No. 8/1/2010-Estt.I/
Government of India
Central Water Commission

...

Room No. 305(s), Sewa Bhawan,
R.K. Puram, New Delhi – 110 066

Dated the 24th June, 2014

OFFICE MEMORANDUM

Subject: Departmental Examination for Engineering Officers of Central Water Commission.

The undersigned is directed to say that Departmental Examination for Engineering Officers of Central Water Commission is conducted every year in accordance with the Rules and Syllabus for Departmental Examination for engineering officers promulgated vide the erstwhile Ministry of Irrigation and Power's letter dated 25/1/60-Admn.I dated 23.12.1965, as amended from time to time. Keeping in view of the new issues emerging in the water sector of the country, Ministry of Water Resources vide letter No. 22/1/2013-E.I dated 4th June, 2014 has accorded its approval to the modifications in the existing Rules and Syllabus for the above said examination. A copy of the modified Rules and Syllabus for the Departmental Examination for Engineering Officers of Central Water Commission is enclosed.

2. It is requested that these modified Rules and Syllabus for the Departmental Examination for Engineering Officers of Central Water Commission may be brought to the notice of all officers concerned.

3. These orders are issued in supersession of the Ministry of Irrigation and Power's letter dated 25/1/60-Admn.I dated 23.12.1965.

24/06/2014

(D.R. Meena)
Under Secretary
Tel.: 26711031

Copy for information and necessary action to:

1. All Chief Engineers, CWC (Hq/Field)/ Commissioners, MoWR/ Chairman, GFCC/ Secretary, CEA/ CE (TCD), CEA/ GM, Farakka BP/ Secretary, SSCAC, Vadodara.
2. All Directors/SEs, CWC, HQ/Field.
3. Secretary, CWC/ Directors (Admn)/ Estt.I/Estt.II/ PCP/ TD/ Trg./ TC/ D&R Coord /RM Coord/ WP&P Coord), CWC, New Delhi
4. Ministry of Water Resources (Attn: Shri Narendra Singh,Under Secretary, Estt.I), Shram Shakti Bhawan, New Delhi.
5. SMD Dte. with the request that enclosed Rules & Syllabus may be uploaded in CWC website urgently.

Copy also for information to:

1. Sr. PPS to Chairman, CWC.
2. PPS to Member (DR)/PPs to Member (WP&P)/PPS to Member (RM), CWC.

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26/06/14
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सत्यमेव जयते
Government of India

RULES AND SYLLABUS FOR DEPARTMENTAL EXAMINATION FOR ENGINEERING OFFICERS OF CENTRAL WATER COMMISSION

CENTRAL WATER COMMISSION
NEW DELHI

JUNE, 2014

No. 8/1/2010-Estt.I/
Government of India
Central Water Commission

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2. It is requested that these modified Rules and Syllabus for the Departmental Examination for Engineering Officers of Central Water Commission may be brought to the notice of all officers concerned.

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24/06/2014

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2. All Directors/SEs, CWC, HQ/Field.
3. Secretary, CWC/ Directors (Admn)/ Estt.I/Estt.II/ PCP/ TD/ Trg./ TC/ D&R Coord /RM Coord/ WP&P Coord), CWC, New Delhi
4. Ministry of Water Resources (Attn: Shri Narendra Singh,Under Secretary, Estt.I), Shram Shakti Bhawan, New Delhi.

Copy also for information to:

1. Sr. PPS to Chairman, CWC.
2. PPS to Member (DR)/PPs to Member (WP&P)/PPS to Member (RM), CWC.

No. 22/1/2013-E.I
Government of India
Ministry of Water Resources
(Establishment-I)
*****

Shram Shakti Bhawan, Rafi Marg
New Delhi the dated 4th June, 2014

1436
6/6

To

The Chairman,
Central Water Commission
Sewa Bhawan, P. K. Puram
New Delhi.

Subject:-Review of existing Rules and Syllabus for conducting the Departmental Examination for Engineering Officers of Central Water Commission.

Sir,

I am directed to refer CWC's letter No. 8/1/2010-Estt.I/470 dated 20.03.2014 on the subject cited above and to convey the approval of the Secretary (WR) to the modification suggested by CWC in the existing Rules and Syllabus for the Departmental Examination for engineering officers of CWC.

Secretary C.W.C.
Dy. No. 1286
Date. 10/6/2014

Yours faithfully,

(Narendra Singh)
Under Secretary to the Govt. of India
Tel: 2371 6928

No. F.25/1/60-Adm.IV
Government of India
Ministry of Irrigation and Power

New Delhi, the 23rd Dec., 1965.

To

The Chairman,
Central Water & Power Commission,
Sewa Bhawan, R.K. Puram,
New Delhi.

Subject:- Departmental Examination for Engineering Officers of the Central Water and Power Commission.

Sir,

I am directed to say that the question of introducing a Departmental Examination for Engineering Officers of the Central Water & Power Commission has been under consideration for some time. The President has been pleased to decide that an annual Departmental Examination should be held for all Engineering Officers in the Grade of Assistant Director/Assistant Executive Engineer/Research Officer in the Central Water Commission including its regional and Subordinate Offices other than the Central Water and Power Research Station, Poona, in accordance with the provisions contained in the enclosed Rules. The Engineering Officers working in the grade of Extra Asst. Director/Asst.Engineer/Asst. Research Officer in the Central Water Commission may also be permitted to take the departmental examination subject to the conditions contained in the said Rules.

