



**SIX MONTH CERTIFICATE, ONE YEAR POST
GRADUATE DIPLOMA AND TWO YEAR MASTER
DEGREE
IN
EROSION CONTROL AND LAND RECLAMATION**

**SYLLABUS
CREDIT
&
GRADING SYSTEM**

**UNDER
GAUHATI UNIVERSITY :: GUWAHATI
&
POGL GROUP OF INSTITUTIONS,**

Institution of Engineers, 3rd Floor, Panbazar, Ghy-01

GAUHATI UNIVERSITY :: GUWAHATI

Syllabus for Erosion Control and Land Reclamation

SEMESTER-WISE COURSE STRUCTURE

Semester I

Total Marks – 500

Duration – 6 Months

S.No	Paper Name	Univ. Marks	Internal marks	Total Marks
I	Introduction to Brahmaputra and Its Tributaries and Overview of World Rivers	100	25	125
II	Basics of Flood and River Management	100	25	125
III	Erosion Basics	100	25	125
IV	Projects	(Report) 100	25	125

Paper I : Introduction to Brahmaputra and its Tributaries and Overview of World Rivers :

Introduction to Brahmaputra River and Majuli, Erosion in Brahmaputra and Majuli, environmental setting of Majuli, Regimes of the Rivers around Majuli Island, Flood Inundation, Nature and Type of Sediment, Seismic Activity, Properties of Soils of Majuli Island, Formation and Evolution of the Island

Activities of Brahmaputra Board.

Study of Nile River, Rhine River, Hudson River, Mississippi River, Selz River.

Paper II : Basics of Flood and Objectives of River Management :

River morphology and channel processes-erosion, transportation, sedimentation, graded rivers, rejuvenation and river terrace, incised river, river capture,

Drainage patterns, drainage basins, shape of drainage basins, Horton form factor, stream order, channels in Alluvial plains,

Streams – Consequent, Subsequent and Superimposed Stream, Stream Modules – River Evaluation, Assessment and Monitoring, Causes of Floods, Effects of Floods, Measurements taken to Control Flood-Planting, terracing, floodways, Levees, Dikes, Dams, Reservoirs or Retention Ponds. Flood Control by Continent- America, Asia, Europe. Flood Clean-up, Safety, Benefits of Flooding. Flood Discharge Estimation.

Objectives of River Management. Introduction to River Morphological Report- Objectives, River Morphological Time Scale, Fluvial Geomorphology, Channel Characteristics,

River basin organization for participatory flood management, Financial aspects of flood management schemes, socioeconomic and environmental aspects of flood management measures,

Paper III : Erosion Basics :

Definition of Soil Erosion and Sedimentation and Terms Associated with it, types and size range of particles that river can carry (clay, silt, sand, gravel, cobbles, boulders), Erosion and Sedimentation Processes and its Control Principles, Types of Erosion, Hjulstrom diagram (the relationship between flow velocity, particle erosion, transportation and deposition), Erosion Factors, Evidence of Erosion, impacts of soil erosion and sediment runoff,

River channel cross-sections, flow regimes (laminar flow regime, turbulent flow regime), long profile of a river, stages of a river course (upper, middle and lower course)

Vegetative Considerations – Effects of Vegetation on Erosion, Sedimentation, and Property Value, Site Considerations, Seasonal Considerations, Selection of Vegetation, Establishing Vegetation, Maintenance,

Types of Soils, Soil Test for High Risk Soils, Landscape. Stream bank Erosion Analysis, Calculation of Erosion Rates. Soil Erodibility, Modeling of Soil Erosion and Sediment Flux, Model Selection, Sediment Sampling and River Discharge Measurement, X-Ray Diffractometry (XRD), Requirements for Implementing Soil Erosion and Sedimentation Monitoring Framework,

Paper IV : Projects and Field Training :

Projects and Field Training on Estimating average Annual Rainfall, Estimating the Size of a Catchment, Estimate Annual Runoff from a Catchment (Catchment yield), Estimate Peak Discharge,

Certificate will be issued after 1st semester, 6 months. Eligibility class XII for certificate course

