

UGC NET

TEACHING & RESEARCH APTITUDE

GENERAL PAPER-I

- ▶ Teaching Aptitude
- ▶ Research Aptitude
- ▶ Comprehension
- ▶ Communication
- ▶ Mathematical Reasoning and Aptitude
- ▶ Logical Reasoning
- ▶ Data Interpretation
- ▶ Information and Communication Technology (ICT)
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TEACHING APTITUDE

TEACHING: CONCEPT, OBJECTIVES, LEVELS, CHARACTERISTICS AND BASIC REQUIREMENTS

1.2 TEACHING: MEANING AND CONCEPT

1.2.1 Etymology and everyday meaning

The English word *teach* descends from Old English *tæcan*, meaning to show, to point out, to demonstrate. That origin still carries the core idea: teaching is fundamentally an act of **making something available to another person's understanding**.

In ordinary usage “teaching” covers almost any act of telling. In educational science the term is far narrower. Teaching is a **deliberate, purposive, goal-directed activity intended to produce learning in another person**. Three words in that sentence carry the weight:

- **Deliberate** — accidental influence is not teaching. A person who is overheard and imitated has not taught.
- **Purposive** — teaching aims at a stated outcome. Aimless activity in a classroom is not teaching.
- **Intended to produce learning in another** — teaching is other-directed. Self-study is learning, not teaching.

EXAM POINT Teaching is defined by its **intention**, not by its **success**. A teacher who teaches well but whose students do not learn has still taught. This is the basis of a recurring statement item: “*Teaching necessarily results in learning.*” That statement is **false**. Teaching and learning are related but independent; the relationship is one of intention, not of guarantee.

1.2.2 Standard definitions and what each one adds

The following definitions are grouped by the *distinctive feature* each contributes, because that is how the examination uses them.

Teaching as influence on behaviour

- **N.L. Gage** described teaching as a form of interpersonal influence directed at changing the behaviour potential of another person. The key phrase is **behaviour potential** — not behaviour itself, but the capacity for behaviour.
- **Clarke** described teaching as those activities designed and performed to produce change in student behaviour.

Teaching as a system of actions

- **B.O. Smith** offered the widely quoted formulation that teaching is a **system of actions intended to induce learning**. Smith later broadened this to include the *interactional* dimension, describing teaching as a system of actions involving an agent, an end in view, and a situation.

⚠ **COMMON CONFUSION:** B.O. Smith is associated with **two** formulations. The short one (“system of actions intended to induce learning”) is the one usually tested. Do not treat the longer tri-partite formulation as a different scholar’s work.

Teaching as relationship

- **Ryburn** treated teaching as a **relationship** that helps the child develop all his or her powers. This definition is the philosophical opposite of the behavioural definitions: it locates teaching in the bond, not in the activity.
- **H.C. Morrison** — the same Morrison associated with the understanding level — described teaching as an **intimate contact between a more mature personality and a less mature one**, designed to advance the education of the latter.

Teaching as guidance and stimulation

- **Burton** described teaching as the **stimulation, guidance, direction and encouragement of learning**. This four-verb formulation is frequently used in match-the-following items.
- **Yoakam and Simpson** described teaching as guiding and stimulating the learner so that desired changes occur.

Teaching as interaction

- **Edmund Amidon** described teaching as an **interactive process, primarily involving classroom talk** between teacher and pupil, occurring during definable activities. Amidon’s definition is the bridge to Flanders’s interaction analysis.
- **Philip W. Jackson** described teaching as a **face-to-face encounter** between two or more persons, one of whom intends to effect a change in the other.

3. **Coding** — attaching labels to segments of data that capture what they are about. *Open coding* generates initial categories; *axial coding* relates categories to one another; *selective coding* integrates them around a core category. Codes may be *a priori* (derived from theory) or *emergent* (derived from the data), or both.
4. **Categorising** — grouping codes into broader categories.
5. **Theme development** — identifying patterns of meaning that run across categories.
6. **Interpretation** — explaining what the themes mean in relation to the research question and existing literature.
7. **Representation** — writing the account, with illustrative quotations, so that the reader can see the evidence for the interpretation.

Named approaches. *Thematic analysis* (the identification of patterns of meaning across a data set); *constant comparative method* (each new datum is compared with existing codes, in grounded theory); *content analysis* (systematic coding, which may be quantitative); *discourse analysis* (the study of language in use and its effects); *narrative analysis* (the study of story structure and function); *framework analysis* (a matrix-based approach widely used in applied policy research); *interpretative phenomenological analysis*.

2.5.8 Trustworthiness in Qualitative Research

The concepts of internal validity, external validity, reliability and objectivity were developed for quantitative work. **Guba and Lincoln** proposed four parallel criteria of **trustworthiness** for naturalistic enquiry, and these are frequently examined as a matching set.

Table 2.12 — Trustworthiness Criteria and Their Quantitative Parallels

Qualitative criterion	Quantitative parallel	Meaning	Principal techniques
Credibility	Internal validity	Are the findings a believable representation of participants' realities?	Prolonged engagement, persistent observation, triangulation, peer debriefing, negative case analysis, member checking
Transferability	External validity / generalisability	Can the findings be applied usefully in another context?	Thick description so that the reader can judge fit; purposive sampling
Dependability	Reliability	Is the process logical, traceable and documented?	Audit trail , inquiry audit, stepwise replication
Confirmability	Objectivity	Are the findings shaped by the data rather than by the researcher's bias?	Audit trail, reflexivity, confirmability audit, triangulation

An **audit trail** is a systematic record of raw data, field notes, coding decisions, analytical memos and drafts, sufficient for another scholar to follow how conclusions were reached. **Member checking** (respondent validation) is the practice of returning findings or interpretations to participants for comment.

EXAM POINT The four trustworthiness criteria and their quantitative parallels are a classic match-the-following item. The most frequently missed pairing is **transferability ↔ external validity**, and the technique most often associated with credibility is **member checking**.

