



ODISHA PUBLIC SERVICE COMMISSION

ADVERTISEMENT NO. 16 OF 2023-24

Special Drive recruitment to the posts of Assistant Fisheries Officer, Group-B of Odisha Fisheries Cadre under Fisheries & Animal Resources Development Department.

WEBSITE - <http://opsc.gov.in>

Online applications are invited from the prospective candidates through the proforma application to be made available on the Website of the Commission (<http://opsc.gov.in>). **The link for Registration and submission of Registered online application shall be available from 16.09.2023 to 16.10.2023 (Note: 16.10.2023 is the last date for submission of Registered Online Application)** for Special Drive recruitment to **62 (Sixty-two)** posts of **Assistant Fisheries Officer, Group-B** of Odisha Fisheries Cadre under Fisheries & ARD Department carrying the scale of pay of Rs.44,900/- in Level-10 of ORSP Rules, 2017 with usual Dearness and other Allowances as may be sanctioned by the Government of Odisha from time to time. The type of recruitment is normal.

2. VACANCY POSITION: As per requisition filed by the Fisheries & ARD Department, Government of Odisha, the vacancy position along with reservation thereof is given below:-

Sl. No.	Category	No. of vacancies
1.	Scheduled Caste	08 (03-w)
2.	Scheduled Tribe	54 (18-w)
	Total	62 (21-w)

- (a) Out of the total of **62** nos. posts mentioned above, **02** posts are reserved for **Ex-Servicemen**, **01** post is reserved for **Sports Persons** and **04** posts are reserved for **Persons with Disabilities whose permanent disability is 40% and more**. Candidates belonging to PWD category, Ex-servicemen & Sports Persons shall be adjusted against the categories to which they belong. The details of such reservations are given below :-

Sl. No.	Category	Sub-Category	No. of vacancies reserved
(i)	Ex-Servicemen		02
(ii)	Sports Persons		01
(iii)	Persons with Disabilities	Cat-I (Visually Impaired) i.e. LV	01
		Cat-II (Partially deaf with suitable aid) i.e. HI	01
		Cat-III (Orthopaedically Handicapped) i.e. OL,OA,BL(MNR)	01
		Cat-IV (Multiple Disabilities)	01

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- (b) The physical requirements and functional classification of Persons with Disabilities suitable for the job as Assistant Fisheries Officer are as follows :

Physical requirements H, SE, ST, S & W	Functional classification LV, HI, OL, OA & BL(MNR)
H-Work performed by hearing / speaking	LV-Low vision
SE- Work performed by seeing	HI-Partially deaf with suitable aid
ST- Work performed by standing	OL-One leg affected (R or L)
S- Work performed by sitting on bench or chair	OA-One arm affected (R or L) – (a) impaired reach; (b) weakness of grip; (c) ataxia.
W- Work performed by walking	BL(MNR)-Both leg affected but not arms Mobility not be restricted

- (c) Exchange of reservation between Scheduled Caste & Scheduled Tribe will not be considered.
- (d) In case of non-availability or availability of insufficient number of eligible women candidates belonging to any particular category, the vacancies or the remaining vacancies will be filled up by male candidates of that category.
- (e) The number of vacancies to be filled up on the basis recruitment is subject to change by Government without notice, depending upon the exigencies of public service at the discretion of the State Government.

3. AGE:

A candidate must have attained the age of 21 (twenty one) years and must not be above the age of 43 (Forty-three) years as on the 1st day of January 2023 i.e. he/she must have been born not earlier than 2nd January, 1980 and not later than 1st January, 2002.

Persons with Disabilities whose permanent disability is 40% (forty percent) and more and belonging to **SC/ST** categories are eligible for **age relaxation benefit of 10 (Ten) years**.

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

Provided that a candidate who comes under more than one category mentioned above, he/she will be eligible for only one age relaxation benefit, which shall be considered most beneficial to him/her.

Date of birth entered in the High School Certificate or equivalent certificate issued by the concerned Board/Council will only be accepted by the Commission.

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4. EDUCATIONAL QUALIFICATION:

A candidate must have possessed a Bachelor of Fishery Science (B.F.Sc.) Degree from any recognized University in India or abroad.

5. METHOD OF SELECTION:

The selection of candidates for recruitment to the posts shall be made on the basis of **Written examination and Interview (Viva Voce test).**

- (i) The written examination will be of Objective type Multiple Choice Question pattern and consist of two papers whose details is placed at **Annexure-A.**
- (ii) Paper-I shall be of 400 marks with 200 questions carrying 2 marks for each question. Duration of time shall be two and half an hours.
- (iii) Paper-II shall be of 400 marks with 200 questions carrying 2 marks for each question. Duration of time shall be two and half an hours.
- (iv) Their shall be no negative marking for wrong response or answer.
- (v) The candidates who secure such minimum qualifying marks in the written examination, as may be fixed by the Commission shall be called to appear at the Viva Voce test in the following manner:

“WHERE THE NUMBER OF VACANCIES IS UPTO 2(TWO), THE NUMBER OF CANDIDATES TO BE CALLED FOR VIVA VOCE MAY BE 5(FIVE). WHERE THE NUMBER OF VACANCY EXCEEDS 2, THE NUMBER OF CANDIDATES TO BE CALLED FOR VIVA VOCE MAY BE TWICE THE NUMBER OF VACANCIES.”

- (vi) The Interview (Viva Voce test) shall consist of 100 marks.
- (vii) Merit list of the selected candidates will be prepared by the Commission basing on the total marks secured in the Written Examination and Interview (Viva Voce test).

NOTE : Any details relating to this recruitment like cut-off marks, individual marks etc. shall only be declared on the website of the Commission after publication of the final result and select list.

6. PLACE OF EXAMINATION:

The written examination shall be held at Cuttack. It may also be held at Bhubaneswar/Balasore/Berhampur/Sambalpur depending on the number of candidates from the respective zones.

The candidates are to mention their choice of Examination Zone at appropriate place in the online application form.