BSc/ BE may go for PG Diploma & Master Degree Courses

Semester II

Total Marks – 500

Duration – 6 Months

Paper.No	Paper Name	Univ. Marks	Internal marks	Total Marks
V	Erosion and Sediment Control, Planning, and Design	100	25	125
VI	Flood and Erosion Control Technology	100	25	125
VII	Sand Slurry Pumping and Land Reclamation	100	25	125
VIII	Projects	(Report) 100	25	125

Paper V : Erosion and Sediment Control, Planning and Design :

General Considerations for Planning and Design, Writing the Plan, Recommended Symbols for Erosion and Sedimentation Control Plan, site management, preparing a site for expected weather conditions, site inspection and monitoring, vegetation management,

Definition of various terms used in flood reports (Low flood, Medium flood, High flood, Danger Level, Warning Level, Highest Flood Level, Very high flood, Flood Plain, Alluvial river, Bank, Braided river, Delta Stage of river, Meander etc.)

Site Preparation – Construction Sequence Schedule, Land Grading, Surface Roughening, Topsoiling, Tree Preservation and Protection, Temporary Gravel Construction Entrance/ Exit.

Land clearing, Soil management- topsoil management, stockpile management, recognizing and managing problematic soils, non-official soil tests, management of dispersive soils, management of temporary access roads, temporary site shutdowns, site rehabilitation,

Surface Stabilization – Temporary Seeding, Permanent Seeding, Sodding, Trees, Shrubs, Vines, and Ground Covers, Mulching, Riprap, Vegetative Dune Stabilization, Rolled Erosion Controlled Products.

Paper VI : Flood and Erosion Control Technology :

Inspection, Installation and Maintenance of various Erosion Control Measures, Runoff Control Measures – Temporary Diversions, Permanent Diversions, Diversion Dike, (Perimeter Protection), Right-Of-Way Diversion (Water Bars),

Runoff Conveyance Measures – Grass-Lined Channels, Riprap and Paved Channels, Temporary Slope Drains, Paved Fumes (Chutes).

Outlet Protection – Level Spreader, Outlet Stabilization Structure.

Inlet Protection – Excavated Drop Inlet Protection (Temporary), Hardware Cloth and Gravel Inlet Protection (Temporary), Block and Gravel Inlet Protection (Temporary), Sod Drop Inlet Protection, Rock Doughnut Inlet Protection, Rock pipe Inlet Protection.

Sediment Traps and Barriers – Temporary Sediment Trap, Sediment Basin, Sediment Fence (Silt Fence), Rock Dam, Skimmer Sediment Basin, Porous Buffles.

Stream Protection – Temporary Stream Crossing, Permanent Stream Crossing, Vegetative Streambank Stabilization, Structural Streambank Stabilization, Buffer Zones.

Other Related Practices – Construction Road Stabilization, Subsurface Drain, Grade Stabilization Structure, Check Dam, Dust Control, Sand Fence(Wind Fence), Flocculants, Check Dam with Weir.

Basement Flooding and its control, Erosion Control Using Willow, Use of Gabion System, Mattresses, Wire-faced Walls, Block-faced Wires, Drainage Maintenance, Dams that Minimise Erosion - Dam Structure, Types of Dams, Site Selection. Natural Stream Channel Classification and Design, Stream Simulation Design,

Paper VII : Sand Slurry Pumping and Land Reclamation :

Hydraulic Engineering of Land Reclamation, Reclamation Techniques – Instream Techniques (Channel Modification, Cross vanes and Related Structures, Engineered Log Jams), Off- line Techniques.

Common restoration problems and its solutions

Dredging – its Uses, Types of Dredging Vessels, dredging technology- historical review, the importance of dredging, development of dredging equipment-the dredging bail, scratcher, , underwater scraper, mud-mills and bucket- wheels, bucket dredger, suction dredgers, Back-Hoe dredger, dipper dredger, grab dredger, water injection vessel, auxiliary equipment,

Different types of dredging- maintenance dredging, water-injection dredging, capital dredging, offshore dredging, dredging for mining, environmental dredging,

Survey and positioning systems for dredging,

Disposal of Materials, beneficial use of sediment for river restoration, Environmental Impacts, Major Dredging Companies.

Paper VIII : Projects and Field Training :

Projects and Field Training on Sand Slurry Pumping and Dredging Machine.