2. It is requested that these orders may please be brought to the notice of all officers concerned.

3. These orders are issued in supersession of this Ministry's letter No.45/1/56-Adm.I, dated the 9th November, 1959.

Yours faithfully,

Sd/-

(P.L. GUPTA)
Under Secretary to the Govt. of India

Rules for the Departmental Examination for Engineering Officers of Central Water Commission

1. Amended as per MoWR's approval vide letter No.22/1/2013-E.I dated 4th June, 2014	A Departmental Examination shall be conducted every year for Engineering Officers of the Rank of Assistant Director (AD) / Assistant Executive Engineer (AEE) in the Central Water Engineering Service, Gr.-A (CWES, Gr.-A). The number of papers, the marks for each paper and the subjects to which the examination shall be conducted and the detailed syllabus for each paper are given in **Annexure-I**.
2. (a) Amended as per MoWR's approval vide letter No.22/1/2013-E.I dated 4th June, 2014	All Engineering Officers (in service or who will join in future) of the rank of Assistant Director/Assistant Executive Engineer in the CWES, Gr.-A will be required to pass the Departmental Examination within 4 years of appointment/promotion to the posts provided that no officer avails of more than four chances.
(b) Amended as per MoWR's approval vide letter No.22/1/2013-E.I dated 4th June, 2014	Engineering officers of the rank of Assistant Director-II/Assistant Engineer in the Central Water Commission (CWC) or its Regional Offices, including National Water Academy, Pune, are also eligible to appear in the Departmental Examination. If they pass the Departmental Examination, they will not be required to pass the same again after promotion to the grade of Assistant Director/Assistant executive Engineer. The limitation of 4 years will not, however, apply in their case so long as they serve in the grade of Assistant Director-II/Sub-Divisional Engineer.
(c) Amended as per MoWR's approval vide letter No.22/1/2013-E.I dated 4th June, 2014	If the first Examination is held within six months of joining of a Direct Recruit AD / AEE in the CWES Gr.-A, it will not be taken into account and the limit of four chances will be extended suitably in order to enable the officer to take the examination held next.
(d) Retention of old provision	In exceptional cases, owing to exigencies of public service illness or due to other circumstances beyond his control, if an officer is unable to appear in or pass the Departmental Examination within the prescribed period, the Government may grant extension of the time for such period as may be deemed necessary.
(e) New provision inserted as per MoWR's approval vide letter No.22/1/2013-E.I dated 4th June,	An AD/AEE of CWC is expected to clear the Departmental Examination in the first available examination, subject to rule 2(c) above. Same is the case with AD/AEE who are promoted from AD-II/AE but have not cleared Departmental Examination while being AD-II/AE. If he / she does not clear the Departmental Examination in the first available examination, he

2014	/ she would have no claim to seniority in case officers junior to him / her, who have already cleared Departmental Examination and promoted as per available vacancies while he / she could not be promoted due to non-clearance of Departmental Examination.
3.	No officer, who fails to pass the Departmental Examination, shall be considered for promotion to the grade of Deputy Director (DD) / Executive Engineer (EE) in CWES, Gr.-A posts.
4. (a) Amended as per MoWR's approval vide letter No.22/1/2013-E.I dated 4th June, 2014	The date of passing the Departmental Examination prescribed for the Engineering officers of the CWES Gr.-A should be the date following the last date of the Departmental Examination in which an officer clears all the written papers as well as the viva-voce test.
(b) Amended as per MoWR's approval vide letter No.22/1/2013-E.I dated 4th June, 2014	Passing the Departmental Examination will not confer claim for promotion. It is only a qualifying test and not a test for seniority. Seniority shall not be disturbed in case of an officer passes the test earlier or in the same test gets a higher position than his seniors, subject to rule 2(e) above.
5. Amended as per MoWR's approval vide letter No.22/1/2013-E.I dated 4th June, 2014	The CWC shall constitute a Committee for conducting the Departmental Examination each year and notify the dates of examination for each year along with date for submission of application in prescribed format.
6. (a) Amended as per MoWR's approval vide letter No.22/1/2013-E.I dated 4th June, 2014	An officer who wishes to appear at the Examination shall submit an application to the concerned establishment in CWC through proper channel, in the prescribed format by a date not later than the date specified by the CWC.
(b) Amended as per MoWR's approval vide letter No.22/1/2013-E.I dated 4th June, 2014	The Heads of Offices shall promptly forward the applications to the concerned establishment in CWC. The date of receipt of application from the officer shall be the date on which he / she submits his application in the office where he / she is working for forwarding to concerned establishment of CWC.
7. (a) Amended as per MoWR's approval vide letter No.22/1/2013-E.I dated 4th June, 2014	The percentage of marks for passing in the individual paper and in aggregate shall be 50.

(b) Amended as per MoWR's approval vide letter No.22/1/2013-E.I dated 4th June, 2014	If a candidate fails to obtain the required percentage of marks in any paper or papers, he will be required to take the Examination in the paper or the papers in which he fails to secure 50% of the marks. In any and all circumstances, the limit of 4 chances to clear the examination shall hold good as per para 2 (a)
8.	The Government may amend, cancel or add to any of these provisions from time to time.

ANNEXURE – I

Syllabus for the Departmental Examination for Engineering Officers in the Central Water Commission

Information for candidates for the Departmental Examination of Central Water Engineers Service (Gr.-A) Officers

The Examination will consist of the following papers carrying the marks indicated against each:

	Paper	Marks	Time
1.	Professional Paper – I	100 Marks	3 Hrs.
2.	Professional Paper – II	100 Marks	3 Hrs.
3.	Professional Paper – III	100 Marks	3 Hrs.
4.	In addition, there shall be a Viva-Voce Test of 50 Marks		

The details of syllabus, marks and other instructions regarding the Departmental Examination are given below: -

I. Professional Paper-I

[Max. Marks – 100]

1. **Section A** (Common to both Civil & Mechanical Engineers) [Max. Marks – 60]

(a) Marks - (i) 20 Multiple choice objective type questions having 1 mark each
(ii) 5 short answer type questions (to be attempted out of 7 questions given in paper) having 8 marks each

(b) Syllabus

(i) Appraisal of Water Resources Projects:

Need of Project Appraisal of water resource projects, Guidelines for submission, Appraisal and Clearance of Irrigation, flood control and Multipurpose Projects, Check-list for timely appraisal of proposals submitted by the State Governments, Process of Project Appraisal, Appraisal of "Preliminary Project Report" and "Detailed Project Report", Various aspects of the project proposal to be examined by Central Water Commission (CWC) and outside agencies with emphasis on irrigation planning, hydrology, cost estimation, inter-state issues, design of important structures and B.C.Ratio, Statutory clearances required to be produced by the project authorities during appraisal of the project proposals,

Preparation of proposals for consideration of the Advisory Committee of Ministry of Water Resources (MoWR).