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7. OTHER ELIGIBILITY CONDITIONS:

- (i) A candidate must be a citizen of India;
- (ii) He/She must be able to read, write and speak Odia and have –
 - a) Passed Middle School Examination with Odia as a language subject; **or**
 - b) Passed Matriculation or equivalent examination with Odia as a medium of examination in non-language subject; **or**
 - c) Passed in Odia as language subject in the final examination of Class-VII from a school or educational institution recognized by the Government of Odisha or the Central Government; **or**
 - d) Passed a test in Odia in Middle English School Standard conducted by the School & Mass Education Department.
- (iii) A candidate must be of good mental condition and bodily health and free from any physical defect likely to interfere with the discharge of his duties in the service. A candidate, who after such Medical examination as the Government may prescribe, is not found to satisfy these requirements shall not be appointed to the service.
- (iv) A candidate, who has more than one spouse living, will not be eligible for appointment unless the State Government has exempted his/her case from operation of this limitation for any good and sufficient reasons;
- (v) Government servants, whether temporary or permanent, are eligible to apply provided that they possess the requisite qualification and are within the prescribed age-limit as provided under Para-3 and 4 of this advertisement. **They must inform their respective Head of Offices in Writing regarding submission of their application for this recruitment and obtain 'No Objection Certificate',**
- (vi) If a candidate has at any time, been debarred for a certain period/chance(s) by the Odisha Public Service Commission or other State Public Service Commission or U.P.S.C. from appearing at any examination/Viva Voce test, he/she will not be eligible for such recruitment for that specified period/chance(s);
- (vii) **Only those candidates, who fulfil the requisite qualification & are within the prescribed age limit etc. by the closing date of submission of online application, will be considered eligible;**
- (viii) Every candidate selected for appointment shall be examined by the Medical Board. A candidate, who does not satisfy the requirement after medical examination, shall not be appointed.

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Provided that the candidates who do not join the place of their posting in Tribal/Backward/Rural areas shall be permanently debarred from joining any Fishery Service under the State Government.

- (ix) A candidate who claims change in his/her name after having passed the High School Certificate Examination or equivalent examination, he/she is required to furnish copy of publication of the changed name in the local leading daily newspaper as well as copy of notification in the Gazette in support of his/her change of name.

8. IMPORTANT POINTS:

- (i) **Online applications submitted to OPSC if found to be incomplete in any respect are liable to rejection without entertaining any correspondence with the applicants on that score;**
- (ii) **Admission to the Written Examination / Viva Voce test will be provisional. If on verification at any stage before or after the written examination / viva voce test, it is found that a candidate does not fulfil all the eligibility conditions, his/her candidature will be liable to rejection. Decision of the Commission in regard to eligibility or otherwise of candidate shall be final;**
- (iii) Concessions meant for **S.T./ S.C. by birth** are admissible to the Scheduled Tribes and Scheduled Castes of Odisha only;
- (iv) **Community / Caste status once mentioned by the candidates under the appropriate box of the online application form will be treated as final and the same shall not be changed subsequently under any circumstances.**
- (v) This advertisement should not be construed as binding on the Government to make appointment;
- (vi) **Any misrepresentation or suppression of information by the candidate in the online application, will result in cancellation of his/her candidature or penalty, as decided by the Commission be imposed on the candidate;**
- (vii) Mere inclusion of a candidate's name in the list shall confer no right to appointment unless the Government is satisfied after such enquiry as may be considered necessary, that the candidate is suitable in all respect for appointment to the service.

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9. CERTIFICATES/DOCUMENTS TO BE ATTACHED:

Candidates those who are called for the Viva Voce test will be required to bring with them the hard copy of online application form along with copies of certificates, mark sheets etc. and originals of the same for document verification on the date of Viva Voce test which will be notified later on in due course, failing which he/she shall not be allowed to appear at the Viva Voce test. **The candidates are required to mention on copy of each document "Submitted by me" and put their full signature & date on the same.**

- (i) H.S.C. or equivalent certificate in support of declaration of age issued by the concerned Board /Council;
- (ii) Intermediate/+2 Examination Certificate issued by the concerned Board /Council;
- (iii) B.F.Sc. Degree certificate issued from a recognized University;
- (iv) Mark-lists in support of all the aforesaid Examinations (H.S.C to B.F.Sc) passed including fail marks, if any, issued by the concerned Board / Council /University.

NOTE 1:

- (a) **Candidates who have not been awarded percentage of marks, but only "GRADE MARKS", should, along with their applications, produce the conversion certificate from the concerned University indicating the actual equivalent percentage of marks and the conversion formula failing which, their applications are liable to be rejected.**
- (b) **While filling up the marks in the online application form, the candidate has to mention the actual marks secured by him/her in each Semester/Annual examination in the H.S.C, +2 & B.F.Sc. Degree (excluding the marks secured in the Extra Optional paper).**
- (v) Fishery Registration Certificate;
- (vi) Required Odia test pass certificate;
- (vii) Caste Certificate **by birth** in support of claim as S.C./S.T. whichever applicable.
- (viii) Four recent passport size photographs (unsigned and unattested) which has been uploaded in the Online Application Form, along with the printout/hard copy of the Online Application Form;
- (ix) **Ex-Servicemen** are required to attach copy of Discharge Certificate issued by the Commanding Officer of the Unit last served. They must submit an affidavit undertaking that he/she has not been appointed against any civil post after retirement from military service, wherever applicable;

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- (x) Permanent Disability Certificate (indicating percentage of permanent disability i.e. **40% and more**);
- (xi) Sports Persons Identity Card issued by the Director of Sports, Odisha;
- (xii) Any proof of identity.

NOTE 2:

- (i) **Candidates claiming to be belonging to S.C./S.T. categories of Odisha by birth are required to submit copy of the relevant Caste Certificate as mentioned in their online application form and issued by the competent authority in the prescribed form.**
- (ii) **Women candidates belonging to S.C. /S.T. Categories are required to submit Caste Certificates by birth showing "daughter of". Caste Certificates by virtue of marriage (i.e. showing "wife of") is not acceptable.**
- (iii) **Community (Caste status) once mentioned by the candidates in the online application shall not be changed under any Circumstances.**

The competent authorities are:- District Magistrate/ Collector or Additional District Magistrate or Sub-divisional Magistrate/Sub-Collectors or Executive Magistrates or Revenue Officers, not below the rank of Tahasildar /Additional Tahasildar of Government of Odisha.

NOTE 3: B.F.Sc. Degree Certificate, Caste Certificate, Odia Test Pass Certificate, Discharge Certificate of Ex-Servicemen, Identity Card of Sports Persons and Permanent Disability Certificate indicating percentage of permanent disability must have been issued by the competent authority on or before the last date fixed for submission of online application form as indicated above.

10. GROUND OF REJECTION OF APPLICATION:

Applications of candidates will be rejected by the Commission on any of the following grounds:-

- (a) In-complete online application form.
- (b) Non-submission of hard copy of online application form at the time of verification of original documents.
- (c) Declaration not signed (full signature) by the candidate in the hard copy of online application form.
- (d) Not coming within age limit as mentioned in Para-3 of the Advertisement (Overage relaxation shall not be allowed to PWD candidates having less than 40% disability).

