bears marks of efficient vaccination; and

(o) that he/she is free from communicable disease.

13. Radiographic examination of the chest for detecting any abnormality of the heart and lungs, which may not be apparent by ordinary physical examination, will be restricted to only such candidates who are declared finally successful at the concerned Indian [illegible] Examination.

The decision of the Chairman of the Central Standing Medical Board (conducting the medical examination of the concerned candidates) about the fitness of the candidate shall be final.

When any defect is found it must be noted in the certificate and the medical examiner should state his opinion whether or not it is likely to interfere with the efficient performance of the duties which will be required of the candidate.

In case of doubt regarding health of a candidate, the Chairman of the Medical Board may consult a suitable Hospital Specialist to decide the issue of fitness or unfitness of the candidate for Government Service e.g. if a candidate is suspected to be suffering from any mental defect or aberration, the Chairman of the Board may consult a Hospital Psychiatrist/Psychologist, etc.

NOTE: Candidates are warned that there is no right of appeal from medical board, special or standing appointed to determine their fitness for the above service. If, however, Government are satisfied on the evidence produced before them of the possibility of an error of judgement in the decision of the first Board, it is open to Government to allow an appeal to second Board. Such evidence should be submitted within one month of the date of the communication in which the decision of the first Medical Board is communicated to the candidate, otherwise no request for an appeal to a second Medical Board will be considered.

If any medical certificate is produced by a candidate as a piece of evidence about the possibility of an error of judgement in the decision of the first Board, the certificate will not be taken into consideration unless it contains a note by the medical practitioner concerned to the effect that it has been given in full knowledge of the fact that the candidate has already been rejected as unfit for service by the Medical Board.

Medical Board's Report

The following intimation is made for the guidance of the Medical Examiner:—

1. The standard of physical fitness to be adopted should make due allowance for the age and length of service, if any, of the candidate concerned.

No person will be deemed qualified for admission to the Public Service who shall not satisfy Government or the appointing authority, as the case may be that he/she has no disease constitutional affliction, or bodily infirmity unfitting him/her, or likely to unfit him/her for that service. It should be understood that the question of fitness involves the future as well as the present and that one of the main objects of medical examination is to secure continuous effective service, and in the case of candidates for permanent appointment to prevent early pension or payments in case of premature death. It is at the same time to be noted that the question is one of the likelihood of continuous effective service and that rejection of a candidate need not be advised on account of the presence of defect which in only a small proportion of cases is found to interfere with continuous effective service.

A lady doctor will be coopted as a member of the Medical Board whenever a woman candidate is to be examined.

The report of the Medical Board should be treated as confidential.

In case where a candidate is declared unfit for appointment in the Government Service the grounds for rejection may be communicated to the candidate in broad terms without giving minute details regarding the defects pointed out by the Medical Board.

In case where a Medical Board considers that a minor disability disqualifying a candidate for Government service can be cured by a treatment (medical or surgical) a statement to that effect should be recorded by the Medical Board. There is no objection to a candidate being informed of the Board's opinion to this effect by the appointing authority and when a cure has been effected it will be open to the authority concerned to ask for another Medical Board.

In the case of candidates who are to be declared "Temporarily unfit" the period specified for re-examination should not ordinarily exceed six months at the maximum. On re-examination after the specified period these candidates should not be declared temporarily unfit for a further period but a final decision in regard to their fitness for appointment or otherwise should be given.

(a) Candidate's Statement and Declaration :

The candidate must make the statement required below prior to his/her medical examination and must sign the Declaration appended thereto. His attention is specially directed to the warning contained in the Note below:—

1. State your Name in full ______________________________ (in Block letters)

2. State your age and birth place ______________________________

3. (a) Do you belong to races such as Gorkhas, Garhwalis, Assamese, Meghalaya, Tribals, Ladakhies, Sikkimese, Bhutanese, Nepalese, Kumaonis, Nagas and Arunachal Pradesh, whose average height is distinctly lower. Answer 'Yes' or 'No' and if the answer is 'Yes' state the name of tribe/race ______

(b) Have you ever had small pox, intermittent or any other fever, enlargement or suppuration of glands, spitting of blood, asthma, heart disease, lung disease, fainting attacks rheumatism, appendicitis?

OR

any other disease or accident requiring confinement to bed and medical or surgical treatment.

4. Have you suffered from any form of nervousness due to over work or any other cause ? ______________

5. Furnish the following particulars concerning your family :

Father's age if living and state of health	Father's age at death and cause of death	No. of brothers living, their ages and state of health	No. of brothers dead, their ages at death and cause of death
1.			
2.			
3.			

