TRIBHUVAN UNIVERSITY

INSTITUTE OF SCIENCE AND TECHNOLOGY

SCHOOL OF MATHEMATICAL SCIENCES

Bachelor in Mathematical Sciences (B.Math.Sc.)

Course of Study

Code No.: MSAC 351 Full Marks: 75

Paper: **Corporate and Managerial Accounting** Pass Marks: 30

Nature: Theory Credit: 3

Course Description

The course covers to Corporate governance and organization, Sources of financing, Introduction of taxation, Capital structure and dividend policy, Financial restructuring, Cost of capital, Analysis of capital budgeting.

Course Objectives

On successful completion of the course the student will be able to provide students and understanding of concept and the theories of corporate finance and develop skills to analyze issues in corporate finance for sound financial decision in business.

Mode of Delivery

The course will be taught by lecture (48 hrs), and problem solving and class discussion (24 hrs). The use of spreadsheet software for problem solving will be encouraged.

***Contents*:**

Unit 1 Corporate Governance and Organization 6 hrs

Concept of corporate governance and organization, Types of firm/organization, Types of Joint Stock Company, Advantages and Disadvantage of Corporate Finance, Financial and real resources , Agency problems, Capital market, Goal of firm/organization, Corporate social responsibilities, Outline the strategies employer by managers to maximize Shareholders wealth.

Unit 2 Sources of Financing 6 hrs

Concept of financing Sources, Differences types of short term, medium term and long term of company finance, Alternative method of raising finance outside the regular banking, Role of underwriting in the issue of securities.

Unit 3 Introduction of Taxation 6 hrs

Basic principle of personal taxation of income and capital gains, Basic principles of company taxation, Different system of company taxation from the points of view of an individual shareholders and the company, Basic principles of double taxation relief.

Unit 4 Capital Structure and Dividend Policy **6 hrs**

Concept of capital structure and dividend policy, Capital structure and taxation, Capital structure and firm value, Dividend policy and firm value, Relationship between growth and profitability, Constraints of firms growth

Unit 5 Financial Restructuring **7 hrs**

Concept of Merger and Acquisition, Motives of Merger, Types of Merger, Methods of evaluating Target Company, Leverage buyout

Unit 6 Cost of Capital **7 hrs**

Meaning and concept of cost of capital, Determining component of cost of capital, Cost of equity and the capital assets pricing model (CAPM), Weighted Average cost of capital

Unit 7 Analysis of Capital Budgeting **10 hrs**

Concept and meaning of cost of capital, Types of proposal, Capital Budgeting Process
Estimation of Cash Flow: Net Investment cost or Net cash outlay (NCO), Depreciation of the project Annual Cash Flow after tax, Evaluation technique of project: Traditional method and discounted cash flow method.

References

1. Van Horne James, C., (2002), *Financial Management and Policy*, 12/E, Pearson Education India.
2. Brealey, R. A., Myers, S. C., Allen, F., and Mohanty P. , (2012), *Principles of Corporate Finance,*Tata McGraw-Hill Education.
3. Ehrhardt, M. C., and Brigham, E. F., (2011), *Financial Management: Theory and Practice,* South-Western Cengage Learning.

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SCHOOL OF MATHEMATICAL SCIENCES

Bachelor in Mathematical Sciences (B.Math.Sc.)

Course of Study

Code No.: MSAS 351 *Full Mark:* 75

Paper: **Actuarial Models II** *Pass Mark:* 30

Nature: Theory *Credit:* 3

Course Description:

The course is a continuation of Acturial Model-I. This is a grounding in the principles of modeling as applied to actuarial work – focusing particularly on stochastic asset liability models and the valuation of financial derivatives. These skills are also required to communicate with other financial professionals and to critically evaluate modern financial theories.

Learning Objectives:

On successful completion of this subject, a student will be able to:

1. Describe, construct, interpret and discuss the models underlying asset valuations.
2. Describe, construct, interpret and discuss the models underlying liability valuations.
3. Describe, construct, interpret and discuss the models underlying option pricing.

Mode of Delivery:

The course will be taught by lecture (48 hrs), and problem solving and class discussion (24 hrs). The use of spreadsheet software for problem solving will be encouraged.

Contents:

Unit 1 Asset Valuations **8 hrs**

Single and Multifactor Models for Investment Returns:

Multifactor models of asset returns and their types (macroeconomic models, fundamental factor models, statistical factor models), Single index model of asset returns, diversifiable and non-diversifiable risk, Construction of the different types of multifactor models.

Stochastic Models for Security Prices:

Continuous time log-normal model of security prices and empirical evidence for and against the model, Standard Brownian motion, Wiener process, Stochastic differential equations, Ito integral, Diffusion and mean-reverting processes, Statement of Ito's Lemma and its application, Stochastic differential equation for the geometric Brownian motion and Ornstein-Uhlenbeck process.