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- (e) No required educational qualification as provided under Para-4 of the Advertisement.
- (f) Not furnishing copies of certificates/documents as provided under Para-9 of the Advertisement.
- (g) Odia Test pass evidence not furnished as required under Para-7(ii) of the Advertisement.
- (h) Submission of wrong information / false information about qualification / Age/ O.T. Pass evidence / Category Status (S.T. / S.C. / PWD / Women / Ex-servicemen / Sports Person etc.).
- (i) Suppression of facts / information about eligibility, if any.
- (j) Any other ground as per the decision of the Commission.

N.B:- APPLICATION / CANDIDATURE OF A CANDIDATE SHALL BE REJECTED AT ANY STAGE OF RECRUITMENT PROCESS, WHEN DISCREPANCY IS NOTICED / DETECTED.

11. HOW TO APPLY:

- (a) Candidates must go through the details of this Advertisement available in the Website of OPSC before filling up online application form.
- (b) Candidates must apply online through the concerned Website of the OPSC <http://opsc.gov.in>. Applications received through any other mode would not be accepted and summarily rejected.
- (c) **The candidates are requested to upload the self attested copies of the documents as per para-9 of the advertisement.**
- (d) **Before filling up the online application form, the candidates must go through the following documents available at OPSC portal.**
- (e) The online application form is automated and system driven and will guide the candidate seamlessly in filling the application. The requisite options shall be enabled and information shall be asked as per data furnished by the candidate. Before filling up the information, ensure that accurate information is fed, for edit option is limited and on confirmation there is no scope for further edit even if wrongful entry has been made while filling up application.
- (f) Candidates are requested to upload the scanned image of latest passport size photograph along with scanned image of his/her full signature and scanned image of Left Hand Thumb Impression(LTI) in the online application form. Uploaded photograph, Specimen (full) signature and LTI must be clearly identifiable / visible, otherwise the application of the candidate is liable to be rejected by the Commission and no representation from the candidate will be entertained.

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- (g) Candidates should keep at least **two** copies of latest passport size photograph which is uploaded to the online application form for future use.
- (h) *On successful submission of the online Registration, an unique "Permanent Public Service Account Number (PPSAN)" will be assigned to the applicant. Candidates are required to take printout of the finally submitted online Registration/Re-registration and Application and finally submitted Online Application forms and put his/her signature under the declaration for submission to OPSC along with copies of requisite certificate & documents as and when asked.*
- (i) The candidates are advised to submit the Online Application Form well in advance without waiting for the closing date to avoid last hour rush.
- (j) *Certificate of Admission of written examination to the eligible candidates will be uploaded in the Website of the OPSC prior to the date of written examination which will be published in the Website of the Commission and Newspapers. The candidates are required to download their Admission Certificate from the Website of the Commission and produce the same at the Examination centre for admission to the written examination. No separate correspondence will be made on this score.*
- (k) Notice to candidates for document verification & interview and "Attestation form" & " Bio-data form" shall be uploaded in the website of OPSC prior to the date of Document Verification/Interview.
- (l) Any complaint on the conduct of examination must be sent to the Grievance Wing of the Commission by e-Mail (opsc@nic.in) within 07 (Seven) days of completion of the examination.

12. FACILITATION COUNTER:

*To resolve any Technical problem faced in filling up of online Registration/Re-registration and Application forms, candidate may contact OPSC Technical Support **over Telephone No. 0671-2304707** between **10.30 A.M. to 1.30 P.M. & 2.00 P.M. to 5.00 P.M.** on any Odisha Government working days.*

In case of any guidance/information on this advertisement & recruitment, candidates may go through the **FAQ** available in the website of the Commission or contact the O.P.S.C. Facilitation Counter over **Telephone No. 0671-2304141/ 2305611 & Extn.-207** on any working day between **10.30 A.M. to 1.30 P.M. & 2.00 P.M. to 5.00 P.M.**

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The candidates are required to visit the website of the Commission at <http://opsc.gov.in> for detailed information about important notice, rejection of application, the date & time of Written Examination/Document Verification/Interview and also keep track of publication of various notices to the effect in the leading local daily newspapers for information.

CLOSING DATES

- 1. THE LINK FOR ONLINE APPLICATION AND SUBMISSION SHALL BE AVAILABLE IN THE WEBSITE FROM 16.09.2023 TO 16.10.2023 (11:59 P.M).
(Note : 16.10.2023 is the last date for submission of Registered online application form)**
- 2. Only online applications received within the deadline i.e. 16.10.2023 shall be accepted.**

NB: THE ONLINE APPLICATIONS, IF FOUND DEFECTIVE IN ANY RESPECT IS LIABLE TO BE SUMMARILY REJECTED.

CUTTACK

DATE: 12.09.2023


SECRETARY

ODISHA PUBLIC SERVICE COMMISSION
CUTTACK

ANNEXURE-A

Syllabus and Plan of Written Examination for recruitment to the post of Assistant Fisheries Officer under Fisheries & ARD Department

The Written examination will consist of two papers (Paper-I and Paper-II), each paper carries 400 marks.

A. Plan of Examination

Subject	Settings	Duration	No. of Questions	Total Marks	Type of Question
Paper-I	1 st	2 ½ hrs	200	400	Objective & Subject specific
Paper-II	2 nd	2 ½ hrs	200	400	-do-

B. Outline of Course Syllabus

PAPER-I

1. Fresh Water Aquaculture, 2. Aquaculture in Reservoirs, 3. Ornamental Fish Production and Management, 4. Genetics and Breeding, 5. Finfish Hatchery Management, 6. Fish Nutrition and Feed Technology, 7. Coastal Aquaculture and Mariculture, 8. Taxonomy of Finfish, 9. Anatomy and Biology of Finfish, 10. Inland Fisheries, 11. Physiology of Finfish and Shellfish, 12. Marine Fisheries, 13. Information and Communication Technology, 14. Fisheries Extension Education, 15. Fisheries Co-operatives and Marketing and 16. Fisheries Policy and Law

1. Fresh Water Aquaculture

Major species cultured, production trends and prospect in different parts of the world. Freshwater aquaculture resources-ponds, tanks, lakes, reservoirs etc. Nursery, rearing and grow-out ponds preparation and management-control of aquatic weeds and algal blooms, predatory and weed fishes. liming, fertilization/manuring, use of biofertilizers, supplementary feeding. Water quality management. Selection, transportation and acclimatization of seed. Traits of important cultivable fish and shellfish and their culture methods-Indian major carps, exotic carps, air breathing fishes, cold water fishes, freshwater prawns, mussels. Wintering ponds, quarantine ponds and isolation ponds. Sewage-fed fish culture. Principles of organic cycling and detritus food chain. Use of agro-industrial waste and biofertilizer in aquaculture. Composite fish culture system of Indian and exotic carps-competition and compatibility. Exotic fish species introduced to India. Culture of other freshwater species. Medium and minor carps, catfish and murrels. Species of fish suitable for integrated aquaculture. Integration of aquaculture with agriculture/horticulture. Integration of aquaculture with livestock. Cultivation of aquatic macrophytes with aquaculture (makahana). Paddy cum Fish/Shrimp Culture.