2.5.9 Strengths and Limitations of Qualitative Research

Strengths. Depth and richness; sensitivity to context and to participants' meanings; flexibility to pursue unanticipated

lines; ability to study processes as they unfold; usefulness for theory generation; suitability for phenomena that resist measurement; strong ecological validity.

Limitations. Statistical generalisation is not available; small samples; analysis is labour-intensive and slow; findings depend heavily on the skill of the researcher; the risk of researcher bias is high; replication is not possible in the usual sense; and the volume of data can be unmanageable.

2.6 THE QUANTITATIVE METHOD

2.6.1 Meaning and Characteristics

Quantitative research is enquiry in which phenomena are expressed numerically through measurement and analysed by statistical methods, in order to describe distributions,

test hypotheses about relationships and differences, and generalise from samples to populations.

Characteristics.

1. **Measurement.** Concepts are converted into numbers by defined procedures.
2. **Operationalisation.** Abstract constructs are given *operational definitions* specifying exactly how they will be measured. "Academic achievement" becomes "total score on the prescribed end-of-year examination".
3. **Variables.** The phenomenon is analysed as relationships among defined variables.
4. **Deductive logic.** Theory → hypothesis → data → test → conclusion.
5. **A priori design.** The design and instruments are fixed before data collection; they are not revised as the study proceeds.

6. **Large probability samples**, when generalisation is intended.
7. **Standardised instruments** — tests, scales, structured questionnaires.
8. **Statistical analysis**, descriptive and inferential.
9. **Researcher detachment.** The researcher is a neutral, replaceable observer.
10. **Generalisation** to a defined population, with stated confidence.
11. **Reliability and validity** as the criteria of instrument quality.

2.6.2 Measurement and Scales

Measurement is the assignment of numerals to objects or events according to rules. **S. S. Stevens'** classification of four levels of measurement is standard and heavily examined.

Table 2.13 — Stevens' Levels of Measurement

Scale	Properties	Permissible operations	Typical statistics	Examples
Nominal	Classification only; categories are mutually exclusive and exhaustive; numbers are labels	Counting, equality/inequality	Mode, frequency, chi-square, contingency coefficient	Gender, religion, subject taught, jersey numbers
Ordinal	Classification + rank order; intervals not equal	Greater than / less than	Median, percentile, Spearman's rho, Mann-Whitney	Rank in class, socio-economic status categories, agreement ratings
Interval	Order + equal intervals; arbitrary zero	Addition and subtraction	Mean, standard deviation, Pearson's r, t-test, ANOVA	Temperature in Celsius, calendar years, most standardised test scores
Ratio	Order + equal intervals + absolute (true) zero	All arithmetic, including ratios	All of the above, plus geometric mean, coefficient of variation	Height, weight, time taken, income, number of errors

EXAM POINT The single distinguishing feature between **interval** and **ratio** scales is the **absolute zero**. Because 0 °C does not mean the absence of temperature, one cannot say that 40 °C is twice as hot as 20 °C — Celsius is interval. Because 0 kg does mean the absence of mass, 40 kg is twice 20 kg — weight is ratio.

Attitude scales. Four are standard:

- ☐ **Likert scale (summated rating).** A set of statements to which respondents indicate degree of agreement,

commonly on a five-point scale; item scores are summed. Developed by **Rensis Likert**.

- ☐ **Thurstone scale (equal-appearing intervals).** Statements are pre-scaled by judges, and the respondent selects those with which he agrees; his score is the median scale value of the endorsed items. Developed by **L. L. Thurstone**.

- ☐ **Guttman scale (cumulative or scalogram).** Items are ordered so that agreement with a stronger item

2.9 Identifying Attitude

2.9.1 Tone, Attitude and Purpose Distinguished

These three overlap and are constantly confused. The distinction is worth stating precisely.

Term	Definition	Question it answers	Directed at
Tone	The attitude conveyed by the writing	<i>How does the passage sound?</i>	The reader's ear
Attitude	The author's stance towards the subject	<i>What does the author think of it?</i>	The subject matter
Purpose	What the author is doing in writing	<i>Why was this written?</i>	The communicative act

They are related but distinguishable. A passage may have an **analytical tone**, a **doubtful attitude** towards the theory it examines, and the **purpose** of persuading the reader to suspend judgement. Nothing prevents all three from being true simultaneously.

COMMON CONFUSION — Attitude questions ask about the author's stance towards a *specified object*: "The author's attitude towards X is best described as...". Always identify what X is before evaluating. A passage may be admiring of a scholar's method and doubtful of her conclusion; the answer depends entirely on which the stem names.

2.9.2 Attitude Towards Multiple Objects

Longer passages carry different attitudes towards different things, and examiners exploit this. Track them separately:

"Bhattacharya's monograph is the most careful survey of the archival material we possess, and the reconstruction of the trade routes in Chapter 4 is likely to stand. The final chapter's account of causation is another matter. It rests on a single set of customs records whose completeness the author herself questions in a footnote, and it is asserted with a confidence the evidence does not carry."

- Attitude towards the survey and Chapter 4: **appreciative**.
- Attitude towards the causal account in the final chapter: **critical**.
- Attitude towards the author personally: **respectful throughout** — note "the author herself questions", which credits her honesty even while faulting her conclusion.

A question asking "the author's attitude towards Bhattacharya's monograph" would require the balanced answer; a question asking "the author's attitude towards the final chapter's account of causation" would require the critical one. Two different correct answers, one passage.

2.9.3 Attributed Attitude versus the Author's Own

This is a continuation of Section 2.2.3 and repays repetition, because it is among the most costly errors in the unit.

"Critics of the reform have described it as an abdication of public responsibility. The description is too strong. What the reform does is transfer a function, not abandon it — though it transfers it without building the capacity to receive it, and that is a real failure."

