PROGRESSIVE EDUCATION SOCIETY'S
MODERN COLLEGE OF ARTS, SCIENCE AND COMMERCE, GANESHKHIND PUNE - 411016

Department of Economics

M.A. ECONOMICS SYLLABUS

(CREDIT & SEMESTER SYSTEM)

Part - II

Revised Syllabus will be implemented from the academic year 2023-2024

Introduction:

M.A. degree will be awarded to students who complete a total of 64 credits in two years taking four courses per semester (4 x 4=16 credits). Each course will be of 4 credits.

- A Student may take three courses (twelve credits) per semester from the parent department and therefore one course of four credits from any other department per semester. In case a student wishes to take all courses from the parent department he/she may also do so.
- All courses are open to all students from outside the department. Eligibility for registering for each course will be decided by the departmental committee.
- For the students doing M.A. degree in Economics the courses for divided into compulsory and Elective. Every student has to take three core courses and one elective course each semester.

Programme Specific Outcomes (PSOs):

PSO1: To learn basic concepts of Economics so as to make the students aware of importance of Economics.

PSO2: Students become aware of economic situation of India and countries across the world.

PSO3: Provides through understanding and deep knowledge about basic principles that lead to trade across the countries.

PSO4: To learn restructuring of economic policies as per the requirement of the economic situation.

PSO5: Students' get to know various career opportunities related to Economics.

Examination Pattern:

- Each course will have 50% marks as End of Semester Examination and 50% marks for Continuous Assessment.
- The student has to pass in the combined total of Continuous Assessment and End of Semester Examination.
- In order to pass a student shall have to get minimum 40% marks (E and above on grade point scale) in each course. Any student getting less than16 marks in each component will be declared as failed, even if the combined total is over 40%.
- If a student misses a Continuous Assessment examination, he/she will have a second chance with the permission of the teacher concerned. Students who have failed for the entire course may reappear at the semester-end exam. Their internal marks will not change. They can also repeat during the 5th /the 6th semester whichever is applicable.

Suggested internal assessment tools for courses:

1. MCQ Tests
2. Home Assignments
3. Tutorials/ Practical
4. Research Project
5. Group Discussion
6. Open Book Test
7. Study Tour
8. Written Test
9. PPT presentation
10. Field Visit

Teaching Methodology:

Classroom lectures, Use of ICT, YouTube lectures, Online PPTs, Group Discussions, Teacher driven Power Point Presentations, Case Studies

Subject List

Sr. No.		Subject Type	Subject Code & Title	Credits			Total No.of Lectures
				Theory	Practical	Total	
1	Semester III	Compulsory	23-EC-211 Macro Economics Analysis-I	4		32	48
2			23-EC-212 Growth & Development -I	4			48
3			23-EC-213 Research Methodology- I	4			48
		Elective (any one)	23-EC-214A Economics of Finance	4			48
			23-EC-214B Demography				
			23-EC-214C Capital Market				
			23-EC-214D Industrial Economics				
4	Semeste	Compulsory	23-EC-221 Macro I Economics	4			48

	r IV		Analysis II				
5			23-EC-222 Growth & Development II	4			48
6			23-EC-223 Research Project Macro	4			48
7			23-EC-224A Econometrics				
		Elective (any one)	23-EC-224B Public Policy	4			48
8			23-EC-224C Economics of Environment				
			23-EC-224D Foreign Exchange Market				

M.A. ECONOMICS PART- II

SEMESTER III

CORE PAPERS (COMPULSORY PAPER)

01 - MACRO ECONOMICS ANALYSIS - I
02 - GROWTH AND DEVELOPMENT- I
03 - RESEARCH METHODOLOGY- I

CORE COURSE
SEMESTER III

MACRO ECONOMICS ANALYSIS – I

Subject Code: 23-EC-211
Subject: Macro Economics Analysis – I (4 Credit Course)

Total Lectures = 48

PREAMBLE

Macroeconomics or aggregative economics analysis establishes the functional relationship between various aggregates of the economy. Aggregative analysis assumed such a great significance in recent times that a prior understanding of macroeconomic theoretical structure is considered essential for proper comprehension of different issues and policies. Macroeconomics now is not only a scientific method of analysis but also a body of empirical economic knowledge. The course equips the students at the postgraduate level to understand systematic facts and theoretical developments for empirical analysis,

Course Objectives:

- To provide a thorough understanding of the principles of macroeconomics and the application of macroeconomic concepts in real-life situations.
- To discuss the modern developments in macroeconomics.