Unit 2 Asset Valuations (Contd.) **8 hrs**

Models of Term Structures of Interest Rates:

Theory of a term structure of interest rates, Characteristics of models for the term-structure of interest rates, Application of the term structure of interest rates to modeling various cash flows and calculating the sensitivity of the value to changes in the term structure, Risk-neutral approach to the pricing of zero-coupon bonds and interest-rate derivatives for a general one-factor diffusion model for the risk-free rate of interest, The approach using state-price deflators to the pricing of zero-coupon bonds and interest-rate derivatives for a general one-factor diffusion model for the risk-free rate of interest,

Vasicek, Cox-Ingersoll-Ross and Hull-White models for the term-structure of interest rates, Limitations of these one-factor models.

Simple Models for Credit Risk:

Credit event and recovery rate, Different approaches to modelling credit risk (structural models, reduced form models, intensity-based models), Merton model, Two-state model for credit ratings with a constant transition intensity, Jarrow-Lando-Turnbull model for credit ratings, Generalisation of the two-state model to incorporate a stochastic transition intensity.

Unit 3 Liability Valuations **16 hrs**

Ruin Theory:

Aggregate claim process, Cash-flow process for a risk, Poisson process and distribution of inter-event times, and their application, Compound Poisson process and its use, Probability of ruin in infinite/finite and continuous/discrete time, Relationships between the different probabilities of ruin, Effect on the probability of ruin of changing parameter values, Probabilities of ruin by simulation.

Run-off Triangles:

Development factor and use of a set of assumed development factors to project the future development of a delay triangle, A basic chain ladder method for completing the delay triangle using development factors and its application, adjustment of the basic chain ladder method to make explicit allowance for inflation, The average cost per claim method, Bornhuetter-Ferguson method for estimating outstanding claim amounts, Underpinning a run off triangles approach, Value basic benefit.

Unit 4 Option Pricing and Valuations **8 hrs**

Arbitrage and a complete market, Option prices, Factors that affect option prices, options which are not model dependent, Valuation of a forward contract, Upper and lower bounds for European and American call, Put-call parity, Use of binomial trees and lattices in valuing options, Risk-neutral pricing measure for a binomial lattice, Risk-neutral pricing approach to the pricing of equity options, Difference between the real-world measure and the risk-neutral measure, Alternative names for the risk-neutral and state-price deflator approaches to pricing.

Unit 5 Black-Scholes Model **8 hrs**

Black-Scholes derivative-pricing model, and it's applications, Validity of the assumptions underlying, Black-Scholes model, Approach to pricing using deflators and its application in simple models, Binomial and Black-Scholes model, Its equivalence to the risk-neutral pricing approach, Commonly used terminology for the first, and where appropriate second, partial derivatives (the Greeks) of an option price, Value basic benifit.

References

1. *ActEd Study Material Subject CT8*, Actuarial Education Company, 2016.

2. Baxter, Martin & Andrew Rennie, *Financial calculus; An introduction to derivative pricing*, Cambridge University Press, 1996.

3. Panjer, Harry H (ed), *Financial economics: with applications to investments, insurance and pensions*, The Actuarial Foundation, 2001.

4. Elton, Edwin J, Martin J Gruber, Stephen J Brown et al, *Modern portfolio theory and investment analysis* (8th edition), John Wiley, 2010.

5. Hull, John C, *Options, futures and other derivatives* (7th edition), Prentice Hall, 2008.

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Bachelor in Mathematical Sciences (B.Math.Sc.)

Course of Study

Code No.: MSCS 351 Full Marks: 75

Paper: **R Programming** Pass Marks: 30

Nature: Theory and Practical Credit: 3

Course Description:

The course covers introduction of R, various statistical distributions, functions, loops, various vectors, simulations, linear model and graphics.

Learning Objectives:

On successful completion of this subject, a student will be able to:

1. Program in R widely used open software and apply a range of techniques to solve business problems in the areas of syllabus covered by the subject.
2. Apply R programing for large data
3. Link statistical distribution with R
4. ApplyR programing in data analysis and actuarial field.

*Mode of Delivery***:**

The course will be taught by lecture, class discussion. There will be a project and students will prepare a model as per the instructor/lecturer.

Contents:

Unit 1 Introduction 12 hrs

R in basics, installation of Console &environment, gettinghelp, CRAN, datastructures; logical, integers, factors, build in functions, basic arithmetic operations, sum, divide ,multplications and division, mean, median, mode, vectors, vectors arithmatics, matricis, matricsarithmatic, subsetting vectors, factors,data frame, short data frame,basic graphics, customizing plots,multiple plots.