PG Diploma will be issued after completion of Semester I & Semester II

Semester III

Total Marks – 500

Duration – 6 Months

S.No	Paper Name	Univ. Marks	Internal marks	Total Marks
IX	Advanced study on Brahmaputra and Its Tributaries and Detailed Overview of World Rivers	100	25	125
X	Advanced study on Flood, erosion and River Management	100	25	125
XI	Erosion Details	100	25	125
XII	Projects	(Report) 100	25	125

Paper IX : Advanced Study on Brahmaputra and its Tributaries and Overview of World Rivers :

Weather and rainfall analysis of North-East India, climate change –recent evidences, water and climate induced hazards, management options to mitigate climate change

Meteorological factors of flood in India, frequency of floods in Indian rivers, chars stabilization and its significance,

Anthropogenic influence on flow and sediment regime of Brahmaputra river basin, influence of climate, influence of river engineering works, influence of anthropogenic activities, river discharge and sediment flux, biogeochemical fluxes,

Overall river features of Brahmaputra river, geology, seismicity, and geomorphology, river gradients and dimensions, river flows and sediment transport (average discharges, flood discharges), channel shifting and bank erosion, key implications for control of flooding and erosion, probabilistic flood hazard modeling of embankment breaching in the river Brahmaputra,

Detailed study of some major tributaries of Brahmaputra river (Jiadhal, Barak etc.) – Physiographic and morphologic features (alluvial floodplain, river planform, gradients and sinuosity, channel width, bed and bank materials), Hydrology and hydraulics (maximum and min discharge, water levels, depths, and velocities of flow), Sediment transport, causes of Flooding, measures in place to control flooding, other proposed flood management measures (upstream reservoirs, river channel improvements, pumping)

flood frequency analysis, flow analysis, fluvial hazard, flooding and related costs, flood management strategy considerations,

Flooding and related costs-Significance and causes of flooding, Flood damage, Flood relief; Flood management- History, Institutions (central institutions, state institutions), Flood management assets, Flood management issues;

Future development considerations-(Existing plans, Strategy considerations

Majuli, Erosion in Majuli,

Regions in India prone to floods,

Flood risk management mitigation and management practices of various rivers like Nile River, Rhine River, Hudson River, Mississippi River, Selz River.

Paper X : Advanced study of Flood, Erosion and River Management :

Management strategies- determining tolerable erosion rates, mapping of erosion incidence, field measurements of erosion, the Universal soil lose equation, monitoring soil erosion, assessing erosion hazards,

Determining appropriate erosion control strategies, Implementation strategies- landform design, vegetation cover, Structural methods- a) Contour cultivation, b) Contour deep ripping or contour furrowing, c) Contour or level banks, d) Absorption and Pondage banks, e) Diversion banks, f) Spillways/ grassed waterways, g) Lined waterways

Special soil erosion problem areas-Dispersive spoils, subsidence areas, Aeolian materials

Removing of organic pollutants in the rivers after flood,

Flood forecast technology for disaster preparedness, real time flood forecasting and its needs and methodology, methods for formulating real time flood forecasts, statistical methods, various correlation models between upstream and downstream gauges/discharges, real time flood forecasting using Fuzzy logic, Decision support system (DSS), Space technology for flood disaster management, data integration (computer model) for adaptation to sea level rise, storm surges, and erosion,

Streams – Consequent, Subsequent and Superimposed Stream, Stream Modules – River Evaluation, Assessment and Monitoring, Causes of Floods, Effects of Floods, Measurements taken to Control Flood-Planting, terracing, floodways, Levees, Dikes, Dams, Reservoirs or Retention Ponds. Flood Control by Continent- America, Asia, Europe. Flood Clean-up, Safety, Benefits of Flooding. Flood Discharge Estimation.