Course Outcome:

- Ability to analyze and demonstrate knowledge of the basic theories/laws in macroeconomics.
- At the end of the course, the student should be able to evaluate macroeconomic concepts, models and its use in real life situations.

1. Traditional Approaches to Macroeconomics **12**

1.1 Classical Approach-Introduction and main features
1.2 Keynesian Approach-Introduction and main features
1.3 Neoclassical Approach-Introduction and main features

2. National Income and Social Accounting **12**

2.1 Circular Flow Income in two-three and four sector economy
2.2 Different forms of national income accounting-
2.2.1 Social accounting
2.2.2 Input-output accounting
2.2.3 Flow of funds Accounting
2.2.4 Balance of payments Accounting
2.2.5 Matrix presentation of Social Accounting

3. Demand and Supply of Money **12**

3.1 Definition of Money, Debates relating to definition of Money
3.2 The Liquidity Theory, Gurley and Shaw Hypothesis, Demand for Money-Classical and Keynesian
3.4 Cash Balance Approach- Post Keynesian Theories of Demand for Money, Tobins Approach, Baumol's Inventory Theoretic Approach, Friedman‘s Theory of Demand for Money.

4. Supply of Money **12**

4.1 Financial Intermediation
4.2 A Mechanistic Model of Bank Deposit Determination.
4.3 A Behavior Model of Money Supply Determination,
4.4 A Demand-determined Money Supply process,
4.5 RBI approach to Money Supply-High Powered Money and Money Multiplier; Budget Deficit and Money Supply, Money Supply and Open Economy.
4.7 Control of Money Supply.

BASIC READING LIST:

1. August Swanenberg (2005) _Macroeconomics Demystified‘ A Self Teaching Guide, Mcgraw Hill Education
2. Ackley,G.(1978), Macro Economics : Theory and Policy, Macmillan, New York.
3. Agrawal Vanita, Macroeconomics: Theory and Policy, Pearson Publication, New Delhi.
4. Ahuja H.L., Macroeconomics: Theory and Practice, S.Chand & Co. New Delhi.
5. Blackhouse, R. and A. Salansi (Eds.) (2000) Macroeconomics and the Real World (2 Vols.), Oxford University Press, London. Dornbusch,
6. Campbell R. McConnell, Stanley L. Brue, (2001) Macroeconomics: Principples, Problems and Policies‘, McGraw Hill, Inc, New York.
7. Froyen Richard T (2006) _Macroeconomics– Theories and Policies‘ Pearson Education; 8th edition
8. Gupta S.B. (1997) _Monetary planning for India‘ OUP
9. Jha, R. (1991), Contemporary Macroeconomic Theory and Policy, Wiley Eastern Ltd., New Delhi.
10. Mankiw Gregory (2007) _Macroeconomics‘ Worth, New York
11. Rao, V.K.R.V. (1983) India's National Income : 1950 to 1980, Saqe Publications, New Delhi
12. Gupta, S.B. (1995), Monetary Planning in India, OUP, New Delhi.
13. Sampat Mukherjee (2013), _A Global Text-Macroeconomics‘, New Central Book Agency
14. Soumyen Sikdar (2006) _Principles of Macroeconomics‘ Oxford University Press

Recommended Readings:

1. Branson, W.A. (1989), Macroeconomic Theory and Policy, (3rd Edition), Harper and Row, New York.
2. Culbertson, J.M. (1968), Macroeconomic Theory and Stabilization Policy, McGraw Hill, Kogenkosh, Tokyo.
3. Duesenberry, J.S. (1949), Income Saving and the Theory of Consumer Behaviour. Harvard University Press, Harvard.
4. Edey, M. and A.T. Peacock (1967), National Income and Social Accounts, Hutchinson University Library, London
5. Fisher, Dornbusch, Schamalensee (1988) _Economics‘ McGraw Hill International Edition ; 2nd edition
6. Friedman, M. (1957), The Theory of Consumption Function, Princeton University Press Princeton.
7. Friedman, M. (1956), Studies in the Quantity Theory of Money, The University of Chicago Press, Chicago
8. Glahe, Fred, R.(1973), Macroeconomics: Theory and Policy, Harcourt Brace Javanovich, Inc, New York.
9. Harris Lawrrence (1980) _Monetary Theory‘ McGraw Hill Inc.
10. Keynes, J.M. (1936), _The General Theory of Employment Interest and Money‘,