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2. Aquaculture in Reservoir

Definition of reservoirs in India; nature and extent of reservoirs, topography and species diversity; importance of morpho-edaphic index in reservoir productivity and classification; factors influencing fish production; trophic phases in reservoir; pre-impoundment and post-impoundment stages and their significance in establishment of reservoirs fisheries. Salient features of reservoir limnology and their significance to fisheries development; management of small, medium and large reservoirs; present status and future prospects in reservoirs fish production. Fisheries of some important reservoirs; recent advances in reservoirs fisheries management; conservation measures in reservoir fisheries. Fish stocking in Reservoirs. Role of cage and pen culture in enhancement of fish production from reservoirs; history of cage culture, advantages of cage culture; selection of suitable site of cage culture; cage materials, designs, shape, size and fabrication; cage frames and supporting system. Integration of cage culture with other farming systems. History of pen culture, pen materials, fabrication; breeding of fish in pen; rearing of spawn in pen; grow-out from pens. Suitable species for culture in cages and pens; constraints in cage and pen culture; economics of cage and pen culture.

3. Ornamental Fish Production and Management

World trade of ornamental fish and export potential. Different varieties of exotic and indigenous fishes. Principles of a balanced aquarium. Fabrication, setting up and maintenance of freshwater and marine aquarium. Water quality management. Water filtration system-biological, mechanical and chemical. Types of filters. Aquarium plants and their propagation methods. Lighting and aeration. Aquarium accessories and decorative. Aquarium fish feeds. Dry, wet and live feeds. Breeding and rearing of ornamental fishes. Broodstock management. Application of genetics and biotechnology for producing quality strains. Management practices of ornamental fish farms. Common diseases and their control. Conditioning, packing, transport and quarantine methods. Trade regulations and wild life act in relation to ornamental fishes.

4. Genetics and Breeding

Principles of genetics and breeding, Gene and chromosome as basis of inheritance, Mendel's law of inheritance – complete and incomplete dominance, monohybrid and dihybrid ratios. Gene interactions – dominant and recessive epistasis. Pleiotropism. Lethal genes. Mutation. Sex - linked genes, sex influenced and sex limited traits. Linkage and crossing over. Introduction to population genetics. Hardy- Weinberg law and its significance. Chromosomal structure and aberrations. Chromosome manipulation techniques - androgenesis, gynogenesis and polyploidy and identification of ploidy. Sex determination. Cross breeding (hybridization) – types of cross breeding, heterosis and design of cross breeding programmes, hybridization in different fishes. Quantitative genetics – quantitative traits, polygenic traits, heritability. History and present status of selective breeding programs in aquaculture. Selection methods and mating designs. Design for selective breeding. Inbreeding and its consequences. Domestication methods. Seed certification and quarantine procedures. Cryopreservation of gametes. Principles of genetics and breeding, Gene and chromosome as basis of inheritance, Mendel's law of inheritance – complete and incomplete dominance, monohybrid and dihybrid ratios. Gene interactions – dominant and recessive epistasis. Pleiotropism. Lethal genes. Mutation. Sex - linked genes, sex influenced and sex limited traits. Linkage and crossing over. Introduction to population genetics. Hardy- Weinberg law and its significance. Chromosomal structure and aberrations. Chromosome manipulation techniques – androgenesis, gynogenesis

and polyploidy and identification of ploidy. Sex determination. Cross breeding (hybridization) – types of cross breeding, heterosis and design of cross breeding programmes, hybridization in different fishes. Quantitative genetics – quantitative traits, polygenic traits, heritability. History and present status of selective breeding programs in aquaculture. Selection methods and mating designs. Design for selective breeding. Inbreeding and its consequences. Domestication methods. Seed certification and quarantine procedures. Cryopreservation of gametes.

5. Finfish Hatchery Management

Freshwater and marine fish seed resources. Natural breeding of finfishes. Selection of riverine spawn collection sites, gears used and methods of collection. Spawn quality and quantity indices. Advantages and disadvantages of riverine seed collection. Sexual maturity and breeding season of various cultivable species. Development of gametes in male and female. Fish egg and embryonic development. Methods of breeding; bundh breeding - wet and dry bundhs, collection and hatching of eggs, factors involved in bundh breeding, advantages and disadvantages of bundh breeding. Induced breeding of warmwater finfishes, environmental factors affecting spawning, sympathetic breeding. Hypophysation of fishes. Fish pituitary gland – its structure, collection, preservation and preparation of extract for injection, dosages and methods of injection. Brood-stock management and transportation of brood fish. Synthetic hormones used for induced breeding of carps. Different types of fish hatcheries-traditional, Chinese, glass jar and modern controlled hatcheries. Causes of mortalities of eggs and spawn and remedies. Spawn rearing techniques. Use of anesthetics in fish breeding and transport. Breeding techniques for Indian major carps, exotic carps, mahaseers, trouts, tilapias, catfishes, grey-mullets, milk fish, pearl spot, sea bass, sea hourse, groupers, pacu, cobia, pompanos and indigenous fishes, etc. Off-season and multiple breeding of carps.

6. Fish Nutrition and Feed Technology

Fundamentals of fish nutrition and growth in fish. Principal nutrients and nutritional requirements of cultivable fish and shellfish. Nutritional energetics: definition and forms of energy partitioning. Methods of feed formulation and manufacturing. Forms of feeds: wet feeds, moist feeds, dry feeds, mashs, pelleted feeds, floating and sinking pellets. Feed additives: binders, antioxidants, enzymes, pigments, growth promoters, feed stimulants. Feed storage: use of preservatives and antioxidants. Feed evaluation: feed conversion ratio, feed efficiency ratio, protein efficiency ratio, net protein utilization and biological value. Essential aminoacids and by-pass protein, Energy requirements, digestibility coefficient, pepsin digestibility. Feeding devices and methods. Non-conventional feed ingredients and antinutritional factors. Digestive enzymes, feed digestibility. Factors affecting digestibility. Nutritional deficiency diseases.