(ii) Inter-State Aspects of the Water Resources Development projects:

Constitutional Provisions related to water and Inter-State Rivers, Acts enacted under the Constitutional Provisions such as the Inter-State River Water Disputes Act-1956 and the River Boards Act-1956, etc., Provision in National Water Policy with regard to sharing of waters of inter-State rivers, Guidelines for sharing of waters of inter-State / international rivers, Mechanism for adjudication / resolution of inter-State river water disputes, General idea about Agreements / Awards of Tribunals on sharing of waters of inter-State rivers. General concepts of conflicts resolution in water, criteria for water allocation etc.

(iii) Monitoring of Projects by CWC and Central and External Assistance to States for Irrigation Development:

Background, objective, various schemes regarding central assistance, terminology, funding criteria and procedures including Memorandum of Understanding (MoU), special provisions for specified States / areas, role of CWC in monitoring of various types of projects - General, Centrally Funded [like Accelerated Irrigation Benefit Programme (AIBP), Command Area Development & Water Management (CADWM), Repair, Renovation & Restoration (RRR) of Water Bodies, etc] and Externally Aided Projects.

(iv) Association of CWC/MoWR with other Ministries & Departments:

Brief idea about area of association of CWC/ MoWR with National Disaster Management Authority (NDMA), Indian Council for Agricultural Reseach (ICAR), International Commission on Irrigation & Drainage (ICID) / Indian National Committee on Irrigation & Drainage (INCID), Bureau of Indian Standards (BIS), National Remote Sensing Centre (NRSC), Indian Space Research Organisation (ISRO), Survey of India (SOI), Geological Survey of India (GSI), Central Electricity Authority (CEA), Department of Telecom (DoT) and area of association of CWC with other organisations of MoWR like National Institue of Hydrology (NIH), National Water Development Agency (NWDA), Central Soil & Materials Research Stations (CSMRS), Central Water & Power Research Station (CWPRS), etc.

(v) Hydro-meteorological observation and water quality monitoring:

Hydrological observations

Introduction to Hydrological observations, purpose of observation, Selection and Establishment of Hydrological Observation Sites, Installation

of Gauge, Fixing of Center Line, Fixing of Target Posts, Establishment and Fixing of Pivot Point system, Marking of upstream and downstream Slope line, Construction of Musto Type and D-type and Temporary Bench Marks, Connection with GTS Bench Mark, Fixation of Zero of gauge, measurement of crosssection.

A) Gauge Observation: Type of gauge, Non-recording gauges and Recording gauges, Frequency of gauge observations and checking of gauges.

B) Discharge Observations:

(i) Direct Method of Discharge Observation (Area-velocity method): Aspects of Area-velocity method, segmentation of area of cross section, marking of segments, pivot point method, marking of segments for observation from a bridge.

a) Measurement of depth: wading rods, sounding rods, hand line or log line, echo sounder, weights for sounding lines, corrections necessary while using sounding lines: type, air line correction, wet line correction, accuracy of depth measurement record.

b) Measurement of Velocity: Measurement of velocity by current meters, types of current meters and their characteristics: rating of current meters, factors affecting accuracy of current meter readings and methods to compensate errors, Accuracy of discharge observation with current meter, care and check, methods of velocity measurement by a current meter, Computation of discharge , Measurement of velocity by floats, procedure and computation of discharge when velocity is measured by floats, Vertical Velocity Distribution analysis (VVD)

c) Area velocity method: by Wading a stream, by using boats and power launches, from a bridge, from a Cableway.

(ii) Indirect Methods of Discharge observations (Area-slope method, Discharge by Rating Curves)

a) Discharge estimation by area-slope method, limitation, choice of formula, value of Manning coefficient 'n', Selection of site, area and hydraulic mean radius of section, surface slope, procedure, record.

b) Discharge Estimation from stage-discharge relation.

c) Discharge estimation at hydraulic structures: limitation, discharge estimation at a dam, discharge estimation at sluices, discharges estimation at weirs, discharge estimation at bridges.

(iii) Special methods for measurement of discharge: color velocity method, salt velocity method, salt dilution method, radio tracer method, gain and loss of reservoir storage, methods of water measurement in small channels and artificial canals, flumes and falls

(iv) Modern Equipments for Gauge & Discharge Measurements: ADCP, AWLR, AOTT Type Current meter, Digital Echo sounder, Telemetry etc.

C) Sediment observation and analysis:

Purpose of Sediment Observations, Method of Observation/collection of samples, Equipments used, Sediment analysis, classification of sediment, recording of data. River Bed Material method of collection and analysis, grading of bed materials. Vertical Silt Distribution analysis (VSD)

D) Water Quality:

Purpose of Water Quality Monitoring in Rivers, Sources of Pollutions, Type of Labs, Parameters measured in Level-1 labs, Level-II/Level-II+/Level-III labs, Classification of WQ site (Base Station, Trend Station, Flux Station), Frequency of Water Sampling, Sampling Procedures, Preservation of Samples and its Transportation to Lab, essential equipments required to measure the parameters in different type of labs, precautions to be taken. Sag analysis.

Meteorological Observation:

Purpose of observations, Parameters measured at site, Method of measurement, equipments, precautions, Type of Rain Gauges, SRRG, ORG, Automatic Weather Stations, Snow gauge observations, Pan Evaporation, Maximum-Minimum Temperature records, Relative humidity & Dry-Wet Temperature, Sun shine recorder, Wind Velocity.

Data Records & dissemination:

Different Forms such as RD1, RD2, ... RD16, Scrutiny of records, Introduction to Surface Water Data Entry System Software (SWDES) & primary validation, Preparation of Water Year Books and Publication, Data Dissemination Policy & Pricing.

Data Analysis

Interpretation from observed data, quality checks (pre processing of data), trend analysis, estimation and inferno from statistical parameters.

(vi) Climate Change and National Water Mission:

Climate change, its causes and impact on water resources, need for database and initiatives to meet the challenges both globally and in India; General circulation models/ regional climate models; Introduction to National Action Plan for Climate Change (NAPCC) and National Water Mission.

