

S.No	Paper Code	Paper Title	L	T	P	Credits
1	MC 501	Constitution of India/Essence of Indian Knowledge Traditional	3	0	0	0
2	PCC CE 308	Construction Engineering & Management	2	1	0	3
3	PCC CE 303	Design of Steel Structure	3	0	0	3
4	PCC CE 309	Engineering Economics, Estimation & Costing	2	0	2	3
5	PCC CE 306	Environmental Engineering-II	3	0	0	3
6	PCC CE 304	Geotechnical Engineering -II	3	0	0	3
7	-	Industrial Visit	0	0	2	1
8	-	MOOCs / SWAYAM / NPTEL Courses - 2	2	0	0	2
9	-	Program Elective- I	3	0	0	3

[AKU-PATNA] [101-CE]

**CURRICULUM
FOR
CIVIL ENGINEERING**

SEMESTER - VI (CIVIL ENGINEERING)

MC 501	Constitution of India - Basic features and fundamental principles	L:3	T:0	P:0	CREDIT:0 (Mandatory non-credit course)
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Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" - a modern and progressive concept historically developed by the thinkers of "liberalism" - an ideology which has been recognized as one of the most popular political ideologies and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly the European Renaissance and Reformation movement have resulted in progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including the United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that the Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest courts in the world".

Course content:

- Meaning of the constitution law and constitutionalism
- Historical perspective of the Constitution of India
- Salient features and characteristics of the Constitution of India
- Scheme of the fundamental rights
- The scheme of the Fundamental Duties and its legal status
- The Directive Principles of State Policy - Its importance and implementation
- Federal structure and distribution of legislative and financial powers between the Union and the States
- Parliamentary Form of Government in India - The constitution powers and status of the President of India
- Amendment of the Constitutional Powers and Procedure
- The historical perspectives of the constitutional amendments in India
- Emergency Provisions: National Emergency, President Rule, Financial Emergency
- Local Self Government - Constitutional Scheme in India
- Scheme of the Fundamental Right to Equality
- Scheme of the Fundamental Right to certain Freedom under Article 19 → Scope of the Right to Life and Personal Liberty under Article 21.

PAPER CODE - PCC CE 308

PCC CE 308	Construction Engineering & Management	L:2	T:1	P:0	CREDIT:3
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Module 1

Basics of Construction: Unique features of construction, construction projects- types and features, phases of a project, agencies involved and their methods of execution;

Module 2

Construction project planning: Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks. PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.

Module 3

Construction Methods basics: Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges.

Module 4

Construction Equipment basics: Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities

Module 5

Planning and organizing construction site and resources: Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothing and leveling. Common Good Practices in Construction

Module 6

Project Monitoring & Control: Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

Module 7

Contracts Management basics: Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution Methods.

Module 8

Construction Costs: Make-up of construction costs; Classification of costs, time cost trade-off in construction projects, compression and decompression.

Text/Reference Books:

- Varghese, P.C., "Building Construction", Prentice Hall India, 2007.
- National Building Code, Bureau of Indian Standards, New Delhi, 2017.
- Chudley, R., Construction Technology, ELBS Publishers, 2007.
- Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
- Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
- Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
- Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

S.No	Module (No of Lectures in brackets)	Tutorials
1	Basics of Construction (2)	-
2	Construction Planning (6)	Develop a WBS structure for the construction of one storeyed building; Develop a bar chart for the construction of this building, including finishing activities, assuming reasonable activity durations.
3	Construction Methods basics (6)	Develop a CPM chart for a 5 span bridge on open foundations. Develop a comparative table for a 10- storeyed building constructed by at least three different methods, listing their pros and cons.
4	Construction Equipment Basics (3)	Develop a Gantt Chart for the construction of a two storeyed precast framed structure, including open foundations, along with a list of equipment resources, assuming reasonable quantities and productivities. Develop a bar chart for concreting 1500 sq.m. of a 15cm. thick slab using various equipment for production to placing of concrete at 3m height above ground level; show all equipment resources required, along with a site layout.

5	Planning and Organizing Construction Site and Resources (4)	<p>For the construction of a typical 3 storeyed, framed structure with 400 sq.m. area per floor develop the histograms for the various resources required, showing all intermediate calculations; also, draw Curves for concrete placing and blockwork done over the period.</p>
6	Project Monitoring and Control (4)	<p>Write a 500-word note on the advantages of Lean Construction method over conventional project management systems. Write a 500-word note on the Safety and Health precautions you would take for a typical 3 storeyed building with 400 sq.m. plinth area.</p>
7	Contract Management basics (3)	<p>Assuming a 4 month delay in a construction contract of 24 months duration, form 3 groups for arguing the case for or against levying penalty on the contractor; Group A to formulate the contract conditions, Group B to act as Client and Group C to act as the Contractor. One person to act as Arbitrator/ Judge.</p>

8	Construction Costs (2)	Refer to a Standard Schedule of Rates of any PWD (available on the Net), develop the approximate cost of a 3 storey, 400 sqm plinth area building.
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PAPER CODE - PCC CE 305

PCC CE 305	Design Of Steel Structure	L:3	T:0	P:0	CREDIT:3
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Detailed contents:

Module 1

Introduction: Steel structures, material properties, Limit states and design philosophies; analysis and design methods, Loads, partial safety factors and load combinations, analysis of roof for wind loads. Codes and standards. Section Classification: Plastic, compact, semi-compact, and slender sections.