Objectives of River Management. Introduction to River Morphological Report- Objectives, River Morphological Time Scale, Fluvial Geomorphology, Channel Characteristics,

Lessons learnt from disaster management of recent dam/ embankment break events in India and abroad; flood hazard, vulnerability, and risk assessment of rivers, assessment of concurrent mitigation options,

Problem of urban floods in the developing cities of developing world,

Paper XI : Erosion in Details :

Definition of Soil Erosion and Sedimentation and Terms Associated with it, Erosion and Sedimentation Processes and its Control Principles, Types of Erosion, Erosion Factors, Evidence of Erosion,

Vegetative Considerations – Effects of Vegetation on Erosion, Sedimentation, and Property Value, Site Considerations, Seasonal Considerations, Selection of Vegetation, Establishing Vegetation, Maintenance,

Types of Soils, Soil Test for High Risk Soils, Landscape. Stream bank Erosion Analysis, Calculation of Erosion Rates. Soil Erodibility, Modeling of Soil Erosion and Sediment Flux, Model Selection, Sediment Sampling and River Discharge Measurement, X-Ray Diffractometry (XRD), Requirements for Implementing Soil Erosion and Sedimentation Monitoring Framework,

Erosion control for highway applications, Expert system (ES) for selection and documentation of erosion and sedimentation control methods (ESCM)- its concept, design principles, ES knowledge base, ESCM type - quick and short term (0-6 months), transitional ESCMs (6- 12 months), long term erosion control methods(more than 12 months), ESCMs for transitioning

from short term to long term erosion control measures, ESCM purpose, ESCM construction phasing (initial clearing phase, intermediate grading phase, final stabilization of the site), perimeter controls- filter barriers (silt fence, straw bales, and brush barriers), diversion structures (diversion berms and channels), settling structures (sediment traps and sediment basins), Intermediate controls- (temporary slope drains, temporary channel linings, mulching, temporary and permanent turf establishment, checkdams, settling structures, inlet protection, final controls- (permanent turf establishment, channel linings, temporary slope drains, checkdams, outlet protection, curbs, gutters, and downdrains or chutes, road inlets), erosion and water runoff estimation, factors to be considered in ES knowledge base (area type, watershed area size, soil type, topography, climatic factors, ground cover, land use), ES ESCMs contained in the ES knowledge base- 1. Bench, 2. Berm ditches, 3. Brush barriers, 4. Channel liners, 5. Channels, 6. Check dam, 7. Culverts, 8. Detention basins, 9. Ditch checks, 10.Diversions, 11. Energy dissipaters, 12. Filter berms, 13. Filter strip, 14. Flotation silt curtain, 15. Infiltration trench, 16. Infiltration basin, 17. Inlet protection, 18. Matting, 19. Mulching, 20.Outlet protection, 21. Permanent seeding, 22. Retaining walls, 23.Retention pond, 24.Revetment flume, 25.Sediment basin, 26.Serrated cut, 27.Shoulder drains, 28.Shrubs, 29.Silt fence, 30.Slope/Terrace, 31.Sodding, 32.Straw bales, 33. Surface roughening, 34. Temporary sediment trap, 35. Temporary seeding, 36.Temporary slope drain, 37.Top soiling, 38.trees, 39.Under drains, 40. Vines and ground covers,

ES structure and analytical rules,

Paper XII : Projects and Field Training :

Projects and Field Training on Calculating Different Risk Intervals, Estimating Slope, Assessing Ground cover.

Semester IV

Total Marks – 500

Duration – 6 Months

Paper.No	Paper Name	Univ. Marks	Internal marks	Total Marks
XIII	Detailed Erosion and Sediment Control, Planning, and Design	100	25	125
XIV	Advanced Flood and Erosion Control Technology	100	25	125
XV	World Sand Slurry Pumping Deepening water streams and Land Reclamation	100	25	125
XVI	Projects	(Report) 100	25	125

Paper XIII : Detailed Erosion and Sediment Control, Planning and Design :

Purpose of permanent erosion and sediment control design, planning, design and maintenance of river embankment, guide bank, surface drain,

Drainage control measures- management of site drainage during the construction phase, drainage across a slope- catch drains, drainage across a slope-flow diversion banks and berms, drainage down a slope- chutes, drainage down a slope- slope drains, end of drain structures- outlet structures, velocity control structures- check dams, channel and chute linings, temporary watercourse crossings, works in and around watercourses,

Erosion control measures- light mulching (mulching in association with grass seeding), heavy mulching, erosion control blankets, cellular confinement systems, dust suppression measures, miscellaneous erosion control measures- gravelling, polyacrylamide (poly or PAM), revegetation, surface roughening,