(vii) Ecology and Environment:

Introduction to ecology and environment, Considerations about ecology and environment in Water Resources Department (WRD) Projects, Environmental Impact Assessment (EIA) studies and its essential elements, Procedures involved in obtaining environmental and forest clearance of WR projects, National R & R Policy.

(viii) Remote Sensing and Geographic Information System (GIS):

Remote Sensing: Introduction, Electromagnetic waves, satellite orbit, atmospheric effects, platforms and sensors; Digital Image processing- Spectral signatures of various earth features and satellite image interpretation, Digital image, Colour composite, Image rectification & registration, re-sampling, Digital enhancements, NDVI, Classification techniques; Application - Use of data in Water resources sector such as Reservoir Sedimentation, Irrigation Infrastructure mapping, flood inundation mapping.

Fundamental of GIS: Introduction to basic concept including definition of GIS, Principle technique, procedure and terminology of GIS and digital representation and data acquisition; Coordinate system and projection; Geographic data concept: Geo-spatial data components, data type/models, database management, RDBMS concept, and database design; GIS data models: Raster based GIS its concept and basic operation of spatial analysis. Vector based GIS: Definition, Concept and data analysis. Advantage and disadvantages in raster and vector based GIS; Introduction to Spatial analysis, Network analysis, TIN, web GIS, DEM generation, DEM analysis for Water Resources Applications; Various softwares available in the market.

2. Section B (for only Civil Engineers) [MAX MARKS – 40]

(a) Marks - (i) 10 Multiple choice objective type questions having 1 mark each
(ii) 3 short answer type questions (to be attempted out of 5 questions given in paper) of 10 marks each

(b) Syllabus

(i) Irrigation Planning:

General: Irrigation, Ultimate Irrigation Potential, Irrigation Potential Created and Utilised, Productive and Protective Irrigation, Gross Command Area (GCA), Culturable Command Area, Gross and Net Irrigated Area, Irrigation Intensity, Irrigation practices and technique in India, advantage of Irrigation, types of irrigation, drip and sprinkler irrigation, deficit irrigation, Extensive and intensive irrigation, Participatory Irrigation Management.

Crop Water Requirement: Crop seasons in India, Various methods for computation of crop water requirements, Modified penman method, Penman-Monteith method, Reference evapotranspiration and crop evapotranspiration, growth states of crops, crop factor, percolation losses, considerations for ponded and non-ponded crops, effective rainfall, net irrigation requirement, field irrigation requirement, gross irrigation requirement, conveyance and field application efficiency.

Water Demand: Consideration for drinking water requirement, demand table, canal capacity, working table, success rate.

Soils Survey: Importance of soil survey in irrigation planning, various types of soils, cropping patterns, drainage, water logging, Soil salinity and alkalinity, agro-climatic zones of India.

Conjunctive use of surface and ground water: Monitoring of Pre and post monsoon ground water levels, quantum of ground water availability for exploitation, quantum of additional ground water likely to be available for use after application of surface water for irrigation, rising/falling trend in ground water, quantity of ground water to be used in conjunction with surface water so as to maintain water balance.

Economic issues of Irrigation Projects: Computation of Benefit Cost Ratio and Internal Rate of return. Criteria for sanction of projects, Apportionment of cost among various purposes in a multipurpose project, Water rates.

Evaluation of Irrigation Projects- important considerations: Need of performance evaluation of completed irrigation project, reasons for gap in irrigation potential envisaged at the time of planning and actually achieved on completion of the project, remedial measures, review of hydrology, Review of project's organizational structure, regulation and management procedures/practices adopted, agro-economic and socio-economic impacts, farm and non-farm employment, Changes in the field of Infrastructural and Institutional facilities for pre and post project periods, Demographic pattern for pre and post project periods, Literacy, Health Care and Family Planning, Direct and indirect (positive as well as adverse) impacts on environment of commands with reference to Soil degradation, Forest inundation, Soil erosion, Wild life, Fragile eco-system, Air pollution, Displacement of human population, Water-logging, Salinity and alkalinity, Sedimentation, Nutrient Loss, etc.

Benchmarking of Irrigation projects, Water Audit and Water Conservation.

(ii) Hydrology:

Hydrology Cycle: Forms and types of precipitation measurement of rain and interpretation of rainfall data, precipitation-gauge net work- average depth of precipitation over catchment area, arithmetical, Thissen, isohyetal methods- depth-area-duration and depth duration analysis of storm precipitation mass rainfall curves and their use in adjustment of data time distribution of precipitation-variation in storm intensity over small periods. Snowfall, their measurement and water equivalent of snow depth, evaluation of snow depth over the catchment.

Evaporation Losses: Factors affecting evaporation measurement of evaporation, estimation of reservoir from pan evapori meter and related meteorological data evaporation formulas-determination of total evaporation showing seasonal and diurnal variation.

Stream Flow: Interpretation of gauge and discharge data stage discharge relation, relating curves (stage discharge curve), their construction and extrapolation beyond the rage of observed gauge and discharge-factors giving rise to a change in stage-discharge relationship. Adjustment of stream from data-plotting-hyrolgraphs-mean daily flows mean annual runoff-extremes of stream flow giving rise to peak floods.

Water Availability Studies: Surface retention and detention - overland flow, determination of runoff through infiltration approach, estimation of volume of stream flow, rainfall-runoff relations, runoff series, dependable yield.

Design Flood: Flood Peak Estimations for Ungauged Catchments: Rational method, Empirical Equations, Envelop Curves; Flood Estimations for Gauged Catchment: Flood Frequency Analysis, Unit Hydrograph.

Flood Frequency Analysis: Various methods of frequency analysis such as Gumbel's Distribution, Pearson Type III Distribution, Log Pearson Type III Distribution, Normal Distribution, Log Normal Distribution, Goodness of fit etc.