Unit 2 Excel and its Functions 10 hrs

Use of various excel functions like sum,count,sumifs,coutifs,basic airthmatic,referring the cell,range,shortcut keys,merge, wrap,row, column,filter,font,colour,advanced filter,conditional formatting,date and time,text to column,vlookup,hlookup,index & match,pivot table, tables and charts

Unit 3 Random Numbers and Distribution 8 hrs

Random numbers, Poisson distribution, binomial, normal distribution, simulations, complex system, MCMC, rnorm, runif, PRNG, rgamma, complex & random fluctuations, Monte Carlo simulation.

Unit 4 Constructing, Reading, Writing, Working and Manipulating the Data 15 hrs

Column, sequence, rep, combine, rbind, cbindlogicalindex, properties of vector and matrix for all data types, reading data and importing from Excel, SPSS, text, SAS,

working directory, scan and readlines, data import from Excel, SAS, SPSS, textfilesink, dump, dput, save&load, dataframes, adding and removing the column, merge, getting dimension and information working with text, textmining, date , time and Objects, customization, transform, summarystastics, groupedmeans, masking R objects, the function, tabling data.

Unit 5 Control Flow and Loops **5 hrs**

For loop,vector,list,data frame and matrix,the while loop for vector,listnad repeat loop.lapply and sapply functions for vectors and matrix.

Unit 6 Models and Graphics **10 hrs**

Dependent and independent variable, stostatic term, error term, coefficients, plottingdata, lines, modeldiagnosis, linear model and lm function,general and genarilizedmodel,types of response variable,logisticregression,classificationmodels,graphics in R,ggplot2 package, lattice, base, quickplot, ggmap package

References:

1. Introduction to actuaries N.D.Silva Microsoft Cop
2. R course university of Wisconsin
3. Introduction to R Mike Marin

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Bachelor in Mathematical Sciences (B.Math.Sc.)

Course of Study

Code No.: MSEC 351 Full Marks: 75

Paper: **Principle of Economics I (Micro)** Pass Marks: 30

Nature: Theory Credit: 3

Course Description:

The course covers to Economic models, Competitive markets, Consumer Demand and Behaviour, Production, Cost and Revenue functions, Market, Pricing Strategies.

Learning Objectives:

On successful completion of the course the student will be able to introduce the core economic principles and how these can be used in a business environment to help decision making and behavior. It provides the fundamental concepts of macroeconomics that explain how economic agents make decisions and how these decisions interact. It explores the principles underlying macroeconomics that explain how the economic system works, where it fails and how decisions taken by economic agents affect the economic system.

Mode of Delivery:

The course will be taught by lecture (48 hrs), and problem solving and class discussion (24 hrs). The use of spreadsheet software for problem solving will be encouraged.

***Contents*:**

Unit 1 Economic Models and Recent Historical Applications 8 hr

Relevance of economics to the world of business: opportunity cost and scarcity and their relevance to economic choice, economic concepts involved in choices made by businesses relevant to selection of outputs, inputs, technology, location and competition, microeconomics and macroeconomics, Main strands of economic thinking : Classical, Marxian, socialism, neo-classical, Keynesian, neo-Keynesian and post-Keynesian, Monetarist, Austrian, Progress of the world economy since the Great Depression: a history of banking crises and irrational behavior, consequences of banking crises, Banking crisis of 2008, the Great Recession and recovery, Effectiveness of the monetary policy in the 2008 financial crisis and the government's actions to combat recession, Aftershocks in Europe following the 2008 financial crisis., Stimulus-austerity debate and regulatory action after the 2008 crisis

Unit 2 Competitive Markets 10 hrs

Market operation, Price mechanism in a free market, Behaviour of firms and consumers in free markets, Market demand and supply, Market equilibrium quantity and price, Market reaction to changes in demand and supply, Price and income elasticities of demand, Price elasticity of supply, Effect of elasticity on the workings of markets in the

short and long run, Risk and uncertainty about future market movements, Price expectations and speculation, Price bubbles.

Unit 3 Consumer Demand and Behaviour **7 hrs**

Concept of utility, Representation of consumer preferences as indifference curves, Rational choice, Optimal consumption choice, Perfect information and irrational behaviour in behavioural economics, Effects of advertising on sales and demand.

Unit 4 Production, Cost and Revenue Functions **8 hrs**

Production function, production costs, Reflection of production function in the relationship between inputs and outputs in short and long run, average and marginal physical product, Measurement of costs and their relation with output in short and long run, Total, average and marginal costs, Economies of scale, Efficiency in selecting the level of inputs, Revenue and profit, Influence of market conditions on revenue and profit, Average and marginal revenue, Measurement of profit, Profit maximizing output of a firm, "shut-down" point in the short and long run.