Sediment control measures- entry/exit sediment controls (Exit), stockpile sediment controls, sediment control techniques suitable for 'sheetflow' conditions, sediment fence-suitable for 'sheet flow conditions, Kerb inlet sediment controls, Field (drop) inlet sediment controls, sediment control techniques suitable for 'minor' concentrated flow, U-shaped sediment trap (UST)- suitable for 'minor' concentrated flow, sediment control suitable for- pipes and culvert inlets, stormwater outlets, Rock filter dams (RFD) – type 2 sediment trap for concentrated flows, sediment weirs(SW)- type 2 sediment trap for concentrated flows, sediment basins- type C (dry) , F & D (wet) basins, sediment basin spillways,

De-watering sediment controls

Standard identification codes and drawing symbols of various sediment control techniques,

Mathematical modeling of land reclamation effect on river flow and water quality

Regulatory requirements for sediment control and urban development, responsibilities, monitoring, maintenance and repair of erosion and sediment control measures,

Checklist for examination of flood control projects, preparation of project estimates, Best Management Practices (BMPs), maintenance Check Sheets, preparation of comprehensive plan for flood management, criteria for taking up updating of a comprehensive plan for flood management,

Various erosion modeling programs such as SIBERIA and other digital terrain modeling software, erosion model parameters,

Paper XIV : Advanced Flood and Erosion Control Technology :

Advanced erosion control methods- seeding, hydroseeding, sodding, rip-rap, aggregate cover, chemical stabilization, trees and shrubs, grassed waterways, stormwater channels and ditches, BMP standards and specifications for constructing roads and parking areas and dust control,

mulches, blankets and mats, materials used, advantages and limitations, design and construction, installation, types of organic mulch- wood fiber, straw mulch, hydro mulch-bonded fiber matrix, wood chips, blended mulch, peat moss, bark chips, shredded bark, pine needles, compost of straw manure, Chemical mulches, Tackifiers, various types of tackifiers- latex base, guar gum etc. , Turf-Reinforcement Mats (TRMs), types of blankets- jute netting and fabripute netting,

Management measure for erosion and sediment control, factors in the selection of management practices,

Various sediment control measures vegetative buffer strip, rock filters and brush barriers, check dams, fiber rolls, silt fences, geosynthetic permeable berms, drain inlet protection, run-off traps, sediment traps, sediment ponds, coir logs, tree revetments, root wads,

Standard and specifications for erosion and sediment control measures,

Coastal erosion control methods- various profile face shape (concave, re-entrant, vertical, sloping, stepped, convex) and its effects, Sand Dune Protection System (SDPS), Subsurface Dune Restoration System (SDRS), Inspection, Installation and Maintenance of various Erosion Control Measures, Runoff Control Measures – Temporary Diversions, Permanent Diversions, Diversion Dike, (Perimeter Protection), Right-Of-Way Diversion (Water Bars),

Runoff Conveyance Measures – Grass-Lined Channels, Riprap and Paved Channels, Temporary Slope Drains, Paved Fumes (Chutes).

Outlet Protection – Level Spreader, Outlet Stabilization Structure.

Inlet Protection – Excavated Drop Inlet Protection (Temporary), Hardware Cloth and Gravel Inlet Protection (Temporary), Block and Gravel Inlet Protection (Temporary), Sod Drop Inlet Protection, Rock Doughnut Inlet Protection, Rock pipe Inlet Protection.

Sediment Traps and Barriers – Temporary Sediment Trap, Sediment Basin, Sediment Fence (Silt Fence), Rock Dam, Skimmer Sediment Basin, Porous Buffles.

Stream Protection – Temporary Stream Crossing, Permanent Stream Crossing, Vegetative Streambank Stabilization, Structural Streambank Stabilization, Buffer Zones.

Other Related Practices – Construction Road Stabilization, Subsurface Drain, Grade Stabilization Structure, Check Dam, Dust Control, Sand Fence(Wind Fence), Flocculants, Check Dam with Weir.