Unit Hydrograph Approach: Hydrograph Concept, Components of Hydrograph, Unit Hydrograph-Assumption & Conditions in Unit Hydrograph, Limitations of Unit Hydrograph, Uses of Unit Hydrograph; Derivation of Unit Hydrograph –From Simple Storm Hydrograph, From Complex Storms, S-Hydrograph; Change of Unit Duration of Unit Hydrograph-Required duration is an integer Multiple of D-hour, Required duration is a Real Multiple of D-hour; Instantaneous Unit Hydrograph-Derivation of UH from IUH; Critical Sequencing of Excess Rainfall, Two Bell Approach, Convolutions of Rainfall over Unit Hydrograph.

Flood routing: Natual flood wave-channel storage equation determination of channel storage and storage from surveys and by hydrographs analysis-requirements of data for reservoir and stream flow routing technique flood routing through reservoirs ISD curves-stream flow routing through river reaches, Muskingnim method, Chow's method and multiple-phase-storage method.

Measurement of Sediment, Reservoir Sedimentation: Determination of Sediment Yield at River Site-Sheet Erosion, Sediment Measurement by Sample Recorder, Bed Load Estimation, Empirical Relations for Total Sediment Load. Reservoir Sedimentation-Reservoir Classification, Distribution of Sediment in Reservoir, Area –Elevation Capacity Curve, Working out New Zero Elevation by Empirical Area Reduction Method.

(iii) **Construction Management:** Process of Tendering, Bid evaluation-adequacy of Construction methods and equipment deployment proposed by bidders etc.

3. <u>Section C (for only Mechanical Engineers)</u> [MAX MARKS – 40]

(a) Marks - (i) 10 Multiple choice objective type questions having 1 mark each
(ii) 3 short answer type questions (to be attempted out of 5 questions given in paper) having 10 marks each

(b) Syllabus

Construction Equipment and Planning:

Construction Plants and Equipment : Different types of Earth-moving (Hydraulic Excavators, Dozers, Dumpers, Wheel Loaders, etc.), Tunnelling (Drill Jumbos, shot-crete machine, Rock-bolter, TBM, etc.) and Concreting equipment (Concrete Mixers, Weigh Batchers, Transit Mixers, Tower Cranes, Cable-ways, etc.) and Construction Plants (Aggregate Crushing and Screening Plants, Batching and Mixing Plants, etc.) used on WR Projects; their components, specifications, types, applications etc, Estimation of their Outputs/ progress.

Construction Methods: Various Structures and Components of Water Resources Projects & their layout, Construction methods for various civil structures- Related construction activities, their sequencing & construction methodologies and techniques- various alternatives.

Construction Schedule: Time estimation of construction activities- Cycle time analysis, Project Monitoring and Management tools, Preparation of Bar charts, CPM/PERT

Economic Analysis: Estimation of Hourly Use rates and hire charges of equipment, Transfer Value, Comparison of different alternatives.

Construction Management: Process of Tendering, Bid evaluation-adequacy of Construction methods and equipment deployment proposed by bidders etc.

Machinery and Equipments used in Project Investigations: Various types drilling machines, its use for various strata, depth etc. Equipments used in exploratory drifts, etc.

II. Professional Paper-II [MAX MARKS – 100]

1. **Section A** (Common to both Civil & Mechanical Engineers) [MAX MARKS – 50]

(a) Marks - (i) 20 Multiple choice objective type questions having 1 mark each
(ii) 3 short answer type questions (to be attempted out of 5 questions given in paper) having 10 marks each

(b) Syllabus

(i) National Water Policy:

National Water Policy and its salient features, Constitution of National Water Resources Council and National Water Board and its constitution and functions.

(ii) Basin Planning and Inter-linking of rivers:

Guidelines on Preparation of River Basin Master Plan and Integrated Water Resources Management and Development; Mathematical models in Basin Planning & Management, Basin-wise Assessment of Water Resources Potential in the Country; Basin-wise Requirement of Water for Diverse Uses in the Country; Case Studies of River Basin Planning in India; Provisions of BIS 7323 : 1994, Guidelines on Operation of Reservoir; National Perspective Plan for Interlinking of rivers.

(iii) Cost Engineering:

Broad idea about estimate of cost of new water resources projects such as Irrigation Projects, Hydropower projects, Flood Control Projects, Water Supply Project and Multipurpose Project as well as revised cost of ongoing water resources project, Apportionment of cost of various aspects in case of Multipurpose Project.

(iv) Dam Safety Measures:

General Principles: Introduction, Classification of Dams, Selection of Safety Criteria, Distribution of Large Dams in India, Dams of National importance, important Dam Failures and Causes, Responsibility for Dam Safety, Dam Safety Organization and Management.

Operation, Maintenance & Surveillance of Dam: Standard Operating Procedures, Maintenance Procedures, Policies, Records & Responsibilities, Funding & Prioritization of Maintenance, Periodic inspection Program, Documentation.

Rehabilitation of Dams & Appurtenant Works: Report on Distress Condition of Dam, Risk Analysis and Prioritization of Rehabilitation Measures, Preliminary Option Studies and Technical and Economic Feasibility, Mitigation Measures using State-of-art Methods and the Materials, Finance Plan, Rehabilitation Plan, Construction Management, Contract Management, Project Management, Environmental & Social Management Framework.

Emergency Preparedness: Development of Emergency Action Plan, Dam Break inundation Studies, Evaluation of Emergency Potential, Actions to Prevent Failure or Minimize Effects of Failure, Flow of Communication, Maintenance & Testing of an EAP, Training.

Comprehensive Safety Review of Dam: Areas of Review- Dam classification, Site Inspection, Design & Construction, Operation & Maintenance, Surveillance & Monitoring of Dam Performance, Review of Design Floods, Structural Review, Seismic Review, Deficiency investigation, Emergency Preparedness, Compliance with Previous Reviews; Detailed Distress Condition investigation; Coverage of the Report of Comprehensive Safety Review.

Dam Safety Initiatives in India: Central Dam Safety Legislation, Dam Rehabilitation & Improvement Program.