7. Coastal Aquaculture and Mariculture

An overview of sea farming and shore-based aquaculture in different parts of the world. Resources for shore-based aquaculture and sea farming in India. Traits of important cultivable fish and shellfish (seabass, mullet, milkfish, grouper, cobia, snappers, ayu, pearlspot, tiger shrimp, white shrimp, mud crab, mussel, clam, oysters (edible and pearl oyster), lobster, seaweeds, Seed resources. Shore based aquaculture system: traditional (pokkali, bheries, gazaris, khazans), semi- intensive, intensive aquaculture practice of commercially important species of fish and shellfish. Methods of Shellfish Culture rafts, racks, cages, poles and ropes., Water and soil quality

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management. Estimation of growth, survival and pond productivity. Seaweed culture, Pearl culture, Sea ranching.

8. Taxonomy of Finfish

Principles of taxonomy. Nomenclature, types. Classification and interrelationships. Criteria for generic and specific identification. Morphological, morphometric and meristic characteristics of taxonomic significance. Major taxa of inland and marine fishes up to family level. Commercially important freshwater and marine fishes of India and their morphological characteristics. Introduction to modern taxonomic tools: karyotaxonomy, DNA barcoding, protein analysis and DNA polymorphism.

9. Anatomy and Biology of Finfish

Study of external and internal anatomy of important groups of finfish. Study of oral region and associated structures. Digestive system and associated digestive glands. Food and feeding habits of commercially important fishes. Qualitative and quantitative methods of analysis of gut contents. Circulatory system, respiratory system, nervous system, urino-genital system, endocrine system, skeletal systems and sensory organs. Reproductive biology – maturity stages, gonado-somatic index, ponderal index, fecundity, sex ratio and spawning. Eggs and larval stages and developmental biology. Age and growth determination by direct and indirect methods. Fish migration - type and significance. Tagging and marking.

10. Inland Fisheries

Freshwater fishery regions of the world and their major fish species composition. Global inland fish production data. Capture fishery resources of India. Potential of inland water bodies with reference to respective state. Problems in the estimation of inland fish catch data. Fishing crafts and gears. Major riverine and estuarine systems of India. Major brackish water lakes and their fisheries. Fisheries of major reservoirs / natural lakes of India. Flood-plain capture fishery- present status of their exploitation and future prospects. Cold water fisheries of India.

11. Physiology of Finfish and Shellfish

Water as a biological medium. Gas exchange; Circulation; Excretion; Osmoregulation; Reproductive physiology; Muscle physiology; Sense organs; Energy and nutrient status of food; Nitrogen balance; Standard and active metabolism; Energy utilization; Effect of environmental factors on physiology of fin and shellfishes. Stress related physiological changes. Structure and functions of important endocrine glands.

12. Marine Fisheries

Classification and definition of fishery zones and fishery resources of world. Overview of marine fisheries resources of the world and India. Major exploited marine fisheries of India, their developmental history and present status. Important pelagic - demersal fish, shellfish and seaweed resources of India. Traditional, motorized and mechanized fisheries according to major gears. Potential marine fishery resources of the India's EEZ. GIS and Remote sensing in marine capture fishery.

13. Information and Communication Technology

IT and its importance. IT tools. IT-enabled services and their impact on society: computer fundamentals; hardware and software; input and output devices; word and

character representation; features of machine language, assembly language, high-level language and their advantages and disadvantages; principles of programming-algorithms and flowcharts; Operating systems (OS) - definition, basic concepts, introduction to WINDOWS and LINUX Operating Systems; Local area network (LAN), Wide area network(WAN), Internet and World Wide Web, HTML and IP; Introduction to MS Office - Word, Excel, Power Point. Audio visual aids - definition, advantages, classification and choice of A.V aids; cone of experience and criteria for selection and evaluation of A.V aids; video conferencing. Communication process, Berlo's model, feedback and barriers to communication

14. Fisheries Extension Education

Introduction to extension education and fisheries extension - concepts, objectives and principles; extension education, formal and informal education; History and role of fisheries extension in fisheries development. Fisheries extension methods-individual, group and mass contact methods and their effectiveness, factors influencing their selection and use; characteristics of technology, transfer of technology process; important TOT programs in fisheries; role of NGOs and SHGs in fisheries; Fisheries co-management; Adoption and diffusion of innovations, adoption and diffusion process, adopter categories and barriers in diffusion of fisheries innovations; Extension program planning and evaluation - steps and importance; participatory planning process. Basic concepts in rural sociology and psychology and their relevance in fisheries extension; social change, social control, social problems and conflicts in fisheries; gender issues in fisheries; theories of learning, learning experience, learning situation

15. Fisheries Co-operatives and Marketing

Principles and objectives of co-operation, co-operative movement in fisheries in India, structure, functions, status and problems of fisheries co-operatives management in relation to resources, production and marketing. Role of credit for fisheries development, credit requirements of fishers, source and type of credit/finance, micro-credit, indigenous and institutional finance, structure of institutional finance in fisheries; returns, risk bearing ability and recovery in fisheries sector; role of NABARD in fisheries development; role of insurance in fish and shrimp farming and industry. Basic accounting procedures, profit and loss account. Introduction to marketing management; core marketing concepts: market structure, functions and types, marketing channels and supply chain, marketing margins, marketing environment, marketing strategies, product development and product mix, consumer behavior and marketing research. Fish markets and marketing in India, demand and supply of fish, market structure and price formation in marine and inland fish markets; cold storage and other marketing infrastructure in India; export markets and marketing of fish and fishery products; Trade liberalization and fisheries markets. Integrated marketing approach in fisheries. Sea food export case study on product and market diversification- export and import policies (fisheries). New product development and market segmentation. Export and import policies relevant to fisheries sector.