Macmillan, London.
11. Ruggles, R. and N. Ruggles (1956), National Income Accounts and Income Analysis, McGraw Hill New York.
12. Shapiro, E.(1996) Macroeconomic Analysis, Galgotia Publications, New Delhi.
13. D.Wrightsman _An Introduction to Monetary Theory and Policy' The Free Press New York 1983
14. Bhise V.B , Khandare V.B & Babar , (2014) Macro Economics ,Chinmay Publication Aurangabad.
15. Kute S & Rithe M ,Macro Economics , Prashant Publication Jalgaon, MS ,India.

Recommended Journals:

Applied Economics- Taylor & Francis Online
Journal of Macroeconomics-Elsevier
Macroeconomics and Finance in Emerging Market Economies- Taylor & Francis Online
The Indian Economic Journal- Sage Journal

CORE COURSE

SEMESTER - III

GROWTH AND DEVELOPMENT - I

Subject Code: 23-EC-212
Subject: Growth and Development – I (4 Credit Course)

Total Lectures = 48

PREAMBLE

The course makes an attempt to provide an introduction to the economics of Growth and Development and at the same time provide an understanding of the analytical rigour of the subject. Growth and Development-I is a core course that covers meaning and concept of Economic Growth and Development, measuring the economic growth and development, theories of economic growth and development, poverty, inequality and unemployment and role human capital in economic development . Growth and development-I will try to clear the concepts regarding the economic growth and development and provides basic knowledge to the students to get engaged in the activities.

Course Objectives:

- To enable learning and understanding of the basic concepts and process to measure the growth and economic development etc.
- To analyze and evaluate the obstacles in the process of economic growth and development

Course Outcome:

- Ability to apply the concepts of economic growth and compare international comparison of economic development, etc.
- Ability to analyze and demonstrate knowledge of the economic growth and development theories of economic growth and development

1 Principles and Concepts of Growth and Development **12**

1.1 Concepts of growth and Development
1.2 Measuring Economic Development: Income and Alternative Measures
1.3 International Comparison of Incomes: PPP and Exchange Rate Approaches
1.4 Developing / Emerging Economies – Concept
1.5 Barriers to Economic Development

2 Theories of Economic Development and Growth **12**

2.1 Classical Theory of Economic Development: Adam Smith
2.2 The Harrod-Domar Model
2.3 Solow model of economic growth
2.4 The Cobb-Douglas Production Function
2.5 The Big push theory
2.6 The New (Endogenous) Growth Theory

3 Poverty, Inequality and Unemployment **12**

3.1 Measurement of Poverty- Uni-dimensional & Multi-dimensional, Amartya Sen‘s Approach to Poverty measurement, Rural and Urban Poverty, Participatory Approach to Poverty, Women and Poverty
3.2 Measuring Inequality, Lorenz Curve, Gini Coefficient, Functional Distribution,
3.3 Challenge of Unemployment, Disguised Unemployment and Economic Development, Concept of Jobless Growth

3.4 Employment and Migration

4 Human Capital and Economic Development **12**

4.1 Theory of Demographic Transition
4.2 Human Capital Approach of Development
4.3 Demographic Dividends
4.3 Education, Skill and Wages, Health and Efficiency to Work
4.5 Optimum Population

Basic Reading List:

1. Basu Kaushik (1998) Analytic Development Economics: The Less Developed Economy Revisited', OUP
2. Behrman, S. and T.N. Srinivasan (1995), Handbook of Development Economics, Vol. 3, Elsevier, Amsterdam.
3. Felix Raj, Sampat Mukherjee, Mallinath Mukherjee, Amitava Ghose, Ranjanendra N. Nag (2007) ―Contemporary Development Economics From Adam Smith to Amartya Sen‖, New Central Book Agency Private Limited
4. Gillis, M., D.H. Perkins, M. Romer and D.R. Snodgrass (1992), Economics of Development,(3rd Edition), W.W. Norton, New York.
5. Kindleberger, C.P. (1977), Economic Development, (3rd Edition), McGraw Hill, New York
6. Meier Gerald M. and James E. Rauch, ―Leading Issues in Economic Development‖ Oxford University Press, 2006
7. Ray Debraj (1998) ―Development Economics‖, Oxford University Press
8. Solow Robert M. (2000) ―Growth Theory An Exposition‖ Oxford University Press
9. Thirwal, A.P. (1999), (6th Edition), Growth and Development, Macmillan, U.K.
10. Todaro, M.P. (1996), (6th Edition), Economic Development, Longman, London.

Recommended Readings:

1. Banerjee Abhijit V, Esther Duflo (2013) _Poor Economics: Rethinking Poverty & the Ways to End it' Penguin
2. Barro Robert J. and Xavier Sala-i-Martin (2004) ―Economic Growth ‖ Prentice Hall of India Brown, M. (1966), On the Theory and Measurement of Technical Change, Cambridge University Press, Cambridge, Mass.
3. Chenery, H. and T.N. Srinivasan (Eds.) (1989), Handbook of Development Economics, Vols.1 & 2, Elsevier, Amsterdam
4. Dasgupta, P. (1993), An Enquiry into Well-being and Destitution, Clarendon Press, Oxford.
5. Gillis, M., D.H. Perkins, M. Romer and D.R. Snodgrass (1992), Economics of Development,(3rd Edition), W.W. Norton, New York.
6. Meier, G.M. (1995), Leading Issues in Economic Development, (6th Edition), Oxford University Press, New Delhi.
7. Nayyar Deepak (2019) _Resurgent Asia' OUP
8. Todaro Michael (1981) ―Economics for A Developing World‖, Longman, London.

9 Wavre Anilkumar & Londhe M , Economics of Development and Planning , (2019) Educational Publishers , Jalgaon , MS, India**.**

Reports:

- Human Development Report, 1995-2009, UNDP, OUP Latest Reports
- RBI Bulletin (latest issues)
- World Development Report, Latest Reports
- World Development Indicators, World Bank, OUP, Latest Reports

Recommended Journals:
Economic Development and Cultural Change- Chicago Press
Journal of Development Economics-Elsevier
IMF Economic Review- Palgrave Macmilan
Oxford development Studies- Rouledge
Review of Development Economics-Wiley
Review of World Economics-Springer
Review of Economic Dynamics- Elsevier

CORE COURSE
SEMESTER III
RESEARCH METHODOLOGY- I

Subject Code: 23-EC-213
Subject: Research Methodology- I (4 Credit Course)

Total Lectures = 48

PREAMBLE

The main objective of this paper is to make the students aware of the importance of Research Methodology. Today research is of importance in every field of life. Hence students need sound initiation in the world of research. Thus this syllabus is prepared to equip students with basics of research methodology and also provide them acquaintance with the main ingredients of major sources secondary data on Economics, some hands-on experience in conduct so survey including designing questionnaire and interview schedules, collection of data, analysis of data and preparation of report.

Course Objectives:

- To enable an understanding of Research and its methods under various areas of economics.
- To demonstrate the practical and the applied aspects of research in relation to Economics.

Course Outcome:

- Ability to develop, demonstrate and examine topics under Economics to pursue research.
- Ability to evaluate and examine subject areas in economics and explore possibilities of research.

1 Introduction **06**

1.1 Research : Meaning ,Nature , Scoup. And Importance
1.2 Scientific Research : Methods - Stages /Steps
1.3 Social Science Research - Meaning ,Nature , Scoup. And Importance
1.4 Review of Literature- Need, Scope, Use and Precautions

2 Research Problem And Design **10**

2.1 Research Problem- Meaning, Identification and Selection of Research Problems
2.2 Research design ; Meaning , Objective ,
2.3 Need , Characteristics of Research design
2.4 Types of research Design – Descriptive, Diagnostic ,Exploratory, Experimental