(v) Flood Management:

River Systems of India and their general flood problems, Causes of floods, Classification of floods, flood Prone Area (definition, scenario and past efforts)., flood management, statutory provisions, Role of CWC in flood management,

Important recommendations of RBA. Flood Management Measures structural/non-structural, Progress of structural measures in the country so far;

Non-structural measures / Flood forecasting: Definition, Warning Level, Danger Level, HFL, water level forecast and inflow forecast, Flood forecasting methods – conventional / telemetry based. Flood Forecasting and its Utility , User Agencies; Flood Forecasting Network of CWC; Steps involved in Flood Forecasting; Present Criteria for categorisation of floods and evaluation of performance of Forecast in CWC; Travel Time and Forecasts Time; Expectations of user agencies and roads ahead to meet those expectations; linkages with other deptts; International Cooperation in flood forecast.

Data Observation and transmission: Data requirement for Flood Forecasting; Frequency of Observation; introduction to CWC FF network, Modes of data collection and transmission incl. modern techniques.

Flood Forecast Methodology : Conventional and modern methods of FF; level and inflow forecasting, Methods presently used in CWC; Statistical Correlation; Direct Gauge to Gauge Correlation; Gauge and Discharge relationship; Multivariate Correlation; Rainfall Stage methods; introduction to MIKE 11 in FF.

Modes of Dissemination

Structural Measures

Mechanisms for flood management in India, Experiences of construction of embankments as flood control measure, Encroachment in flood plain and need for legislation, for flood plain zoning, new techniques being used for anti-erosion works. Use of remote sensing in flood management, inundation forecasting, Future Strategies, innovative means and modern S&T applications, new materials, embankment durability assurance, Flood Disaster Management.

International Cooperation.

(vi) Survey and Investigation:

- **Investigation of Irrigation and Multipurpose Projects:**

Reconnaissance and preparation of Pre-Feasibility/Feasibility/Preliminary Report: Desktop studies, study of topo sheets/Satellite imageries/Google maps, assessment of water resources, Command area, Considerations/interactions with stakeholders for preliminary assessment of reservoir levels. Preliminary economic evaluation. Resource mobilization – manpower and equipment. Preparation of estimate for investigations.

Topographic Surveys: Survey for Dam and appurtenant works, Barrage & Diversion works, reservoir, command area and Land Use map generation, Alignment of main canals, branches, distributaries, cross drainage works, river surveys and tunnel surveys.

Hydro-meteorological Surveys: Planning and Establishment of hydrometeorological network in the catchment as per BIS/IMD standards. Collection of met-data like rainfall, snow, runoff, temperature, evaporation, humidity and wind. Gauge and discharge observations for main rivers, tributaries and cross drainages.

Geological Surveys: Regional geology, Major rock types, effects of faults, water tightness of reservoir area and remedies for dam site, valuable minerals if any in the reservoir area. Ground traverses and surface mapping of geological features. Landsat and Multispectral scanner data. Foundation explorations by pits, drill holes and drifts (Boring and logging for dam site and appurtenant structure locations).

Silt Surveys: Silt load of the river water, its analysis and the life of the reservoir.

Construction Material Survey: For previous, impervious and semi-pervious materials, Riprap, rock fill and filter material, materials for masonry and concrete-line, surkhee, bricks, stones and sand. Description of quarry location and volume estimation. Source of scarce materials and procedures for procurement. Laboratory tests for the materials for construction suitability and presence of deleterious matter.

Communications: Roads and railways existing as well as those to be constructed. Haul roads for the borrow areas and quarries. Surveys for the lines of communications likely to be affected by the construction of the project and for the diversions.

Seismic Studies: Dam site and reservoir area and the region. Ground movement observations by Seismometers, Seismographs, etc.

Property Survey: Survey of the property of public/Government likely to be affected, Rehabilitation of the displaced persons and providing compensation.

- **Investigation of Hydropower Projects:**

Desktop Studies: Plan capacity in relation of stream flow, Load factor flexibility in selecting load factor, Effect of varying plants installation, Selection of plant, Power evacuation system.

Reconnaissance Surveys: Study of topo-sheets and other available ground surveys – Use of aerial reconnaissance and aerial photography in the evaluation of catchment characteristics, Water resources, Power potential, Construction material available locally, Probable size of project and financial implications involved – Value of hydro-electric power – Cost of production, Possibility of Pumped Storage and or downstream navigation, Cost of transmission, Anticipated development of industry, Capacity of consumers to pay, Load demand within the region including adjacent areas of neighbouring country, Planning of establishment and

scientific/survey equipment required for investigations and preparation of estimate for investigations.

Topographical Surveys: Survey of reservoir area, dam and appurtenant works, diversion works, Head Race Tunnel, power channel, Desilting basin/chamber, Tunnel, surplussing points, forebay, Energy Dissipation lines, pressure shaft alignment, penstock alignment, power house, Switchyard and Tail race channel/tunnel structures,

Hydro-meteorological Surveys: same as for Irrigation Projects.

Chemical properties of the river water

Geological Surveys: same as for Irrigation Projects

Seismic surveys of the area of reservoir and dam site and power house

Construction material Surveys: same as for Irrigation Projects

Communication: same as for Irrigation Projects

Industrial Surveys: Trend of growth of industry – power demand, occupation of the people and impact of power generation on the region
Detailed load survey: Detailed surveys for transmission lines with alternative including lines required for lift irrigation if any, and sub-stations and colonies

Property Surveys: same as for Irrigation Projects

Other Studies: Survey of Power House, Tail race Channel, switchyard, tunnel, etc.

(vii) Preparation of DPRs of Water Resources projects:

Introduction: Purpose of a DPR, Structure of a general DPR

DPR for Irrigation & Multipurpose Schemes: Format of the Comprehensive Checklist; Components of the Salient features; Compositional requirements of each of the various chapters such as Preamble, Physical features, Interstate/International aspects, Surveys and Investigations, Hydrology, Hydro-geology, Design features & criteria for different river valley structures, Reservoir, Irrigation Planning, Command Area, Flood Control, Drainage, Power, Navigation, Construction programme, manpower & plant planning, Foreign exchange element, Environment, Ecology & Forest Aspects of Project, Estimate, Financial Resources, Revenues, Benefit Cost Ratio, Financial Return & Internal

Rate of Return, Future utilization of facilities created (Buildings), Apportionment of cost among various purposes of Multipurpose River Valley Projects. Instrumentation aspects; Important correspondences and decisions that can be included in a DPR; Types of maps, Drawings and plates. (For details CWC's Guidelines for preparation of DPRs of Irrigation and Multipurpose Projects to be referred)

DPR for Flood Management Schemes: Important Flood parameters as per the norms of the Rashtriya Barh Ayog Report, Guiding principles for formulation of flood protect measures in the form of Embankments and Anti-erosion works, Inter-state ramification of flood proposals, Inter-state and bi-lateral treaties on water sharing, Fitment of the scheme in the Master Plan for the basin, Design particulars, instrumentation aspects, Drainage characteristics of the basin, BC Ratio calculation procedures, Relief and Rehabilitation measures, EIA aspects, Categorisation of schemes as per cost and the Competent Authorities to approve them, Guidelines for Investment clearance, Procedures for processing and acceptance of schemes according to cost categorization.