16 . Fisheries Policy and Law

Introduction to public administration, principles of organization and management of public enterprise. Central and State responsibilities for fisheries development, organizational set up of fisheries administration at the Centre and state levels. Present relevance of past fisheries policies and recent policies in fisheries sector. Functions and powers of functionaries of department of fisheries, corporations and cooperatives. Different central and state level fisheries institutions. Role of Central and

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State Government in the regulatory activities of Aquaculture and fisheries. Implementation of community based resource management plans. Historical review of fisheries development and management in India and world. International agencies / organizations for promotion of fisheries worldwide. Fisheries legislation: Overview of fisheries and aquaculture legislations in India. Indian Fisheries Act, 1897. Environmental legislation; Water Act, Air Act and Environmental (Protection) Act. International environmental legislation and its impact on fisheries. Laws relating to conservation and management of fishery resources in marine and inland sectors. Recent changes in land reforms. Land reforms legislation as applicable to aquaculture. Judicial judgments relating to Aquaculture. Objectives, functions and authority of fishery regulatory agencies like Coastal Regulatory Zone (CRZ) and Aquaculture Authority of India. Brackishwater aquaculture act, Marine fisheries policy, Laws relating to fish products and marketing. International Law of the Seas and international commissions on fisheries and their impact.

PAPER-II

1. Fish and Shellfish Pathology, 2. Microbial and Parasitic Diseases of Fish and Shellfish, 3. Pharmacology, 4. Fish Toxicology, 5. Soil and Water Chemistry, 6. Limnology, 7. Marine Biology, 8. Aquatic Ecology, Biodiversity and Disaster Management, 9. Fish in Nutrition, 10. Fish Products and Value Addition, 11. Fish By-Products and Waste Utilization, 12. Aquaculture Engineering and 13. Fishing Craft Technology and 14. Fishing Gear Technology.

1. Fish and Shellfish Pathology

Significance of finfish and Shellfish diseases in aquaculture. Host, Pathogen and Environment Interaction. Disease development process. Stress in aquaculture and its role in disease development. Pathological processes: Cellular response to injury, Inflammatory response to diseases, Pathogenicity mechanism of parasite, bacteria, virus and fungus. Case history and clinical sign in disease diagnosis. Role of physical (injuries, health, cold) chemical (pH, salinity, toxins, ammonia, nitrogenous waste, endogenous chemicals and metabolites, free radicals, oxidants) soil and water parameters in fish health. Nutritional diseases. Non-infectious diseases.

2. Microbial and Parasitic Diseases of Fish and Shellfish

General characteristics, life cycle, diagnosis, prevention and treatment of parasitic, bacterial, fungal and viral diseases of finfish and shellfish. OIE listed diseases. Disease surveillance and reporting. Quarantine and health certification in aquaculture. Health management strategies in Aquaculture: Vaccines, Immunostimulants, Bioremediation, Probiotics, Crop rotation, Good and Best management practices. SPF and SPR stocks –development and application. Bio-security principles, Sanitary and phytosanitary Agreement, Disease control through environmental management. Importance of Biofilm, Biofloc, Periphyton in aquatic Health Management, Zoonotic diseases. Principles of disease diagnosis, conventional, molecular and antibody based diagnostic methods, Rapid diagnostic methods.

3. Pharmacology

Introduction to Pharmacology: History, Importance, Terms and Definitions, Drug development, Screening and Nomenclature, Scope of pharmacology in fishes. Route of Administration and Method of application to fish. Source of

Drugs. Pharmacotherapeutic classification of drugs. Pharmacokinetics: Biological membrane, absorption, distribution, biotransformation and Excretion of drugs. Factors influencing drug metabolism. Pharmacodynamics: Principles of drug action, concept of drug receptor, nature, chemistry, classification. Functions of receptor. Transducer mechanism, second messenger, non receptor mediated action. Dose Response Relationship, half life withdrawal period, potency, efficacy, threshold dose, therapeutic dose, maximal dose, toxic dose, lethal dose. Factors modifying drug action, Adverse drug effects, drug interaction and Bioassay of drugs. Salient features in drug acting on digestive system, and reproductive system. Drugs used in fish transporation. Drug resistance. Recent advances in Pharmacology, biostatistics in experimental Pharmacology, Pharmaceutical industry for aqua-medicines.

4. Fish Toxicology

General Toxicology: Definitions, Branches of Toxicology, Historical developments, Classification of poison. Types of poisoning- Toxicity testing - Chronocity factor, Untoward effects, Common causes, Diagnosis of poisoning, Factors modifying toxicity, Toxicokinetics, Toxicodynamics, General approaches to diagnosis and treatment of poisoning. *Systemic Toxicology:* Toxicity caused by metal and non-metals, Phytotoxins- Toxic principles of various alkaloids and toxic plants, Drug toxicity and toxicity caused by agrochemicals. Mycotoxins, Bacterial toxins. Collections and dispatch of specimens in Toxicological cases, Toxicity of drugs in Aquaculture: Maximum Residual Limits (MRL) of various drugs and chemicals in fish- Metabolism of toxic substances by aquatic organisms.

5. Soil and Water Chemistry

Analytical chemistry: principles, applications and types. Classical methods of analytical chemistry, volumetry and gravimetry. Solutions: Standard solutions, titration, indicators, dilute solutions, units of concentration: standard curve; nomograph. Chemistry of water: the water molecule, properties of pure water, fresh water and sea water. Composition of waters: surface water, ground water and sea water. Dissolved gasses: Factors affecting natural waters. Acid, base, salts: Hydrogen ions, modern concept of pH and buffer. Water analysis: collection and preservation of water samples. Measurement of temperature, transparency, turbidity, determination of pH, electrical conductivity, salinity, chlorinity, total solids (TDS, TSS, TVS, TVDS), dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, Calcium, Magnesium, Inorganic Nitrogen (Ammonium and Nitrate) and phosphorus. Water quality criteria/ requirements for Aquaculture. Soil Chemistry: origin and nature of soils. Physical properties of soil; soil colour, texture, structure, pore size, bulk density, water holding capacity. Soil types and their distribution. Soil chemistry: soil colloids, cation exchange, organic carbon, Carbon - Nitrogen ratio, soil fertility. Soil reaction: acidity, alkalinity, conductivity, redox - potential. Submersed soils: wet lands, peat soils, fluxes between mud and water, methane and hydrogen sulphide formation. Saline soils, Alkali soils, acid sulphate soils, iron pyrites, soil reclamation. Soil analysis: collection and preparation of soil samples. Determination of soil texture, water holding capacity, pH, conductivity, organic carbon, nitrogen, phosphorus, lime requirement. Soil and water amendmets: lime manures, fertilizers, micronutrients, zeolites, alum, gypsum. Environmental ameliorative: chlorination, deodorizers, bacterial formulation. Soil quality criteria/ requirements for aquaculture.

