INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

November 2026

SA7 - Investment and Finance

Time allowed: 3 Hours 15 Minutes

Total Marks: 100

Q.1) Institutional Setting & Context:

The **Bharat Infrastructure & Retirement Trust (BIRT)** is a ₹50,000-crore quasi-sovereign defined benefit pension and retirement fund regulated under statutory authority and aligned with PFRDA prudential guidelines. BIRT is legally distinct from its corporate sponsors and operates with a pure liability-matching mandate.

The liabilities consist of a closed block of long-term retirement annuity cash flows with an aggregate Present Value (PV_l) of ₹20,000 crores, evaluated at the current sovereign benchmark yield curve. The liabilities have a flat nominal cash-flow profile extending out 40 years, exhibiting an Effective Duration (D_l) of 11.50 years and an Effective Convexity (C_l) of 195.0.

Table 1: BIRT Liability Cash-Flow Schedule & Key Rates (Current Yield Curve)

Term Bucket (Years)	Spot Rate (y_t)	Liability PV (₹ Cr)	Key-Rate Duration ($KRD_{l,t}$)
5-Year Bucket	6.50%	₹ 5,000	2.25
15-Year Bucket	7.10%	₹ 8,000	5.25
30-Year Bucket	7.35%	₹ 7,000	4.00
Total / Aggregate		₹20,000	11.50 years

The RBI has conducted Variable Rate Reverse Repo operations to absorb liquidity, while heavy sovereign capital-expenditure borrowing has increased the supply of ultra-long government securities. The yield curve has consequently undergone a non-parallel movement: the 5-year yield has risen by 25 basis points, the 15-year yield has fallen by 15 basis points, and the 30-year yield has risen by 80 basis points.

Simultaneously, BIRT's board has authorized the establishment of an offshore treasury desk within an International Financial Services Centre (IFSC) Insurance Office (IIO) in GIFT City to raise USD 500 million in offshore debt to co-finance high-yielding domestic green infrastructure assets.

i) Macroeconomic Drivers and Term Structure Dynamics

a) Evaluate the structural steepening of the Indian sovereign yield curve described in the context by synthesizing the Expectations Hypothesis and Liquidity Preference Theory. Furthermore, critically assess the paradox of severe +80 bps surge in the 30-year segment, despite strict regulatory mandates forcing domestic pension funds like BIRT to buy ultra-long-dated paper. **[6]**

b) Analyze the transmission mechanisms through which volatile Foreign Portfolio Investor (FPI) debt outflows and INR/USD currency depreciation pressures force domestic sovereign bond yields higher, specifically detailing the impact on short-term money market spreads (91-day T-Bill vs. Tri-party Repo). **[4]**

ii) Advanced ALM, Immunisation Intuition, and Key-Rate Overlays

a) Classical immunisation matches the present value and duration of assets and liabilities and requires suitable convexity conditions. Explain intuitively why a asset structure concentrated in 5-year and 30-year bonds may still experience severe surplus erosion under the specified non-parallel yield-curve movement. Conclude by identifying the additional risk metric required to manage exposure at individual maturity points. **[5]**

b) To fix the ALM mismatch, the fund manager considers three liquid sovereign benchmark bonds to construct a new immunising portfolio:

- **Bond A (5-Year G-Sec):** Key-Rate Durations: KRD(A, 5) = 4.00; KRD(A, 15) = 0.20; KRD(A, 30) = 0.00.
- **Bond B (15-Year G-Sec):** Key-Rate Durations: KRD(B, 5) = 0.30; KRD(B, 15) = 9.00; KRD(B, 30) = 0.50.
- **Bond C (30-Year G-Sec):** Key-Rate Durations: KRD(C, 5) = 0.00; KRD(C, 15) = 1.00; KRD(C, 30) = 15.50.

Calculate the exact portfolio weights—w(A), w(B), and w(C)—required to replicate the liability Key-Rate Durations across all three buckets simultaneously. Determine whether this allocation can be executed purely with a fully funded, long-only cash portfolio (V = ₹20,000 crores), and precisely quantify any resulting funding gap. **[7]**

c) To eliminate cash-flow drag, BIRT's CIO proposes holding a 50/50 allocation in Bond A and Bond B, allocating ₹10,000 crores to each, and closing the 30-year gap synthetically using an OTC MIRS (MIBOR Interest Rate Swap) receiver swap.

Calculate the resulting Key-Rate Duration deficit at the 30-year bucket and determine the exact notional principal required if the swap DV01 is ₹15.50 per basis-point move for each ₹10,000 of notional. Identify one major new risk that this derivative introduces to the pension fund. **[5]**

iii) GIFT City Structuring & Cross-Currency Basis Swaps

a) Explain the financial mechanics of a Cross-Currency Basis Swap (CCBS) used by the GIFT City IIO to convert a USD 500 million floating-rate SOFR liability into a synthetic fixed-rate INR liability. Detail the initial exchange, the significance of the "basis spread," and the maturity exchange. **[6]**

b) The spot rate is ₹84.00/USD. The 5-year USD SOFR swap rate is 4.20%, the 5-year INR MIRS swap rate is 6.80%, and the USD/INR cross-currency basis spread is -45 bps (deducted from USD SOFR). Calculate the synthetic INR fixed borrowing rate. Outline the balance sheet implications if the INR depreciates to ₹92.00/USD. **[4]**