3 Data Collection And Data Analysis **10**

3.1 Collection of Data – Meaning ,Importance
3.2 Sources of data – Primary Data And secondary data
3.3 Methods of Primary Data Collection- Questionnaire and Interview method, Schedule , Observation Method; ,
3.4 Secondary Data Sources
3.5 Sampling Method –Meaning and Types—(Probability and Non-probability)
3.6 Analysis of Data- Classification and Tabulation of Data
3.7 Computer Use Of Data Analysis

4 Testing of Hypothesis **12**

4.1 Hypothesis: Definitions, Characteristics and Importance

4.2 Types Of Hypothesis
4.3 Procedure of Hypothesis Testing
4.4 Basic Concepts: Level of Significance, Statistical Errors (Type --I and Type II Error)
4.3 Procedure of Testing of Hypothesis- Parametric and Non-Parametric tests

5 Report Writing **10**

5.1 Objective of Report Writing
5.2 Importance of Research Report,
5.3 Features of Research Report
5.4 Steps/ Element of Research Report
5.5 Report Writing: Considerations and Precautions,
Ordering References , Bibliography and Appendix in Research

Basic Reading List:

1. Banamati Mohanty (2015) _Statistics for Behavioral and Social Sciences‘ Sage Texts
2. Bryman Alan (2018) _Social research methods‘ OUP
3. Cooper Donald R. & Pamela S. Schindler (1999), ―Business Research Methods‖, Tata McGraw-Hill Edition, New Delhi
4. Flick Uwe (2011) _Introducing Research Methodology‘ Sage Publications
5. Kothari C. R, Gaurau Garg (2019) _Research Methodology, Methods and Techniques‖, New Age International Publications, 4th Edition
6. Kumar Ranjit, (2012), ―Research Methodology‖ 2nd Ed, Pearson Education
7. Wilkinson and Bhandarkar (2016) _Methodology and Techniques of Social Science Research; HPH
8. Willson Jonathan (2017) _Essentials of Business Research: A Guide to Doing Your Research Project‘ Sage Publications

Recommended Readings:

1. Basotia G.R. Sharma K.K. (1999) _Research Methodology‘ Mangal Deeop Publications
2. Don E. Ehridge (2004) _Research Methodology in Applied Economics: Organizing Planning and Conducting Economics Research‘, John Wiley and Sons
3. Gopal M.H. (1971) _An Introduction to Research Procedure in Social Sciences‘, Asia Publishing House
4. Kothari S. R (2012) _Research Methodology, Methods and Techniques‖, Pragun Publications.
5. Khandhare V.B., Yadav Y.,2016, Chinmay Publication ,Aurangabad.
6. Krishnaswamy, O.R. (1993) _Methodology of Research In Social Sciences, HPH
7. Kurein C. T. (1973) A Guide to Research in Economics‘ Sangam Publishers for Madras Institute of Development Studies
8. Les Oakshott (2012) _Essential Quantitative Methods for Business, Management and Finance‘, Palgrave Macmilan, 5th edition
9. Moser C.A., G. Kalton (1985) _Survey Methods in Social Investigations‘ Routeledge
10. BAV Sharma D Ravindra Prasad and P. Satyanarayana (1983) Research Methods in Social Sciences‘ Sterling publishers, New Delhi
11. Sadhu AN, Amarjit Singh (2007) _Research Methodology in Social Sciences‘ HPH
12. Thakur Devendra (2009) _Research Methodology in Social Sciences‘ Deep and Deep Publiations
13. Young P.V. (1984) _Scientific Social Survey and Research‘, Prentice Hall -India

Recommended Journals:
Journal of Mixed Methods Research- Sage
Journal of Applied Social Sciences- Sage
Research in Economics- Elsevier
Social Science Research- Elsevier
The Social Science Journal – Elsevier/ ScienceDirect

M.A. ECONOMICS PART- II

SEMESTER III

ELECTIVE PAPERS

(Choose Any ONE Paper)

01- ECONOMICS OF FINANCE
02- DEMOGRAPHY
03- CAPITAL MARKETS
04- INDUSTRIAL ECONOMICS

ELECTIVE COURSE
SEMESTER III
ECONOMICS OF FINANCE

Subject Code: 23-EC-214A
Subject: Economics of Finance (4 Credit Course)
Total Lectures = 48

PREAMBLE

The positive and significant role of financial institutions in the process of growth and development has been very well recognized in the literature and indeed has become more important during the last two decades as the financial systems of different countries have become integrated in the process of globalization. It is, therefore, essential that the student of economics should be well conversant with the theory and practice of different financial institutions and markets; to understand and analyze the interconnection between the monetary forces and real forces, their developmental role and limitations in shaping and influencing the monetary and related policies both at the national and international levels.