6. Limnology

Introduction to limnology: inland water types, their characteristics and

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distribution; ponds and lakes; streams and rivers; dynamics of lentic and lotic environments. Lakes - their origin and diversity. Famous lakes of the world and India; nature of lake environment; morphometry, physical and chemical conditions and related phenomena; biological relations: influence of physical and chemical conditions on living organisms in inland waters. Plankton: planktonic organisms; classification of plankton; distribution of plankton: geographic, vertical, horizontal and seasonal distribution of phytoplankton and zooplankton; seasonal changes of body form in planktonic organisms; food of planktonic organisms; primary productivity: Aquatic plants: characteristics, classification, zonation, seasonal variations, quantity produced chemical composition distribution in different waters, limnological role. Nekton: composition, distribution, movements. Benthos: classification; periphyton; zonation; distribution; movements and migration; seasonal changes in benthos, profundal bottom fauna. Biological productivity: circulation of food material; classification of lakes based on productivity; laws of minimum; biotic potential and environmental resistance; quantitative relationships in a standing crop; trophic dynamics; successional phenomena; indices of productivity of lakes; artificial enrichment. Lotic environments: running waters in general; physical conditions; classification of lotic environments, biological conditions; productivity of lotic environments. influence of currents; plant growth; plankton; nekton; benthos; temporary and head waters streams; ecological succession.

7. Marine Biology

Introduction to Marine Biology: Divisions of marine environment- pelagic, benthic, euphotic, aphotic divisions and their subdivisions. Life in oceans - general account of major groups of phytoplankton, sea weeds, major zooplankton groups. Environmental factors affecting life in the oceans-salinity, temperature, light, currents, waves, tides, oxygen, and carbon dioxide. Vertical migration of zooplankton, Phytoplankton-Zooplankton relationship, geographical and seasonal variation in plankton production, plankton and fisheries. Inter tidal ecology: Rocky shore, sandy shore and mud flats, zonations, communities, and the adaptation. Mud banks: formation, characteristics. Estuaries: Classification, Physico-chemical factors, Biota and productivity, examples of some Indian Estuaries. Boring and fouling organisms. Nekton outline, composition of nekton, habitats of nekton. Bioluminescence and indicator species, Blooms, Red tides: cause and effects.

8. Aquatic Ecology, Biodiversity and Disaster Management

Aquatic environment, Flora and fauna: Components of aquatic systems, Aquatic productivity, nutrient cycles, energy flow, food chain. Animal associations: Symbiosis, commensalisms, parasitism, prey-predator relationship, host parasite relationship. Aquatic biodiversity-its importance. species diversity, genetic diversity, habitat diversity, diversity indices. Ecological and evolutionary processes. Ecological niches - lagoons, estuaries, mangroves, coral reefs, flood plains, coastal wet lands, bheels, oxbow lakes. Threats to biodiversity- habitat destruction, introduction of exotic species, Conservation of habitats, marine parks and sanctuaries. Conservation programmes for endangered species, *ex situ* and *in situ* conservation, captive breeding and management of endangered species. Various national and international conventions and regulations concerning biodiversity, including use of selective gears and exclusion devices.

Disaster Management in Fisheries: Basic concepts: Hazard, risk, vulnerability, disaster, capacity building. Multi-hazard and disaster vulnerability of India. Types of natural and manmade hazards in fisheries and aquaculture - cyclones, floods, droughts, tsunami, El-nino, algal blooms, avalanches, pollution, habitat

destruction, over fishing, introduction of exotic species, landslides, epidemics, loss of bio-diversity etc. Causes, characteristics and effects of disasters. Management strategies: pre-disaster, during disaster and post-disaster. Pre-disaster: prevention, preparedness and mitigation; different ways of detecting and predicting disasters; early warning, communication and dissemination, community based disaster preparedness, structural and non-structural mitigation measures. During disaster: response and recovery systems at national, state and local, coordination between different agencies, international best practices. Post-disaster: Methods for assessment of initial and long term damages, reconstruction and rehabilitation. Prevalent national and global management practices in disaster management. Agencies involved in monitoring and early warnings at district, state, national and global levels. Sea safety and health. Acquaintance with fire-fighting devices. Life saving appliances and first-aid. Uses of distress signals and technologies. Relief and rehabilitation measures, trauma counselling.

9. Fish in Nutrition

Composition of fish with emphasis on nutritional value. Concept of Biological value, Protein Efficiency ratio, Net protein utilization. Amino acids of fish and shellfishes and importance of essential amino acids. Fish lipids: fatty acids, nutritional quality. Role of fish lipids in human nutrition. Non-protein nitrogen substances in fishes. Vitamins in fish: water soluble, fat soluble, significance in human nutrition. Minerals in fish: micro- and macro-elements, trace elements, significance in human nutrition. Other functional bio-molecules in fish – peptides, collagen and squalene. Effect of different kinds of cooking fish i.e. curry, frying, steaming, smoking, fermentation on nutrition value.

10. Fish Products and Value Addition

Principle of fish preservation and processing. Processing of fish by traditional methods– salting, sun drying, smoking, marinating and fermentation. Theory of salting, methods of salting–wet salting and dry salting. Drying and dehydration- theory, importance of water activity in relation to microbial growth. Sun drying and artificial drying- solar dryer. Packaging and storage of salted and dried fish. Different types of spoilage in salt cured fish. Quality standard for salted and dry fish. Fish preservation by smoking- chemical composition of wood smoke and their role in preservation. Methods of smoking and equipments used for smoking. Carcinogenic compound in wood and method store move them. Hurdle technology in fish preservation and processing. Marinaded and fermented fish products– role of acids in marinades, Fish and prawn pickles, fish sauce and Fish paste, traditional Indian fermented products. Fermented fish products of Southeast Asia. Principles and methods of preparation of various fish paste products like fish sausage, fish ham, surimi, fish cake, kamaboko etc. Fish muscle structure, myofibrillar protein and their role in elasticity formation. Extruded products – theory of extrusion, equipments used, advantages of extruded products, methods of preparation of extruded products. Value addition. Diversified fish products: battered and braided products- fish finger, fish cutlet, fish wafer, and fish soup powder etc. and imitation products. HACCP in safe products production.