- The *critics'* attitude: condemnatory.
- The *author's* attitude: partly disagreeing with the critics ("too strong"), partly agreeing that there is a fault ("a real failure"). The author is **critical but more measured than the critics**.

An option offering "the author regards the reform as an abdication of public responsibility" attributes to the author a view the author explicitly moderates.

EXAM POINT — Underline every attribution verb while reading: *critics argue, supporters claim, it is widely held, the conventional view maintains, proponents insist*. Each marks a view that is **not** the author's until the author endorses it.

2.10 Identifying Assumptions

2.10.1 What an Assumption Is

An assumption is something the author does not state but must take to be true for the argument to work. It is a missing premise, not a stated one.

Two conditions define it:

1. It is **unstated**.
2. The argument **requires** it — if it were false, the reasoning would break.

The second condition does the work. Many things could be true consistently with a passage; only a few are *required* by it.

2.10.2 The Negation Test

The standard technique, and the one to use in the examination:

Take the candidate assumption. **Negate it**. If the argument collapses, it was an assumption. If the argument survives, it was not.

Illustration.

"The department's publication output rose sharply after the new incentive scheme was introduced. The scheme should therefore be extended to other departments."

Candidate assumption A: The increase in output was caused by the scheme. *Negated:* The increase was not caused by the scheme. *Effect:* The argument collapses entirely — there is no reason to extend a scheme that did nothing. *Verdict:* **Assumption.**

Candidate assumption B: Other departments currently have lower publication output than this one. *Negated:* Other departments have equal or higher output. *Effect:* The argument is untouched. One might still extend a scheme that raises output regardless of the starting level. *Verdict:* **Not an assumption.** It is merely consistent with the passage.

Candidate assumption C: Higher publication output is desirable. *Negated:* Higher publication output is not desirable. *Effect:* The argument collapses — there would be no reason to extend a scheme that produces an undesirable result. *Verdict:* **Assumption.** Note that this one is so obvious it is easy to miss: assumptions are often the things too obvious to state.

2.10.3 What Assumption Questions Are Not

COMMON CONFUSION — An assumption question does not invite speculation about the author's beliefs, background, politics or motives. "The author assumes that government intervention is generally beneficial" is not answerable unless the *argument in the passage* requires it. The test is logical necessity, not psychological plausibility.

KEY POINT — Assumption options that are **broad statements of value or ideology** are almost always wrong. Correct assumption options are usually narrow, specific and slightly dull — a link between two things the passage mentions.

2.10.4 Worked Example

Passage. "Institutions that introduced a mandatory research-methods course for first-year doctoral students subsequently reported fewer thesis submissions requiring major revision. Every institution seeking to reduce revision rates should therefore make such a course mandatory."

Question: The argument in the passage assumes that —

- (A) research-methods courses are inexpensive to run
- (B) the reduction in major revisions was attributable to the course rather than to some other difference between these institutions and others
- (C) doctoral students are generally unwilling to take methods courses voluntarily
- (D) thesis revision is the most serious problem facing doctoral education

Answer: (B).

Working. Apply the negation test to each.

- (A) negated: the courses are expensive. The argument that they *would reduce revisions* is untouched; cost bears on advisability, not on the causal inference. Not required.
- (B) negated: the reduction was caused by something else. The argument collapses — there is then no reason to expect the course to reduce revisions elsewhere. **Required.**
- (C) negated: students would take the course voluntarily. The recommendation to make it mandatory is weakened but the causal claim survives, and the passage's inference does not depend on unwillingness. Not required.
- (D) negated: revision is not the most serious problem. The argument, which is conditional on an institution "seeking to reduce revision rates", is untouched. Not required.

Note the shape of the correct answer: it is narrow, specific, and concerns the link between the two facts the passage juxtaposes. Notice also that (D) is the kind of grand statement candidates find satisfying and the negation test rejects immediately.

2.11 Fact, Opinion and Interpretation

2.11.1 The Three Categories

Fact — a statement capable of being verified as true or false by evidence, whether or not the passage supplies that evidence. > "The scheme was introduced in 2016." "Enrolment rose by eleven per cent."

Opinion — a statement expressing a judgement, preference or evaluation, which evidence can inform but cannot settle. > "The scheme was a wise use of public money." "The prose is elegant."

Interpretation — a statement that assigns meaning or significance to facts. It goes beyond the facts but answers to them, and can be better or worse supported. > "The rise in enrolment reflects a change in household expectations rather than a change in supply."

Interpretation is the category candidates handle worst, because it sits between the other two. It is not simply true or false like a fact, but it is not merely preference like an opinion: an interpretation can be *well-supported* or *poorly supported*.

Category	Verifiable?	Contestable?	Answers to evidence?	Marker language
Fact	Yes, in principle	Only as to accuracy	Directly	dates, numbers, events, records

- **Information source** — produces the message. In a telephone call, the speaker's mind.
- **Transmitter (encoder)** — converts the message into a signal. In a telephone call, the handset that converts sound into an electrical signal.
- **Channel** — the medium carrying the signal. The wire.
- **Signal** — the encoded form travelling through the channel.
- **Noise source** — anything added to the signal that was not intended by the source. This element is Shannon's most influential contribution to communication studies.
- **Receiver (decoder)** — reconstructs the message from the signal. The earpiece.
- **Destination** — the person or thing for whom the message is intended.

3.5.3 Weaver's three levels of problems

Weaver's essay generalised the model by distinguishing three levels of problem:

Level	Question	Name
A	How accurately can the symbols of communication be transmitted?	Technical problem
B	How precisely do the transmitted symbols convey the desired meaning?	Semantic problem
C	How effectively does the received meaning affect conduct in the desired way?	Effectiveness (influential) problem

Shannon's mathematics addresses Level A only. Weaver argued that the framework nevertheless illuminates B and C.