Course Objectives:

- To provide an understanding of Finance and its application under various topics under economics.
- To demonstrate the practical and the applied aspects of Finance in relation to Economics.

Course Outcome:

- Ability to develop, demonstrate and examine various topics under Finance with the help of Economics.
- Ability to evaluate and examine subject areas in economics bringing out the relation to finance.

1. Introduction **10**

1.1 Role of Finance in economic development.
1.2 Structure and functioning of the Financial system – Financial Intermediaries, Financial Markets and Financial Instruments
1.3 Markets and Aspects of Risk Sharing, The Problem of Agency

2. Basic Financial Calculations **10**

2.1 Types of Financial securities- Fixed Income Securities, Bonds, Index-linked securities
2.2 The time value of money, Future Value of Asset, Present Value of Asset; Future and present values of multiple cash flows.
2.3 Relation Between Inflation and Interest Rates, Real and Nominal Cash Flows, Valuing Real Cash Payments, Effective Annual Interest Rates
2.4 Bond valuation- Characteristics of Bonds.

3. Portfolio Theory **10**

3.1 Asset Return- random variables and random returns
3.2 Capital Asset Pricing, Validity of CAPM (Capital Asset Pricing Model), the CAPM, Risk and Return
3.3 Arbitrage Pricing Theory
3.4 Measuring portfolio return and risks, effect of Diversification, Minimum Variance Portfolio, Perfectly Correlated Assets, Minimum Variance Opportunity Set, Optimal Portfolio Choice; Mean Variance Frontier Of Risky and Risk-Free Asset, Portfolio Weights

4. Efficient Market Hypothesis **10**

4.1 Efficient Market Hypothesis

4.2 Valuing Stocks, Book Values, Liquidation Values and Market Values, Valuing Common Stocks, The Price-Earnings Ratio

4.3 The Dividend Discount Model -The Dividend Discount Model with No Growth, The Constant-Growth Dividend Discount Model

5. Risk, Return, and Capital Budgeting **08**

5.1 Measuring Market Risk, Using the CAPM to Estimate Expected Returns, Capital Budgeting and Project Risk, Determinants of Project Risk

5.2 Introduction to risk, return and opportunity cost of capital, Estimating Expected Rates of Return,

5.3 Measuring Risk Variance and Standard Deviation Measuring the Variation in Stock Returns Risk and Diversification Asset versus Portfolio Risk

BASIC READING LIST

1. Bhole L.M. (2004) _Financial Institutions and Markets‘, Tata McGraw Hill
2. Chandra P. (2017), _Investment Analysis and Portfolio Management‘, McGraw Hill Education, Fifth Edition
3. Frederic Mishkin (2019) _The Economics of Money, Banking and Financial Markets‘ Pearson Education India, 11th edition
4. Frederic Mishkin and Stanley Eakins (2006) ―Financial Markets and Institutions‖, Pearson 5th Ed
5. Fabozzi Frank J. (2016) Bond Market Analysis and Strategies‘ Pearson, 8th edition
6. Hull John C (2018) ―Fundamentals of Futures and Options Market‖, Pearson Education, 9th Edition
7. Hull John C, Sankarshan Basu (2018) ―Options, Futures and Other Derivatives‖, Pearson Education, 10th Edition
8. Richard A Brealey, Stewart C Myers, and Alan J. Marcus (2003) _Fundamentals of Corporate Finance‘, Third Edition; McGraw-Hill, Inc