DPR for Modernisation of Irrigation Projects: Checklist, Salient features, Details of the contents of various chapters of the Report as per CWC guidelines.

2. <u>Section B (for Civil Engineers only)</u> [MAX. MARKS – 50] [with related books]

(a) Marks - 2 questions (to be attempted out of 3) having 25 marks each

(b) Syllabus

(i) Design of Water Resources Projects – I

Design of Barrages: Waterway, looseness factor, afflux, discharging capacity, energy dissipation arrangements, cut offs, exit gradient, upstream & downstream protection works, regulation, hydraulic design, guide bunds, head regulator design, design of barrage.

Design of Canals: Design of lined & unlined canals, Lacey's theory, Kennedy's equation, critical velocity ratio, Chezy's formula, Manning's formula, types of lining, drainage criteria for lining, transmission losses in canals, free board, typical sections in cutting & embankment, methods of silt exclusion.

Design of Dams:

General: Types of dam, selection of type of dam, importance of investigation of foundation & construction materials, site selection.

River Diversion: Diversion requirements, selection of diversion flood, methods of diversion, tunnels, coffer dams.

Concrete Gravity Dams: Freeboard, Forces acting on the dam, stability criteria, details of layout & design principles of overflow and non-overflow sections, foundation treatment, grouting, galleries & other openings.

Earthfill & Rockfill Dams: Freeboard, Embankment design principles, zoning of dam section, selection of type of materials, pore-water pressure, stability analysis, seepage through embankment, upstream & downstream slope protection, need & design of filters, seepage through foundation in different types of strata and foundation treatment.

Spillways: Types, design flood, flood routing, fixation of size, hydraulic design of free overflow & sluice spillways, energy dissipation arrangements, pier design.

(ii) **Design of Water Conductor System & Power House of Hydropower Projects:**

General: Types of hydropower schemes, layouts, components of water conductor system & their functions.

Power Intake: Types, location, size of intake, submergence requirement, bellmouth & transitions, trash rack, hydraulic design criteria.

Desilting Chambers: Need of desilting chambers, hydraulic design, flow through velocity, fall velocity of particles, transitions, silt flushing tunnel/channel.

Head Race Tunnel: Shapes & size, economical diameter, layout & alignment considerations, General rock support system, design criteria of concrete lining, grouting.

Surge Shaft: Functions, types, location, upstream & downstream surge shafts, surge analysis, hydraulic design, Thoma's criteria.

Pressure Shafts/Penstocks: Layout & alignment, design principles of surface penstocks and steel liner of pressure shafts, anchor blocks & saddle supports, manifolds, branching.

Power House complex: Layout of underground and surface power house & Transformer Hall, Access tunnels, construction adits, ventilation & cable

tunnel, design principles of superstructure & substructure of power house, rock support system for underground caverns, tail race system.

3. **Section C** (for only Mechanical Engineers) [MAX. MARKS – 50] [with related books]

(a) Marks - 2 questions (to be attempted out of 3) having 25 marks each

(b) Syllabus

Design of Water Resources Projects – II

Design of Gates and Hoisting Arrangement:

General: Function of Gates, Types of Gates, general arrangements and installations, recommended shapes of gate slots and gate bottoms, air vent requirements and their necessity, type of seals and their usages, material specification of seals, BIS codal provision for seals.

Vertical Lift Gates and Radial Gates for sluices & Spillways and their Stoplogs: Function of sluice gate, different types of sluice gates, factors influencing the choice of gate, different components of radial and vertical lift wheel type & slide gate, principle of design, material specifications, operating criteria of various types of gates, load transfer mechanism to adjoining civil structures, BIS codal provisions in respect of individual gates.

Valves: Different types of valves, advantages & disadvantages, description & operation, necessity of bypass valve.

Hoists: Different types of hoists, calculation of hoist capacity for gates, factors influencing hoist capacity, important components of rope drum hoist & their functions, design & selection of hoist components, screw hoist, principles of hydraulic hoists, description & operation of hydraulic hoists, components of hydraulic hoists, types of bearings, factors influencing selection of bearings, gantry & monorail crane, different components of gantry & their functions, BIS codal provisions in respect of hoists 7 gantry crane, design of different type of gates.

III. Professional Paper – III

[MAX. MARKS – 100] [with books]

(a) Marks - (i) 30 Multiple choice objective type questions having 1 mark each
(ii) 10 short answer type questions of 7 marks each

(b) Syllabus

(i) Accounts:

i) Budget
ii) Central Public Works Accounts
iii) General Financial Rules, 2005: Chapter-2 General System of Financial Management; Chapter-5 Works; Chapter-6 Procurement of Goods; Chapter-7 Inventory Management.

Part-II Compendium of Rules on Advances to Govt. Servants, General Condition, HBA, MCA, Computer Advance, Motorcycle Advance, Festival Advance, Pay Advance etc.

iv) Delegation of Financial Powers
v) TA Rules
vi) New Pension Scheme

(ii) Administrative Matters:

i) Office procedure:

Transaction of Govt. Business; Department, Attached and Subordinate Office; Forms and procedure/types of Communication; Drafting of Communication; Filing System; Records Management; Security of Official information and documents; Checks on delays; Action plan and monitoring; Inspections; Parliamentary procedure.

ii) General Administration:

General Knowledge of the Constitution of India, Machinery of Government and Practice & Procedure in Parliament: Main principles of the Constitution of India; Rules of Procedure and Conduct of Business in Lok Sabha & Rajya Sabha; the organization of the machinery of Government of India; designation and allocation of subjects between Ministries; Departments and attached and subordinate offices and their relation inter se.