3.5.4 Key concepts introduced

- **Noise** — interference reducing fidelity.
- **Entropy** — the measure of uncertainty in a source.
- **Redundancy** — the predictable part of a message, which protects it against noise.
- **Channel capacity** — the maximum rate at which a channel can carry information.
- **Feedback** — *not* present in the original 1948-49 diagram. Feedback was added to the model in later adaptations, notably by Norbert Wiener's cybernetic work and by DeFleur.

COMMON CONFUSION: The original Shannon-Weaver model contains **no feedback loop**. A question asserting that feedback is one of the components of the Shannon and Weaver model is false. Its most quoted single contribution is the introduction of the concept of **noise**.

3.5.5 Evaluation

Contributions. Introduced noise; introduced the technical vocabulary of information theory; gave communication studies its first precise, quantitative framework; influenced every subsequent model.

Limitations. Developed for machines, not for human meaning-making; linear; no feedback; no context; no account of meaning; treats the destination as an endpoint rather than an interpreter.

[DIAGRAM: Shannon-Weaver Model]

3.6 SCHRAMM'S MODELS AND THE FIELD OF EXPERIENCE

3.6.1 Background

Wilbur Schramm is often described as the founder of communication study as an academic discipline. In his 1954 essay on how communication works he presented a sequence of figures that move from a simple linear arrangement to a circular one.

3.6.2 Schramm's first model

A straightforward adaptation of Shannon and Weaver in human terms:

SOURCE → ENCODER → SIGNAL → DECODER → DESTINATION

3.6.3 Schramm's second model: the field of experience

Schramm's distinctive contribution is the **field of experience**: the accumulated store of experiences, knowledge, culture, values and language that each party brings to the encounter.

Communication is possible only within the **area of overlap** between the source's field and the destination's field. The source can encode only within her own field; the destination can decode only within his. Where the fields do not overlap, encoding produces symbols the destination cannot decode.

Educational application. This is the single most useful model for teaching. It explains why an expert's explanation fails with a beginner: the expert encodes within a field the student does not share. It also prescribes the remedy — the teacher must deliberately encode inside the overlap, using the student's vocabulary, the student's examples and the student's prior knowledge, and must then extend the overlap gradually. The pedagogical principles "proceed from the known to the unknown" and "relate new learning to prior knowledge" are, in communication terms, instructions to work inside and then enlarge the field of overlap.

3.6.4 Schramm's third model: the circular arrangement

Schramm's third figure removes the fixed roles altogether. Each party is drawn as an entity that simultaneously **encodes**, **interprets** and **decodes**, and messages circulate between them continuously. This figure is the one usually referred to as the **Osgood-Schramm model**.

3.6.5 Evaluation

Contributions. Introduced the field of experience; introduced feedback into the mainstream of communication modelling; humanised the engineering model.

Limitations. Assumes broadly equal parties, which does not fit mass communication; does not represent noise explicitly; the circular form implies that communication returns to where it began, which Dance later criticised.

EXAM POINT "Field of experience" → Wilbur Schramm. "Overlap of fields of experience is a condition of understanding" → Schramm. Schramm also co-authored *Four Theories of the Press* (1956) with Siebert and Peterson, a fact tested in the media-theory section.

3.7 THE OSGOOD-SCHRAMM CIRCULAR MODEL

3.7.1 Background and attribution

Charles E. Osgood, a psycholinguist, argued that the sender and the receiver are not different kinds of entity performing different operations, but the same kind of entity performing the same operations. Schramm incorporated this insight into his 1954 circular figure, and the resulting model is conventionally named after both.

3.7.2 The model

Each participant is shown as a unit performing three functions:

ENCODER → INTERPRETER → DECODER

and the two units are joined by messages travelling in both directions in a continuous circle.

- **Encoder** — converts meaning into a message.
- **Interpreter** — the meaning-making centre; assigns significance to what has been decoded and forms the intention for what is to be encoded.
- **Decoder** — converts a received message into meaning.

3.7.3 Key features

- **Circular, not linear.** There is no first and no last.

- **Equal participants.** Both parties perform identical functions; the model dissolves the sender/receiver hierarchy.
- **Interpretation is central.** The interpreter is placed between decoding and encoding, making meaning-making the pivot of the process.
- **Feedback is intrinsic**, not an add-on: every message is simultaneously a response to the previous one.
- **Dynamic and continuous.**

3.7.4 Evaluation

Contributions. The first influential model to treat communication as fundamentally circular and the participants as equals; placed interpretation at the centre.

Limitations. Assumes parity between the parties, which rarely holds in mass communication or in a hierarchical classroom; does not represent noise; the circle implies a return to the starting point, whereas communication in fact moves on; represents the exchange as sequential turns rather than as simultaneous.

REMEMBER E-I-D: Encoder, Interpreter, Decoder — the three functions each participant performs in the Osgood-Schramm model.

3.8 BERLO'S SMCR MODEL

3.8.1 Background

David K. Berlo published *The Process of Communication* in 1960. His model is the most detailed of the linear models and the most useful for analysing the *ingredients* of a communicative act. Berlo also gave the discipline its clearest statement of the idea that communication is a process.

3.8.2 The model

Four components, each with its sub-factors:

S — SOURCE	M — MESSAGE	C — CHANNEL	R — RECEIVER
Communication skills	Content	Hearing	Communication skills
Attitudes	Elements	Seeing	Attitudes
Knowledge	Treatment	Touching	Knowledge
Social system	Structure	Smelling	Social system
Culture	Code	Tasting	Culture

3.8.3 The components explained

Source and Receiver: the same five factors.

- **Communication skills** — speaking, writing, listening, reading, reasoning. Deficiency at either end degrades the exchange.

Dimension	Meaning	Illustration
Cultural convergence	Audiences pursuing a narrative across several media and participating in its extension	A story world experienced across film, television, games and user production

Transmedia storytelling — a related concept — is the practice of telling a single story across multiple media, with each medium making a distinctive contribution.