11. Fish By-Products and Waste Utilization

Fish meal. Dry reduction and wet reduction methods – specification – packaging and storage. Fish oil – body oil – liver oil – extraction – purification – preservation – storage – application. Shrimp wastes – chitin – chitosan- production –

uses. Fish protein concentrate. Fish hydrolysate, partially hydrolyzed and deodorized fish meat, functional fish protein concentrate and their incorporation to various products. Fish silage – acid silage – fermented silage – application. Fish maws, shark leather, fish glue, fish gelatin, isinglass, pearl essence, shark fin rays, beach-de-mer. Biochemical and pharmaceutical products. Utilization of seaweeds: agar agar, algin, carrageenan.

12. Aquaculture Engineering

Fish Farm- Definition, objectives, types of farms; fresh water, brackish water and marine farms. Selection of site for aqua farm- site selection criteria, pre-investment survey viz., accessibility, physical features of the ground, detailed survey viz., site condition, topography, soil characteristics. Land Surveying- definition, principles of surveying, classification of surveying, instruments used for chaining, chaining on uneven or sloping ground and error due the incorrect chain length. Chain surveying- definitions, instruments used for setting out right angles, basic problems in chaining, cross staff survey. Compass surveying - definitions, bearing, meridians, whole circle bearing system, reduced bearing system, theory of magnetic compass, prismatic compass. Leveling - definitions, methods of leveling, leveling instruments, terms and abbreviations, types of spirit leveling. Plane table surveying- instruments required, working operation, methods. Contour surveying- definition, contour interval, characteristics of contour, contouring methods and uses of contour. Calculation of area of regular and irregular plane surfaces, Trapezoidal and Simpson's rule, volume of regular and irregular shape as applied to stacks and heaps, calculation of volume of pond. Earth work calculations- excavation, embankment, longitudinal slope and cross slope, calculation of volume of earth work as applied to roads and channels. Soil and its properties- classification of soil; soil sampling methods; three phase system of soil, definitions of soil properties and permeability of soil. Ponds - classification of ponds; excavated ponds, embankment ponds, barrage and diversion ponds; rosary system and parallel system. Planning of fish ponds, layout planning, materials planning, manual planning, comparison of square and rectangular ponds, large and small ponds; Types of ponds; nursing ponds, rearing ponds and stocking ponds. Design of ponds, pond geometry; shape, size, bottom slope of pond etc., construction ponds viz., marking, excavation etc., Dykes, types of dykes viz., peripheral dykes, secondary dyke, design of dykes, construction of dykes. Water distribution system- canal, types of canals; feeder canal, diversion canal etc., Pipe line system, Water control structures- types of inlet and out let and their construction. Water budget equation, Pond drainage system; seepage and the methods used for seepage control, evaporation; factors affecting evaporation, erosion of soil in dykes and its control. Site selection, planning and construction of coastal aqua farms. Brackish water fish farms- tide fed, pump fed farms, site selection - topography, tidal amplitude, soil and water sources etc., Hatcheries- site selection, infrastructural facilities; water supply system, main hatchery complex viz., Layout plan and design of hatcheries- brood stock ponds, artemia hatching tanks, sheds etc, Raceway culture system- site selection, layout plan, types of raceway culture system viz., parallel system, series system etc., Aerators- principles, classification of aerators and placement aerators. Pumps- purpose of pumping, types, selection of pump, total head, horse power calculation. Filters- types and constructions.

13. Fishing Craft Technology

Introduction: History & development of fishing crafts. Traditional fishing crafts of India. Classification of fishing crafts based on fabrication dimension, nature of fishing, depth of operation. History & development of mechanization of fishing crafts.

Basic geometric concepts and important terminologies of fishing vessel. Form coefficients, properties of irregular shapes Calculation of longitudinal and transverse sectional area of fishing craft by using Trapezoidal rule and Simpson's rules. State of equilibrium; Volume of displacement; centre of gravity (CG); centre of buoyancy (CB); vertical centre of gravity (VCB); longitudinal centre of gravity (LCB). Stability of fishing vessels- longitudinal and transverse. Various equilibrium of ships-stable, unstable and neutral; Light weight, Dead weight, Tonnage system; Gross Registered Tonnage (GRT), Net Registered Tonnage (NRT). Boat building materials: Choice of construction materials: Wood, properties, advantages and disadvantages. Deck fitting. Maintenance of fishing vessels. fouling and boring organisms; seasoning and preservation of wood. Constructional details of boat: Offset tables; Mould lofting; Backbone assembly of wooden boat. Constructional details of Steel, FRP, Ferro Cement and Aluminum boats. Introduction of Outboard and inboard engines

14. Fishing Gear Technology

Development fishing gears and Fishing Technology: Evolution of Fishing gears; Mechanization of Fishing; Basic classification of fishing gears- Principle, Subsidiary and Auxiliary gears. Classification of fishing gears and methods: FAO classification of fishing gear and methods of the world; International Standard Statistical Classification of Fishing gear (ISSCFG). Fishing gear materials: Natural materials and Synthetic netting materials and their classification. Types and important synthetic materials used in fishing gears. Raw-materials for synthetic material; Preparation of nylon (PA 6.66) material; Different types of fibres- continuous fibre; monofilament, staple and split fibers and production of single yarns. Identification of synthetic fishing gear materials: Visual observation, water test, solubility test, burning test and melting point test. Construction of twisted netting materials: Yarn, single yarns, folded yarns, netting twine, cable netting twine and cable netting twine of higher order; Construction of ropes and their higher order; construction of braided netting twines. Yarn numbering system - direct system: Tex system Denier system and calculation of resultant tex value. Indirect system : British count, metric count, runnage system and their conversion. Methods of Preparation of knotted and knotless webbing; advantage and disadvantages of knotted and knotless webbings. Shape of mesh: diamond; square hexagonal and their measurement. Properties of netting material: physical properties- Density, twist and amount of twist, Breaking strength-tenacity, & tensile strength, breaking length, abrasion resistance, elasticity, extensibility, water absorption &, shrinkage, sinking velocity, weather resistance, melting point and visibility. Chemical and Biological properties. Floats – buoys – its materials, types their properties; Classification of floats: based on shape and materials; calculation of buoyancy. Sinkers – types, materials, properties- negative buoyancy. Factors to be considered while designing /selection of fishing gears; Biological, Environmental, oceanographical, Vessel characteristics and mesh size regulation. Choice of netting materials for trawl, gillnet and purse seine. Classification of trawl gears. 2 seam trawl; 4 seam trawl and wing trawl. Design and construction of wing trawl. Rigging of trawl gear: Arrangements of bridles, sweep lines and attachment of ground gears: tickler chain, bobbins and rock hoppers and attachment of otter board.