Mother's age if living and state of health	Mother's age at death and cause of death	No. of sisters living, their ages and state of health	No. of sisters dead, their ages at death and cause of death
1.			
2.			
3.			

6. Have you been examined by a Medical Board before? ____________

7. If answer to the above is 'Yes' please state what services you were examined for? ____________

8. Who was the examining authority? ____________

9. When and where was the Medical Board held ____________

10. Result of the Medical Board's examination, if communicated to you or if known ____________

11. All the above answers are to the best of my knowledge & belief, true and correct and I shall be liable for action under law for any material infirmity in the information furnished by me or suppression of relevant material information. The furnishing of false information or suppression of any factual information would be a disqualification and is likely to render me unfit for employment under the Government. If the fact that false information has been furnished or that there has been suppression of any factual information comes to notice at any time during my service, my services would be liable to be terminated.

Candidate's Signature

Signed in my presence

Signature of the Chairman of the Board

PROFORMA-II

Report of Medical Board on ____________ (name of candidate) physical examination.

1. General Development : Good ______ Fair ______ Poor Nutrition ______ Thin ______ Average ______ Obese ______ Height ______ Best Weight ______ When? ______ Any recent change in Weight ______ Temperature ______

2. Girth of chest :-

(1) After full inspiration

(2) After full expiration

Skin : Any obvious disease

3. Eyes :-

(1) Any disease ____________

(2) Night blindness ____________

(3) Defect in colour vision ____________

(4) Field of vision ____________

(5) Visual acuity ____________

(6) Fundus Examination ____________

Acuity of vision	Naked eye	With glasses	Strength of glasses
		Sph. Axis	Cyl.
Distant Vision			
R.E.			
L.E.			
Near Vision			
R.E.			
L.E.			
Hypermetropia (manifest)			
R.E.			
L.E.			

4. Ears : Inspection ____________

Hearing : Right Ear ____________ Left Ear ____________

5. Glands ____________ Thyroid ____________

6. Condition of teeth ____________

7. Respiratory System : Does Physical examination reveal anything abnormal in the respiratory organs?

If yes, explain fully.

8. Circulatory System :-

(a) Heart, Any organic lesions? ____________ Pulse Standing ____________

After hopping 25 times ____________

2 minutes after hopping ____________

(b) Blood Pressure : Systolic ____________ Diastolic ______

8. Abdomen : Girth ______ Tenderness ______
Hernia ______
(a) Palpable ______ Liver ______ Spleen ______
Kidneys ______ Tumours ______
(b) Haemorrhoids ______ Fistula ______
9. Nervous System : Indication of nervous or mental disability ______
10. Loco-motor System : Any abnormality ______
11. Genito Urinary System : Any evidence of Hydrocele, Varicocele etc.
Urine Analysis :
(a) Physical appearance ______
(b) Sp. Gr. ______
(c) Albumen ______
(d) Sugar ______
(e) Casts ______
(f) Cells ______
12. Is there anything in the health of the candidate likely to render him unfit for the efficient discharge of his duties in the Indian Forest Service?
NOTE : In case of a female candidate, if it is found that she is pregnant of 12 weeks standing or over she should be declared temporarily unfit vide Regulation 22.
13. Has he been found qualified in all respects for the efficient and continuous discharge of duties in the Indian Forest Service?
Note (i) : The Board should record their findings under one of the following three categories :
(i) Fit ______
(ii) Unfit on account of ______
(iii) Temporarily unfit on account of ______
NOTE (ii) : If the candidate has not undergone chest X-Ray test, in view of this, the above findings are not final and are subject to the report on chest X-ray test.
Place :
Date :

Signature

Chairman
Member
Member
Seal of the Medical Board

PROFORMA—II

Candidate's Statement/Declaration
1. State your Name ______
(in Block letters)
2. Roll No.
Candidate's Signature
Signed in my presence
Signature of the Chairman of the Board

To be Filled in by the Medical Board

Note : The Board should record their findings under one of the following three categories in respect of chest X-ray test of the candidate.
Name of the candidate ______
(i) Fit ______
(ii) Unfit on account of
(iii) Temporarily unfit on account of
Place
Date :

Signature

Chairman
Member
Member
Seal of the Medical Board

Uploaded by Dte. of Printing at Government of India Press, Ring Road, Mayapuri, New Delhi-110064
and Published by the Controller of Publications, Delhi-110054.

ALOK KUMAR
Digitally signed by ALOK KUMAR
Date: [illegible]