Consequences for the media industries. Convergence of skills, so that a journalist writes, records, films and edits; convergence of ownership, which intensifies the concentration concerns of Chapter 10; and convergence of regulation, which becomes difficult where a single service performs functions that different regulators previously supervised separately.

11.5 ALGORITHMIC COMMUNICATION AND PERSONALISATION

11.5.1 What algorithmic mediation is

On most digital platforms, what a user sees is not everything available and is not in chronological order. It is a **selection, ranked by an algorithm**, on the basis of inferred interest, past behaviour, the behaviour of similar users, and the platform's own objectives — usually engagement, and hence advertising revenue.

This is a **gatekeeping** function (Chapter 10) performed at enormous scale, individually for each user, by a process that is not transparent, is not editorially accountable, and optimises for a criterion that is not accuracy.

11.5.2 Consequences

Filter bubble. The condition in which a user's information environment has been personalised to the point where content that would challenge existing views is systematically absent. The user is not aware of what has been filtered out.

Echo chamber. An environment in which a user encounters chiefly views similar to their own and in which those views are repeated and amplified. The distinction from the filter bubble is one of mechanism: the **filter bubble** is produced by the **platform's selection**; the **echo chamber** is produced substantially by the **user's own choices** of whom to follow and what to join. In practice the two reinforce each other.

COMMON CONFUSION: Filter bubble = algorithmic selection. Echo chamber = self-selected environment. Where a question distinguishes them, this is the distinction intended. Note also that the empirical extent of both is contested in the

research literature, and a well-set question will not assert that either is universal.

Amplification of emotionally arousing content. Ranking by engagement systematically favours content that provokes strong reaction, which is one structural reason for the circulation of outrage and of misinformation (Chapter 10).

Attention as the scarce resource. Where content is unlimited and attention is finite, the design of systems to capture and hold attention becomes an economic imperative, with consequences for concentration, for study habits and for wellbeing.

Opacity and accountability. Neither the user nor, generally, the regulator can inspect why a particular item was shown, which makes the ordinary mechanisms of media accountability difficult to apply.

Data and profiling. Personalisation requires data. The collection, inference and use of behavioural data is what makes the system work and is what data-protection law addresses.

11.6 THE DIGITAL DIVIDE

The digital divide is the gap between those who have effective access to digital technologies and those who do not.

11.6.1 Three levels

The examination increasingly distinguishes three levels rather than treating the divide as a simple binary of access.

Level	Concerns	Illustration
First-level divide — access	Availability of devices, connectivity, electricity and affordability	A household without a device or a reliable connection
Second-level divide — use and skills	Digital literacy, autonomy of use, quality of the device, whether the connection supports sustained use	A shared low-specification device and limited skill, producing shallow use
Third-level divide — outcomes	Whether use translates into educational, economic and social benefit	Two students with equal access obtaining unequal benefit

11.6.2 Dimensions along which the divide runs

Income; urban and rural location; region; gender; age; level of education; language, since much online content is in a limited set of languages; and disability, where inaccessible design excludes users who have both the device and the skill.

11.6.3 Consequences

The digital divide converts a technology intended to widen access into a mechanism that reproduces existing inequality. The **knowledge gap hypothesis** of Chapter 10 states the general form of the problem: when the flow of information into a system increases, better-resourced segments absorb it faster, and the differential widens.

In education, the divide determines who can participate in online learning, who can access digital library resources, who can submit work in the required format, and who can develop the digital competence that later employment requires.

EXAM POINT The digital divide is **not** merely a question of who owns a device. The three-level formulation — **access, use and skills, outcomes** — is the current framing and is the answer to expect where the options distinguish them.

11.6.4 Responses

Infrastructure provision and connectivity programmes; affordability measures; institutional provision of devices and connectivity; digital literacy programmes; content in Indian languages; accessible design as a requirement rather than an addition; offline and low-bandwidth alternatives, including broadcast delivery of educational content, which reaches households that data connectivity does not.

11.7 TRADITIONAL MEDIA AND DIGITAL MEDIA COMPARED

Basis	Traditional mass media	Digital media
Direction	One to many	Many to many
Producer	Professional institutions	Institutions and users
Barrier to entry	High: capital and licensing	Low
Interactivity	Minimal	High
Feedback	Delayed, aggregated, indirect	Immediate, individual, measurable
Sequence	Linear, set by the producer	Hypertextual, set by the user
Timing	Scheduled	On demand
Audience knowledge	Sampled and inferred	Directly measured
Personalisation	None	Extensive
Gatekeeping	Professional editors	Platforms, algorithms and users

Basis	Traditional mass media	Digital media
Permanence	Print permanent; broadcast transient	Persistent but alterable
Reach	Broad within a territory	Global, but fragmented
Verification	Editorial, before publication	Often after publication, and often by the recipient
Regulation	Established and medium-specific	Contested and evolving
Revenue	Copy sales and advertising	Advertising, subscription and data
Scarcity	Channel capacity	Attention

Basis	Mass media	Social media
Content origin	Professionally produced	Substantially user-generated
Relationship among audience members	None	Networked
Circulation	By the producer	By users, ranked by algorithm
Identity of the receiver	Anonymous	Identified and profiled
Feedback	Aggregate	Individual, public and immediate
Editorial responsibility	Explicit and legally attributed	Contested; the platform's status as intermediary is the central regulatory question
Accountability mechanism	Press councils, broadcast authorities, courts	Terms of service, intermediary rules, courts

11.8 MEDIA AND INFORMATION LITERACY

11.8.1 Meaning

Media literacy is the ability to access, analyse, evaluate and create media messages.

Information literacy is the ability to recognise an information need, locate information, evaluate it and use it effectively and ethically.