Module 2

Connections: Structural fasteners - Rivets, bolts and welds, strength under combined stresses, Bolted and Welded Connections - Simple and Eccentric and Column bases.

Module 3

Tension members: Design based on net section including shear lag effects and block shear, lug angles. Compression members:

Module 4

Design for flexural and flexural-torsional buckling: Effective length factor:
Sway and Nonsway frames, Local buckling, Built-up columns - Battens and lacings. Laterally Supported and Unsupported Beams:

Module 5

Design strength using shear-moment interaction: Built-up beams, Shear buckling strength, Plate girders and design of stiffeners, Lateral torsional buckling, Effect of restraints and effective length.

Module 6

Beam-Columns: Effect of axial load on flexural behaviour, P-M interaction and moment amplification, Flexural torsional buckling and Bi-axial bending.

Text/Reference Books:



Bihar Universities

McCormac, J.C., Nelson, J.K. Jr., Structural Steel Design. 3rd edition.

Prentice Hall, N.J., 2003.

Galambos, T.V., Lin, F.J., Johnston, B.G., Basic Steel Design with LRFD, Prentice Hall, 1996

- Segui, W. T., LRFD Steel Design, 2nd Ed., PWS Publishing, Boston.
- Salmon, C.G. and Johnson, J.E., Steel Structures: Design and Behavior, 3rd Edition, Harper & Row, Publishers, New York, 1990.
- Related Codes of Practice of BIS
- NBC, National Building Code, BIS (2017).
- ASCE, Minimum Design Loads for Buildings and Other Structures, ASCE 7-02, American
- Society of Civil Engineers, Virginia, 2002.
- Subramanian, N. (2010). Steel Structures: Design and Practice, Oxford University Press.
- Duggal, S.K. (2014). Limit State Design of Steel Structures, McGraw Hill.

PCC- CE 309	Engineering Economics, Estimation & Costing	L:2	T:0	P:2	CREDIT:3
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Detailed contents:

Module 1

Basic Principles and Methodology of Economics: Demand/Supply - elasticity - Government Policies and Application. Theory of the Firm and Market Structure. Basic Macroeconomic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes (3 lectures)

Module 2

Public Sector Economics: Welfare, Externalities, Labour Market. Components of the Monetary and Financial System, Central Bank - Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy - Inflation and Phillips Curve. (2 lectures)

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Module 3

Elements of Business/Managerial Economics and forms of organizations Cost & Cost Control -Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis - NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting - Elementary techniques. Statements - Cash flow, Financial. Case Study Method. (3 lectures)

Module 4

Indian economy: Brief overview of post-independence period - plans. Post reform Growth, Structure of productive activity. Issues of Inclusion - Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment- Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors. (2 lectures)

Module 5

Estimation / Measurements for various items: Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying

Module 6

Specifications: Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures.

Module 7

Rate analysis: Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity.

Module 8

Tender: Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management

Module 9

Introduction to Acts pertaining to: Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.

Term Work Assignments may include:

Deriving an approximate estimate for a multistoried building by approximate methods.

Detailed estimate for the following with the required material survey for the same.

- ◆ Ground plus three storied RCC Framed structure building with blockwork walls bridge with minimum 2 spans
 - ◆ factory building
 - ◆ road work
 - ◆ cross drainage work
 - ◆ Ground plus three storied building with load-bearing walls g
Cost of finishes, MEP works for (f) above
 - ◆ Preparation of valuation report in standard Government form.
- Assignments on rate analysis, specifications and simple estimates.
- Detailed estimate of minor structure.
- Preparation of Bar bending schedule.

Text/Reference Books:

- Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia

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- V. Mote, S. Paul, G. Gupta(2004), Managerial Economics, Tata McGraw Hill
- Misra, S.K. and Puri (2009), Indian Economy, Himalaya
- Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publishers
- M Chakravarty, Estimating, Costing Specifications & Valuation
- Joy P K, Handbook of Construction Management, Macmillan → B.S. Patil, Building & Engineering Contracts → Relevant Indian Standard Specifications.
- World Bank Approved Contract Documents.
- FIDIC Contract Conditions.
- Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration
- Typical PWD Rate Analysis documents.
- UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations, 2016
- Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016 **PAPER CODE - PCC CE 306**

PCC CE 306	Environmental Engineering-II	L:3	T:0	P:0	CREDIT:3
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Detailed contents:

Module 1

Sewage: Domestic and Stormwater, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage - quality requirements for various purposes.