General Financial and Service Rules: Fundamental and Supplementary Rules; Central Civil Services (Pension) Rules, 1972; Central Civil Services(Conduct) Rules 1964; Central Civil Services (Classification; Control & Appeal) Rules, 1965;

General Financial Rules, 2005; Delegation of Financial Powers Rules, 1978; Central Civil Services (Leave) Rules, 1972

Procedure and practice in Government of India Secretariat and attached offices comprising General Financial and Service Rules: Manual of Office Procedure; Notes on Office Procedure issued by the Institute of Secretariat Training and Management; Handbook of Orders regarding use of Hindi for official purpose issued a by Department of Official Language

Administrative rules and procedures specific to Central Water Commission (HQ & Field Offices)

iii) Disciplinary matters and Vigilance matters

Disciplinary Matters- Central Civil Services (Conduct) Rules 1964: Rule (3)- General; Rule (4)- Employment of near relatives of Government servant in companies or firms; Rule (9) - Criticism of Government; Rule (13) – Gifts; Rule (13) (a)- Dowry; Rule 15(a)- Sub-letting/vacation of Government accommodation; Rule 16 - Investment, lending and borrowing; Rule 18 - Movable, immovable and valuable property; Rule 22 (a) - Prohibition regarding employment of children below 14 years of age

Vigilance Matters – Central Civil Services (Classification, Control & Appeal) Rules 1965: Rule 10 – Suspension; Rule 11 – Penalties

iv) Right to Information Act, 2005

(iii) Procurement and Works Procedure

i) Works

Stages for Execution of Works: Classification of works, Pre-requisites for execution of works, Administrative approval, Expenditure Sanction, Technical Sanction.

Preparation of Estimates: Preliminary Estimate, Detailed Estimate, Schedule of Rates, Analysis of rate, Recasting of Estimate, Supplementary Estimate, Revised Estimate

Contracts and Forms: What is contract? Forms to be used for contracts

General Terms: Expression of Interest (EoI), Request for Proposal (RFP), Single Bid System, Two bid System

Preparation of Tender Documents: Preparatory works, Tender for normal works, Invitation of tenders for component parts, Composite tenders, Pre-bid

conference, Restricted Tenders, Tenders with two/three envelope system, Preparation of Notice Inviting Tenders

Publicity of Tenders: Wide publicity, Economy in press advertisement, Guidelines regarding publicity of tenders, Duty of Head Clerk, Time limit for publicity of tenders, Procedure for proper publicity of tenders, Action in case of poor response to tenders, Formalities for re-invitation of tenders, All notice in the name of the President

Sale of Tender Documents: General, Sale of tender documents to registered contractors (for normal works), Supply of duplicate set of tender documents, Sale of tender documents for balance works, Time interval between sale of tender documents and opening of tenders, Scale of charges for tender documents, Accounting of tender documents, Responsibilities of Divisional Accountant

Earnest Money: Necessity of earnest money, When to be deposited?, Rates of earnest money, Mode of deposit, Refund of earnest money, Earnest money is not security deposit, Earnest money stipulation in work/supply to be awarded after call of quotations, Forfeiture of earnest money

Receipt, Opening and Acceptance of Tenders: Receipt of tenders, Scrutiny of tenders, Processing of tenders, Acceptance of tenders, Re-invitation of tenders

Award of Work: Procedure, Restrictions in delegated powers

Essential Features of Agreements/Contracts: General principles and guidelines, Execution of agreements, Supply of copies of contracts to contractors, Certification and safe custody of agreements, Weeding out of old agreements, Supplementary agreements, Completion of agreements

Security Deposit and Performance Guarantee: Performance Guarantee, Security deposit, Forms of Security Deposit, Repayment/ Retransfer of Security Deposit, FDR's as Security Deposit

Refund of Security Deposit and Performance Guarantee: Conditions for refund of security deposit and performance guarantee, Refund of security deposit in cases of delay in final bill, Effecting of recoveries, Time limit of claims for refund of security deposit, Refund of security deposit regarding specialized items of work, Divisional Accountant's responsibility for prompt refund of security deposit

Extra, Substituted and Deviated Items of works: Deviations, Extra/ Substituted Items, Determination of rates for deviated/extra/substituted items, Measurements for inadmissible items.

Extension of Time and Compensation for Delay: General principles, Powers of officers for grant of extension of time, Grant of extension of time without application, Form of application for extension of time, Action on belated application for extension of time, Recording hindrances, Processing cases of extension of time, Extension of time without levy of compensation, Compensation under Clause 2

ii) Procurement of Goods and Services

Procurement of Goods: Definition of Goods, Fundamental principles of public buying, Authorities competent to purchase goods, Procurement of goods required on mobilization, Powers for procurement of goods, Rates contract, Registration of Suppliers, Enlistment of Indian Agents, Reserved Items, Purchase of goods without quotation, Purchase of goods by purchase committee, Purchase of goods directly under rate contract, Purchase of goods by obtaining bids, Advertised Tender Enquiry, Limited Tender Enquiry, Two bid system, Late Bids, Single Tender Enquiry, Contents of Bidding Document, Buy – back offer

Procurement of Services: Identification of work / Services required to be performed by Consultants, Preparation of scope of the required work/ service, Estimating reasonable expenditure, Identification of likely sources, Short-listing of consultants, Preparation of Terms of Reference (TOR), Preparation and issue of Request for Proposal (RFP), Receipt and opening of proposals, Late Bids, Evaluation of Technical Bids, Evaluation of Financial Bids of the technically qualified bidders, Consultancy by nomination.

Outsourcing of Services: Outsourcing of services, Identification of likely contractors, Preparation of tender enquiry, Invitation of Bids, Late Bids, Evaluation of bids received.

Budget preparation: General concept of Budget preparation.

Plan preparation: General concept of Plan formulation.