- Major term **P** = administrators (predicate of conclusion).
- Minor term **S** = faculty members (subject of conclusion).
- Middle term **M** = researchers.
- Major premise = *No administrators are researchers* (contains P) — printed **second**.
- Minor premise = *Some faculty members are researchers* (contains S) — printed **first**.

Standard form:

No administrators are researchers. (E) Some faculty members are researchers. (I) Some faculty members are not administrators. (O)

MOOD

The **mood** of a syllogism is the sequence of the **types** (A, E, I, O) of its three propositions, taken **in standard-form order**: major premise, minor premise, conclusion.

The syllogism just standardised has mood **EIO**.

- *All M are P. All S are M. All S are P.* → mood **AAA**
- *No M are P. Some S are M. Some S are not P.* → mood **EIO**
- *All P are M. No S are M. No S are P.* → mood **AEE**

KEY FACT Mood must be read from the **standard-form** arrangement. If the premises are printed in reverse order and you read the mood off the page, you will get it wrong.

There are $4 \times 4 \times 4 = 64$ **possible moods**. Combined with four figures this gives **256 possible syllogistic forms**, of which only 24 are valid traditionally and 15 on the Boolean reading.

FIGURE

The **figure** of a syllogism is determined by the **position of the middle term** in the two premises.

Figure	Major premise	Minor premise	Conclusion	Position of M
Figure 1	M – P	S – M	S – P	Subject of major, predicate of minor
Figure 2	P – M	S – M	S – P	Predicate of both premises

Figure	Major premise	Minor premise	Conclusion	Position of M
Figure 3	M – P	M – S	S – P	Subject of both premises
Figure 4	P – M	M – S	S – P	Predicate of major, subject of minor

THE RULES OF THE CATEGORICAL SYLLOGISM

A syllogism is valid if and only if it violates none of the following rules. The first five belong to the traditional system; the sixth is required by the modern (Boolean) system.

Rule 1 — Three terms rule

A valid categorical syllogism must contain **exactly three terms**, each used in the **same sense** throughout. **Violation:** *fallacy of four terms* (**quaternio terminorum**), which in natural language usually appears as **equivocation** — a word used in two senses counts as two terms.

All banks are financial institutions. The river has steep banks. The river has steep financial institutions.

Rule 2 — Distribution of the middle term

The **middle term must be distributed at least once** in the premises. **Violation:** *fallacy of the undistributed middle*.

All economists are graduates. All statisticians are graduates. All statisticians are economists. M = graduates is the predicate of two **A** propositions, hence undistributed both times. Invalid.

Rule 3 — Distribution in the conclusion

No term may be distributed in the conclusion unless it is distributed in the premise in which it occurs. **Violations:** *illicit major* (the major term is distributed in the conclusion but not in the major premise) and *illicit minor* (the same for the minor term).

All linguists are researchers. No historians are linguists. No historians are researchers. The conclusion (**E**) distributes *researchers*, but in the major premise (**A**) *researchers* is the predicate and undistributed. **Illicit major**.

Rule 4 — Two negative premises

From two negative premises no conclusion follows. **Violation:** *fallacy of exclusive premises*.

No poets are engineers. No engineers are dancers. (nothing follows) Both premises tell us only what is excluded from what; they establish no connection between poets and dancers.

Rule 5 — Quality rule

- (a) If **either premise is negative**, the **conclusion must be negative**.
- (b) If the **conclusion is negative**, **one premise must be negative** — equivalently, two affirmative premises cannot yield a negative conclusion. **Violations:** *fallacy of drawing an affirmative conclusion from a negative premise; fallacy of drawing a negative conclusion from affirmative premises.*

Rule 6 — Existential rule (modern/Boolean system only)

A **particular conclusion may not be drawn from two universal premises**. **Violation:** *existential fallacy*.

This rule is required only because the Boolean interpretation denies existential import to universal propositions (see 3.6). On the traditional interpretation the rule does not apply, and this is exactly why nine syllogisms valid in traditional logic fail in modern logic.

Two Useful Derived Rules

Derived rule A — From two particular premises no conclusion follows. *Proof sketch.* The possible pairs are II, IO, OI, OO. OO violates Rule 4. II distributes no term at all, so the middle term is undistributed (Rule 2). In IO or OI exactly one term is distributed — the predicate of the O premise. Since a premise is negative, the conclusion must be negative (Rule 5a), and a negative conclusion distributes its predicate, the major term, which must therefore be distributed in its premise (Rule 3). But the single distributed term is already needed for the middle term (Rule 2). Two demands, one resource — no valid form exists.

Derived rule B — If one premise is particular, the conclusion must be particular.

4.5.2 The Rules-to-Fallacies Table

Rule	Requirement	Fallacy on violation
1	Exactly three terms, univocal	Four terms / equivocation
2	Middle term distributed at least once	Undistributed middle

Rule	Requirement	Fallacy on violation
3	No term distributed in conclusion unless distributed in its premise	Illicit major / illicit minor
4	Not both premises negative	Exclusive premises
5a	Negative premise $\Rightarrow$ negative conclusion	Affirmative conclusion from a negative premise
5b	Negative conclusion $\Rightarrow$ a negative premise	Negative conclusion from affirmative premises
6 (modern)	No particular conclusion from two universal premises	Existential fallacy

THE VALID MOODS, FIGURE BY FIGURE

Twenty-four moods are valid on the **traditional** interpretation. Fifteen of these remain valid on the **Boolean** interpretation; the other nine require existential import and are marked **▲**.