Unit 5 Market **10 hrs**

Profit maximization under perfect competition and monopoly, Market power of a firm, Main features of a market characterized by perfect competition, output and price in such markets in the short and long run, Monopolies, Barriers to entry in an industry and a contestable market.

Profit maximization under imperfect competition, Behaviour of firms under monopolistic competition, features of an oligopoly, Behaviour of firms in an oligopoly, Determining factors of competition and collusion of firms in an oligopoly, Explanation of the strategic decisions of such firms by game theory.

Unit 6 Pricing Strategies **5 hrs**

Various pricing strategies of firms, Determination of prices in practice, Pricing ability of a firm, Average cost pricing, Price discrimination, Pricing strategy for multiple products, Pricing and life of a product.

Text Book

J., Hinde, K., and Garratta, D. Sloman, Economics for Business, Fifth edition (2010), Prentice Hall,

References

1. Begg, D. K. H.; Fischer, S.; Dombusch, R., Economics, eighth edition (2005), Mc Graw-Hill.

2. Lipsey, R. G.; Chrystal, K. A., Economics, 11th edition (2007), Oxford University Press.

3. Mankiw, N.G.; Taylor, M P. Thomson, Economics, 2006.

4. Parian, M, Powell, M.; Matthews, K., Economics, 7th edition (2007), Pearson Education.

5. Sloman, J., Essentials of economics, 4th edition (2006), FT Prentice Hall.

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Bachelor in Mathematical Sciences (B.Math.Sc.)

Course of Study

Code No.: MSMT 351 *Full Mark:* 75

Paper: **Financial Mathematics II** *Pass Mark:* 30

Nature: Theory *Credit:* 3

Course Description:

This course is the continuation of Financial Mathematics I .This is a grounding in the principles of modeling as applied to actuarial work – focusing particularly on deterministic models which can be used to model and value known cashflows as well as those which are dependent on death, survival, or other uncertain risks.

Learning Objectives:

On the successful completion of this subject, the candidate will be able to:

1. Describe, interpret and discuss the theories on interest rates.
2. Describe, interpret and discuss mathematical techniques used to model and value cashflows which are contingent on mortality and morbidity risks.

Mode of Delivery:

The course will be taught by lecture (48 hrs), and problem solving and class discussion (24 hrs). The use of spreadsheet software for problem solving will be encouraged.

Contents:

Unit 1 Assurance and Annuity Functions 12hrs

Cash flows dependent upon the death or survival of either or both of two lives, functions dependent upon a fixed term as well as age, Valuing cash flows that are contingent upon multiple transition events, Health insurance, Simple health insurance premium and benefit structures, Valuation of a cash flow, contingent upon multiple transition events, using a multiple-state Markov Model, Expected present values of cash flows that are contingent upon multiple transition events, including simple health insurance premiums and benefits and calculated these in simple cases.

Unit 2 Expected Cash Flows Contingent Upon Multiple Decrement Events 6hrs

A multiple decrement model as a special case of multiple-state Markov model, Forces of transition, Dependent probabilities for a multiple decrement model in terms of given forces of transition.

Unit 3 Premiums **10hrs**

Random future loss under an insurance contract, Principle of equivalence, Premiums, Premiums for the insurance contract benefits under various scenarios, Net premiums valuation, Gross premiums valuation,

Unit 4 Reserving **11hrs**

Reserves, Prospective and retrospective reserves, Recursive relationships between successive periodic gross premium reserves, death strain at risk, calculation of single policy or portfolio of policies, expected death strain, actual death strain, mortality profit, Thiele's differential equation

Unit 5 Cashflow Projection and Profit Test **9hrs**

Projection of expected future cash flows for various types of insurance (whole life, endowment assurance and term assurances, annuities, unit-linked contracts, and conventional / unitised with-profits contracts), Profit test model and its use, cash flow projection model and profit test model, unit-linked contracts and a profit test model.

References

1. *ActEd Study Material Subject CT1*, Actuarial Education Company, 2016
2. Kellison *The Theory of Interest*, Irwin Mc-Graw Hill, 2006
3. Bowers, L. Newton, *Actuarial Mathematics*, Society of Actuaries, 2006
4. McCutcheon, J. J.; Scott, W. F. Heinemann, *An Introduction to the Mathematics of Finance*, Institute and Faculty of Actuaries' Online Publications Shop, 1986
5. Mark S. Joshi, *The Concepts and Practice of Mathematical Finance*, Cambridge University Press, 2008
6. Paul Wilmott, Sam Howison and Jeff Dewynne *The Mathematics of Financial Derivatives*, Cambridge University Press, 1995
7. S. M Ross, *An introduction to Mathematical Finance*, Cambridge University Press

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