Module 2

Solid waste management: Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes,

Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste- segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.

Module 3

Government authorities and their roles in water supply, sewerage disposal.

Solid waste management and monitoring/control of environmental pollution.

Practical Work: List of Experiments

- Physical Characterization of water: Turbidity, Electrical Conductivity, pH
- Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorganic etc.
- Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness
- Analysis of ions: copper, chloride and sulfate
- Optimum coagulant dose
- Chemical Oxygen Demand (COD)
- Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)
- Break point Chlorination
- Bacteriological quality measurement: MPN,
- Ambient Air quality monitoring (TSP, RSPM, SO_x, NO_x)
- Ambient noise measurement

Text/Reference Books:

- Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
- Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.
- Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw Hill International Editions, New York 1985.
- MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi.
- Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.

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→ Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999

→ Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil. McGraw Hill Publication

→ Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.

PAPER CODE - PCC CE 304

PCC CE 304	Geotechnical Engineering -II	L:3	T:0	P:0	CREDIT:3
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Detailed contents:

Module 1

Consolidation of Soil: Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.

On completion of this module, the student must be able to:

- Understand the basic mechanism of consolidation of soil;
- Determine various consolidation parameters of soil through laboratory test; Evaluate ground settlements against time.

Module 2

Shear Strength: Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters unconfined compression test, vane shear test

On completion of this module, the student must be able to:

- Determine graphically and analytically the stress state in any plane of the soil mass; Perform various shear strength tests and appreciate the different field conditions which they simulate;

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Understand the significance of shear strength parameters in various geotechnical analyses;
Evaluate the stiffness of soil using shear strength parameters

Module 3

Stability of Slopes: Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts. **On completion of this module, the student must be able to:**

- Differentiate various modes of slope failure;
- Evaluate factor of safety of infinite slopes based on different ground conditions; Understand various methods for computation of factor of safety for finite slopes.

Module 4

Soil Exploration: Introduction, methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, trial pits, borings, penetrometer tests, analysis of borehole logs, geophysical and advanced soil exploration methods.

On completion of this module, the student must be able to:

- Specify a strategy for site investigation to identify the soil deposits and determine the depth and spatial extent within the ground;
- Understand various site investigation techniques and their in-situ applications; Prepare a soil investigation report based on borehole log data and various in-situ tests like SPT, CPT, Etc.

Module 5

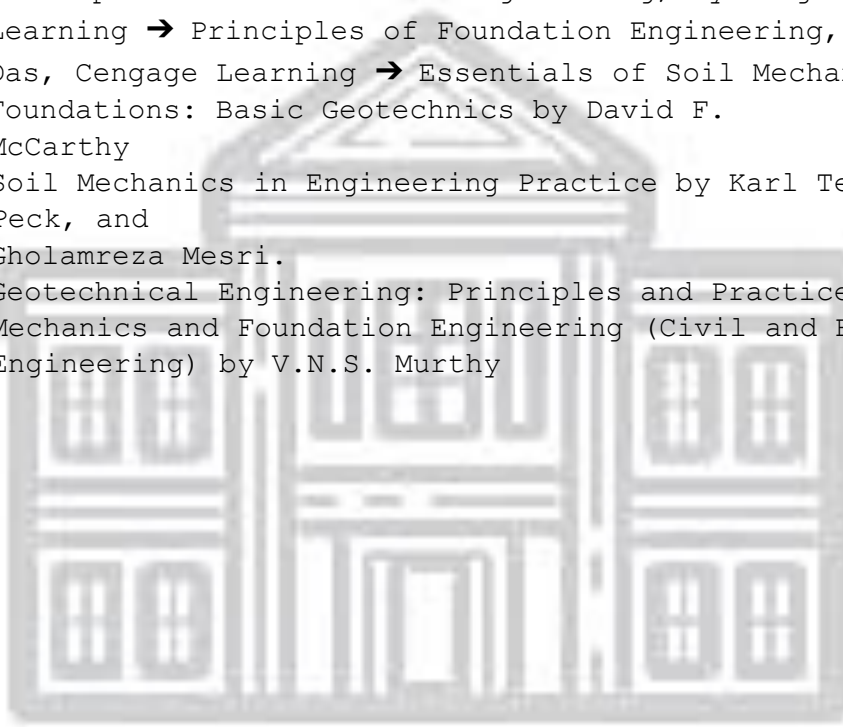
Application of soil mechanics to determine earth pressures, analysis of retaining walls, cuts & excavations and sheet piles, stability of slopes, instrumentation.

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Text/Reference Books:

- Soil Mechanics by Craig R.F., Chapman & Hall
- Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
- An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ
- Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning → Principles of Foundation Engineering, by Braja M. Das, Cengage Learning → Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy
- Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri.
- Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil and Environmental Engineering) by V.N.S. Murthy



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