Figure 1 — M–P, S–M

Mood	Name	Status
AAA	Barbara	Valid in both systems
EAE	Celarent	Valid in both systems
AII	Darii	Valid in both systems
EIO	Ferio	Valid in both systems
AAI	Barbari ▲	Traditional only
EAO	Celaront ▲	Traditional only

Figure 2 — P–M, S–M

Mood	Name	Status
EAE	Cesare	Valid in both systems
AEE	Camestres	Valid in both systems
EIO	Festino	Valid in both systems
AOO	Baroco	Valid in both systems
EAO	Cesaro ▲	Traditional only
AEO	Camestros ▲	Traditional only

Figure 3 — M–P, M–S

Mood	Name	Status
IAI	Disamis	Valid in both systems
AII	Datisi	Valid in both systems
OAo	Bocardo	Valid in both systems

Dimension	Information Technology (IT)	Information and Communication Technology (ICT)
Common usage	Industry, corporate systems	Education, development, policy, governance
Example	A university's offline student database software	The same database accessed by students online, plus SMS alerts, an LMS and video classes

REMEMBER: ICT = IT + Communication. Every IT system is an ICT system only when a communication layer is added; every ICT system contains IT.

COMMON CONFUSION: "ICT is another name for IT" — **false**. "ICT is a subset of IT" — **false and inverted**. IT is the subset.

EXAM POINT. Also reject the option "ICT means only computers." ICT includes radio, television, telephony, satellite systems, conferencing hardware, mobile devices and networks.

8.3 COMPONENTS OF ICT

ICT is best understood as a layered system. Each layer is examinable.

8.3.1 The principal components

- Computers and computing devices** — desktops, laptops, tablets, smartphones, servers, embedded systems. They provide processing capacity.
- Telecommunication systems** — wired and wireless carriage: copper, optical fibre, microwave, satellite, cellular (3G/4G/5G).
- The Internet** — the global interconnected network that makes universal addressing and routing possible.
- Networking equipment and protocols** — routers, switches, modems, access points, gateways, and the rule-sets (TCP/IP) that govern exchange.
- Mobile technologies** — handsets, SIM/eSIM, mobile broadband, mobile applications; in India the dominant access mode for most users.
- Digital platforms** — LMSs, MOOC portals, e-governance portals, repositories, social platforms.

- Audio and video systems** — cameras, microphones, codecs, conferencing bridges, streaming servers, DTH broadcasting.
- Cloud technologies** — on-demand computing, storage and software delivered as a service over a network.
- Digital databases and repositories** — structured stores of records, documents, theses, learning objects and metadata.
- Communication services** — e-mail, messaging, VoIP, conferencing, social media, SMS.

8.3.2 The five components of an information system

Where a question speaks of an **information system** rather than of technology generally, the accepted five components are:

Component	Explanation	Example in a university
Hardware	Physical equipment	Servers, laboratory computers, network switches
Software	Programs and instructions	Examination software, LMS, antivirus
Data	Raw facts stored and processed	Enrolment records, marks, attendance
People (users)	Those who operate and use the system	Students, faculty, examination staff
Procedures	Rules and documented processes	Admission workflow, result-publication protocol

COMMON CONFUSION: Candidates often answer "hardware and software" only. **Data, people and procedures are equally components** of an information system. Questions frequently ask which of the following is *not* a component — "electricity", "furniture" and "budget" are the usual distractors.

8.4 INFORMATION, COMMUNICATION AND TECHNOLOGY — THE THREE CONSTITUENT IDEAS

8.4.1 Data versus information

Basis	Data	Information
Nature	Raw, unorganised facts and figures	Processed, organised, contextualised data

Basis	Data	Information
Meaning	Has no meaning by itself	Has meaning and is usable
Dependence	Independent unit	Depends on data
Decision value	Cannot directly support decisions	Supports decisions
Example	78, 92, 55, 61	"Average marks of the class = 71.5"

The classical hierarchy extends further:

DIKW hierarchy: Data → Information → Knowledge → Wisdom.

- *Data*: raw symbols.
- *Information*: data given structure and context ("what, who, when, where").
- *Knowledge*: information combined with experience and understanding ("how").
- *Wisdom*: judgement about the right application of knowledge ("why, and whether we should").

EXAMPOINT. The sequence Data → Information → Knowledge → Wisdom is a favourite sequence/chronology item. Note also the closely related idea of **metadata** — "data about data" (e.g. a thesis record's author, year, guide, university and subject fields).

8.4.2 Communication in the ICT sense

In ICT, communication means the **technical transfer of digital signals** between a sender and a receiver over a channel, governed by protocols. Its elements — sender, encoder, message, channel, decoder, receiver, feedback and noise — parallel the human-communication model studied in Unit IV, but here the encoder and decoder are devices, and "noise" is literal signal interference or packet loss.

Communication may be classified as:

- **Simplex** — one direction only (radio broadcast, DTH television).
- **Half-duplex** — both directions but not simultaneously (walkie-talkie).
- **Full-duplex** — both directions simultaneously (telephone call, video conference).

EXAM POINT. Match-the-following items regularly pair **simplex** → **television broadcast**, **half-duplex** → **walkie-talkie**, **full-duplex** → **telephone/video call**.

8.4.3 Analog versus digital

Basis	Analog	Digital
Signal form	Continuous wave	Discrete values (0 and 1)
Representation	Physical variation of amplitude/frequency	Binary encoding
Noise effect	Degrades progressively; noise accumulates	Resistant; signal can be regenerated exactly
Copying	Quality falls with each copy	Identical copies
Examples	Traditional radio, landline voice, vinyl record	Computer files, CDs, VoIP, DTH, MP3

ICT TIP. A **modem** (modulator–demodulator) exists precisely to convert digital data into an analog-carried signal and back — the classic textbook illustration of the analog/digital boundary.