Basement Flooding and its control, Erosion Control Using Willow, Use of Gabion System, Mattresses, Wire-faced Walls, Block-faced Wires, Drainage Maintenance, Dams that Minimise Erosion - Dam Structure, Types of Dams, Site Selection. Natural Stream Channel Classification and Design, Stream Simulation Design,

Paper XV : Sand Slurry Pumping, Stream Stabilisation and Land Reclamation :

Slurry pumps- introduction, applications and types, slurry properties and different parameters, slurry pump systems, installation procedures, operating procedures- start up, shutting down; care and maintenance- running checks, preventive maintenance and service schedule, fault finding, lubrication, dismantling and assembly; stock of spare parts and its storage;

Determining stable stream channel form, causes of channel instability, natural stream patterns, stream stabilization techniques, common problems addressed in stream restoration,

Bed control techniques- Pool and riffle design and installation, Benefits of pools and riffles, Designing pool and riffle sequences, Riffle construction, Using large woody debris to build riffles, Rock and grass chutes, Drop structures, Outlet structures, Instream retards

Alignment stabilisation techniques- Rebuilding meanders, Sediment management, Installing large woody debris, Flow Retards and Groynes, Vane Dykes,

Bank protection techniques- Battering and terracing, Brushing, Organic geotextiles, Hard Engineering Options-a) Log Walling, b) Rock Gabions, c) Rock Riprap, d) Geotextiles, mattresses and flexmats,

Hydraulic Engineering of Land Reclamation, Reclamation Techniques – Instream Techniques (Channel Modification, Cross vanes and Related Structures, Engineered Log Jams), Off- line Techniques.

Dredging – its Uses, Types of Dredging Vessels, Disposal of Materials, Environmental Impacts, Major Dredging Companies.

Institutional mechanism for planning and implementation of land reclamation, potential for land reclamation, uses of reclaimed land, development control of reclaimed land, Legal issues of reclaimed land, Issues of coastal land reclamation,

Paper XVI : Projects and Field Training :

Projects and Field Training on Sand Slurry Pumping and Dredging Machine.

MSc (E&R) will be offered after completion of Semester I, II, III & IV

Creditization of Course:

1 Credit = 3 Hours.

Total Credit/Sem = 34 (34 X 3=102 Hrs)

Grading System:

➤ Rel. percentage Score = $(100/\text{Highest marks}) \times \text{Actual Marks}$

• RPS	Letter Grade	Grade Point
• 90 -100	A	10
• 75 – 89	B	8
• 55 -74	C	6
• 40 -54	D	4
• 30 – 39	E	2
• AM/ RPS <30	F	0

For Semester I:

Paper Name	Hours Assigned			Credits Assigned		
	Theory	Practice	Total	Theory	Practice	Total
Introduction to Brahmaputra and Its Tributaries and Overview of World Rivers	24	-	24	8	-	8
Basics of Flood and River Management	24	-	24	8	-	8
Erosion Basics	24	-	24	8	-	8
Projects	-	30	30		10	10

For Semester II:

Paper Name	Hours Assigned			Credits Assigned		
	Theory	Practice	Total	Theory	Practice	Total
Erosion and Sediment Control, Planning, and Design	18	6	24	6	2	8
Flood and Erosion Control Technology	18	6	24	6	2	8
Sand Slurry Pumping and Land Reclamation	18	6	24	6	2	8
Projects		30	30		10	10

For Semester III:

Paper Name	Hours Assigned			Credits Assigned		
	Theory	Practice	Total	Theory	Practice	Total
Area wise erosion behavior of Brahmaputra and Its Tributaries and feasible action to tackle	24	-	24	8	-	8
Flood and erosion management initiative area wise	24	-	24	8	-	8
Long term Erosion Control measures	24	-	24	8	-	8
Projects	-	30	30		10	10

For Semester IV:

Paper Name	Hours Assigned			Credits Assigned		
	Theory	Practice	Total	Theory	Practice	Total
Sediment Control in active dstreams, Planning, and Design	18	6	24	6	2	8
Flood and Erosion Control device using localize ideas	18	6	24	6	2	8
Sand Slurry Pumping, erosion prevention and Land Reclamation	18	6	24	6	2	8
Projects		30	30		10	10

Grading System:

➤ Rel. percentage Score = $(100/\text{Highest marks}) \times \text{Actual Marks}$

• RPS	Letter Grade	Grade Point
• 90 -100	A	10
• 75 – 89	B	8
• 55 -74	C	6
• 40 -54	D	4
• 30 – 39	E	2
• AM/ RPS <30	F	0