iv) Regulatory Asset Compliance & Prudential Governance

a) Evaluate BIRT's asset portfolio compliance against the *PFRDA (*Pension Fund Regulatory and Development Authority) *Master Circular on Investment Guidelines (2025)* with respect to: maximum permissible allocation to corporate debt, prudential single-issuer exposure limits, and the conditions for admitting Gold ETFs. **[3]**

b) Under the PFRDA regulatory fee structure (specifically the '**slabbing**' or tiered management fee model, where fee percentages step down as Assets Under Management scale up), analyze how asset-based management fees incentivize PFMs **(Pension Fund Managers)** toward passive benchmark-hugging rather than active liability duration matching. **[3]**

v) Algorithmic Execution Risk in Portfolio Transitions

To execute the massive ₹26,000+ crore portfolio transition from the failed strategy to the new Key-Rate Duration matched portfolio, BIRT's Investment Committee deploys a proprietary Machine Learning (ML) execution algorithm in the secondary G-Sec market.

a) Identify and explain four primary sources of quantitative model risk (such as regime-shift blind spots or liquidity mirages) that could cause this algorithm to fail catastrophically while dumping 30-year Indian G-Secs during the current butterfly twist regime. **[4]**

b) Formulate a three-point institutional model governance framework to control this algorithmic execution risk before and during the live portfolio transition. **[3]**

[50 Marks]

Q.2) The Suraksha General Insurance & Reinsurance Corporation (SGIRC) is a multi-line non-life insurer operating in India with an investment portfolio of ₹15,000 crores. SGIRC's liabilities are modelled as stochastic cash outgoes originating from commercial liability and catastrophe property lines, possessing an Effective Duration of 3.20 years.

SGIRC's Board has approved diversifying into alternative assets. The Investment Committee committed ₹1,500 crores to the Aegis Private Credit Fund, a closed-end SEBI-registered Category II Alternative Investment Fund (AIF). The AIF requires a ₹900 crore initial drawdown at Year 0, and a ₹600 crore secondary drawdown at Year 1. Capital distributions to the Limited Partner (LP) only begin in Year 2.

Simultaneously, the Chief Risk Officer (CRO) is preparing SGIRC's internal capital models to transition towards modern risk-adjusted statutory capital frameworks, while the equity desk manages a ₹3,000-crore active equity portfolio tilted toward systematic smart-beta factors.

i)

a) Evaluate the regulatory permissibility and Asset-Liability Management (ALM) risks of allocating ₹1,500 crores to the Aegis Private Credit AIF. Contrast the illiquid cash flow profile of the AIF against the stochastic, short-tail nature of SGIRC's catastrophe liabilities, referencing IRDAI Investment Regulations (2024). **[7]**

b) The AIF employs a standard distribution waterfall featuring a "Return of Capital," an "8% Preferred Return (Hurdle)," and a "GP Catch-up." Explain conceptually how these three tiers align the financial interests of the General Partner (GP) with SGIRC, without requiring mathematical calculations. **[4]**

ii) The Board Paper Requirement:

As the Chief Investment Officer (CIO), draft an executive-level **Board Paper** addressing extreme tail-risk scenarios (a severe catastrophe occurring simultaneously with an equity crash in Year 1). Include the following three sections:

1. An intuitive explanation of how a correlation matrix captures real-world diversification between catastrophe and equity risks, providing 'capital relief' over simple linear addition. Critically evaluate two hidden dangers of this approach for the Board: the failure of static correlations during systemic crises, and how non-linear asset payoffs can amplify losses beyond matrix predictions.

2. A qualitative explanation of why traditional Value-at-Risk (VaR) violates the principle of "subadditivity" in fat-tailed environments, and why adopting an Extreme Value Theory (EVT) / Expected Shortfall metric is conceptually superior for joint catastrophe-equity shocks.

3. An actionable liquidity strategy to fund the ₹600 crore Year 1 AIF drawdown if catastrophe claims exhaust cash buffers, avoiding the fire-sale of depreciated equity assets.

[15]

iii)

a) Assess the expected fundamental performance of SGIRC's four equity factors (Value, Quality, Momentum, and Low-Volatility) during a severe economic stagflation regime characterized by high inflation and rising interest rates. **[4]**

b) During a recent correction, SGIRC's managers sold outperforming defensive stocks to lock in gains, while holding severely depreciating cyclical stocks hoping for a recovery. Identify this behavioral finance bias, explain its impact on overall portfolio drawdown risk, and propose two specific governance mechanisms under IRDAI guidelines to mitigate this. **[6]**

iv)

a) SGIRC holds ₹500 crores of distressed, unlisted infrastructure debentures. Explain the 3-stage Expected Credit Loss (ECL) model under Ind AS 109 conceptually. Discuss how the transition from Stage 1 to Stage 2, and subsequently to Stage 3, impacts the insurer's Profit & Loss (P&L) statement. **[8]**

b) Under the IBC (Amendment) Framework 2025, CoC statutory approval thresholds stand at 66% for resolution plans and 90% for out-of-court withdrawals. Discuss how these thresholds affect SGIRC's negotiating leverage and impact the modeled Loss Given Default (LGD) for the distressed debentures. **[6]**

[50 Marks]

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