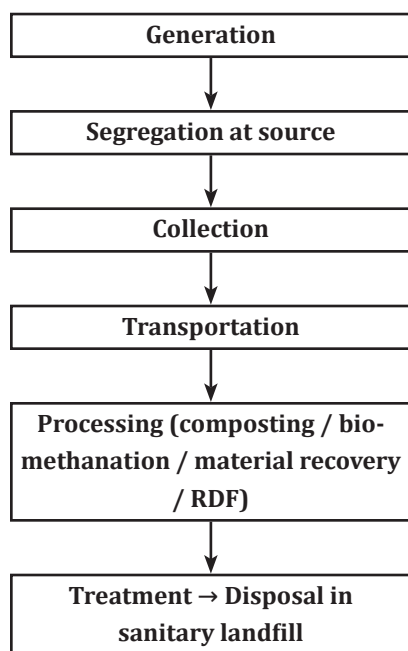
8.5 ICT INFRASTRUCTURE

ICT infrastructure is the layered foundation that makes digital services possible. For examination purposes the layers are:

Layer	What it contains	Indian example
Physical/network layer	Fibre, towers, satellites, submarine cables, spectrum	BharatNet optical-fibre network to gram panchayats; GSAT satellites
Hardware layer	Servers, data centres, devices	National Data Centres of the National Informatics Centre (NIC)
Software/platform layer	Operating systems, databases, application platforms	DigiLocker, SWAYAM, UMANG
Content layer	Digital learning objects, records, documents	NDLI, e-PG Pathshala, Shodhganga
Service and access layer	Portals, apps, kiosks, helpdesks	Common Services Centres (CSCs), state service portals
Human/capacity layer	Digital literacy, trained staff, support	PMGDISHA-type digital-literacy efforts, institutional IT cells

Type	Source	Typical composition
Institutional waste	Schools, colleges, offices, government premises	Paper, packaging, canteen waste
Industrial solid waste	Manufacturing processes	Process residues, off-cuts, packaging, sludge, fly ash
Construction and demolition (C&D) waste	Building activity	Concrete, brick, mortar, wood, metal, soil
Agricultural waste	Farming	Crop residue, husk, animal waste

9.18.2 The management chain



Stage	Content
Segregation at source	Separation into streams by the generator. Segregation at source is the foundation of the entire system, because mixed waste cannot afterwards be separated into clean recyclable or compostable fractions at reasonable cost

Stage	Content
Collection	Door-to-door collection, secondary storage, avoidance of open storage points
Transportation	Covered vehicles; transfer stations where haul distances are long
Processing — composting	Aerobic decomposition of the wet fraction into a soil conditioner
Processing — bio-methanation	Anaerobic digestion of the wet fraction producing biogas and digestate
Processing — material recovery	Sorting of the dry fraction at a Material Recovery Facility (MRF) for recycling
Processing — RDF and waste-to-energy	Conversion of the high-calorific non-recyclable fraction into refuse-derived fuel, or combustion with energy recovery
Disposal	Engineered sanitary landfill for the residual, non-recoverable, inert fraction

9.18.3 Open dumping versus sanitary landfill

Feature	Open dumping	Sanitary landfill
Site selection	None or arbitrary	Engineered, based on hydrogeology and distance criteria
Liner	Absent	Impermeable liner system
Leachate	Percolates freely to soil and groundwater	Collected and treated
Landfill gas	Escapes to atmosphere	Collected; may be flared or used for energy
Covering	None	Daily and intermediate cover; final capping
Compaction	None	Compacted in cells

Feature	Open dumping	Sanitary landfill
Health effects	Vectors, odour, fires, groundwater contamination, waste-picker exposure	Substantially controlled
Post-closure	Abandoned	Monitored for a prescribed period after closure

ENVIRONMENT LINK — Two outputs of a landfill matter environmentally. **Leachate** is the liquid that percolates through the waste, carrying dissolved organic and inorganic

contaminants; uncontrolled, it contaminates groundwater. **Landfill gas** is roughly half methane by volume, generated by anaerobic decomposition; methane is a far more potent greenhouse gas than carbon dioxide over short time horizons, which is why landfill diversion of organic waste is a climate measure as well as a sanitation measure.

9.18.4 Legacy waste and biomining

Legacy waste is waste that has accumulated at old dumpsites over years or decades. It is remediated through **biomining** — excavating, screening and separating the aged waste into soil-like fraction, combustible fraction and inerts — and **bioremediation** of the site. The objective is to recover land and to stop continuing leachate and gas emission.

9.18.5 The Indian regulatory position

Instrument	Year	Key feature
Municipal Solid Wastes (Management and Handling) Rules	2000	India's first dedicated MSW rules; addressed chiefly to municipal authorities
Solid Waste Management Rules	2016	Extended duties to waste generators ; introduced three-stream segregation (wet, dry, domestic hazardous); bulk waste generator obligations; user fees; expanded applicability beyond municipal areas
Solid Waste Management Rules, 2026	Notified 27 January 2026; in force from 1 April 2026	Supersede the 2016 Rules. Mandate four-stream segregation at source — wet, dry, sanitary and special-care (domestic hazardous) waste ; strengthened bulk waste generator obligations including Extended Bulk Waste Generator Responsibility ; restriction of landfilling to non-recyclable, non-recoverable and inert waste; higher landfill charges for unsegregated waste; time-bound mapping and remediation of legacy dumpsites; a centralised online portal for tracking; and an environmental-compensation mechanism aligned to the polluter-pays principle

EXAM POINT — **THIS IS THE MOST IMPORTANT CURRENCY POINT IN THE UNIT.** Most preparation material still states that municipal solid waste in India is governed by the **Solid Waste Management Rules, 2016** with **three-stream** segregation. That position has been superseded. The **Solid Waste Management Rules, 2026** supersede the 2016 Rules and require **four-stream** segregation — wet, dry, sanitary and special-care waste.

REMEMBER — The four 2026 streams: **W-D-S-S — Wet, Dry, Sanitary, Special-care.**

9.19 LIQUID WASTE

9.19.1 Categories

Category	Source	Character
Domestic wastewater / sewage	Households — toilets, bathing, kitchen, laundry	High in organic matter; pathogens, nutrients, detergents
Industrial wastewater	Manufacturing processes	Highly variable; may contain heavy metals, acids, alkalis, oils, dyes, toxic organics