Recommended Books

1. Ajay Shah Susan Thomas Michael Gorham (2008) ―Indian Financial Markets: AN Insider‘s Guide to How the Market Works‖ Elsevier Science
2. Baye Micheal R, Dennis W Jansen (1996) ― Money, Banking & Financial Markets An Economic Approach‖, A.I.T.B.S. Publishers & Distributors. Delhi
3. Chandra P. (1997), ―Financial Markets‖, Tata McGraw Hill, 4th Edition
4. David G. Lueberger (2012) ―Investment Science‖, OUP, 1st edition
5. Elton Edwin J, Martin J Gruber, Stephen J Brown & William Goetzmann (2002) ―Modern Portfolio Theory and Investment Analysis‖ John Wiley & Sons
6. Fama E.F. (1997) ―Foundations of Finance‖, Basil Blackwell, Oxford, Ch.5
7. Hauthkkar H.S., Williomson P.J., (1996) ―The Economics of Financial Market‖, OUP
8. Hearth Douglas & Zaima J K (1998) ―Contemporary Investment: Security and Portfolio Analysis‖ The Dryden Press
9. Hull John C (2018) ―Risk Management and Financial Institutions‖, John Wiley & Co
10. LeRoy Stephen F, Jan Werner (2014) ―Principles of Financial Economics‖ Cambridge University Press
11. Ross Stephen and Rudolph W.W., (1998) ―Fundamentals of Corporate Finance‖,McGraw Hill

12. Smith, P.F., (1978), ―Money and Financial Intermediation: The Theory and Structures of Financial System‖, Prentice Hall
13. Susan Thomas, (ed) (2003) ―Derivatives Market in India‖, Invest India
14. Wavre A. & Dhonde S, Finance of Village Panchayat, Shubhan publication, Kanpur. UP, India
15. Zvi Bodie, Robert C. Merton, Devid L. Cleeton (2008) ―Financial Economics‖ Pearson

Recommended Journals:

Journal of Finance- Wiley Online
Journal of Applied Statistics- Francis & Taylor
Journal of Banking and Finance – Elsevier
Global Finance Journal – Elsevier

ELECTIVE COURSE
SEMESTER III
DEMOGRAPHY

Subject Code: 23-EC-214B
Subject: Economics of Finance (4 Credit Course)

Total Lectures = 48

PREAMBLE

The main objective of this paper is to make the students aware of the importance of population in economic development and the various theories that explain the growth of population in a country. The paper also enlightens the students on the quantitative and the qualitative aspects and characteristics of the population through various demographic techniques. In recent times, the gender aspect of the population has acquired importance and these have also been included in the framework of study. Fertility and Aging are also vital characteristics of the undergoing structural change. Their study is essential to understand the dynamics of this change. The paper exposes the students to sources of population and related characteristics and also to the rationale, need and evolution of population policy.

Course Objectives:

- To provide an understanding of Demography and its application under various topics under economics.
- To demonstrate the practical and the applied aspects of Demography and the study of Population and its relation to Economics.

Course Outcome:

- Ability to develop, demonstrate and examine various topics under Demography.
- Ability to evaluate and examine subject areas in economics bringing out the relation to population studies and demography.

1. **Demography** **10**

1.1 Demography: Evolution, Nature and Scope
1.2 Development of Population Studies - relationship with other disciplines
1.3 History of Population Growth – Primitive, Pre-Industrial, Developed and Developing
1.4 Population Growth- Components, Interdependence, World Population Growth and Distribution, Growth in Developed and Developing Countries
1.5 Measures of Population Growth- Sources of Demographic Data

2. Population theories **14**

2.1 The Malthusian theory
2.2 Post-Malthusian Theories
2.3 The Optimum Population Theory
2.4 The Theory of Demographic Transition
2.5 Population and Development (Meadows, Enke and Simon)

3. Population structure and characteristics **10**

3.1 Structure of Population, Growth Rate and
3.2 Mortality- Meaning, Measurement of Mortality, Measures - causes of death.
3.3 Fertility- Meaning, Measurement of Fertility, Extent and Trends of Fertility, Factors affecting Fertility, Fertility Differentials in India
3.4 Pattern of Age and Sex Structure- Determinants, Impact and Implications; Age and Population

4. Population and Development **14**

4.1 Relation between Population and Development; Effects of Development on Population Growth and vice versa

4.2 Population and Natural Resources- Demographic and Socio-economic factors influencing Saving, Investment, Capital Formation and Technology

4.3 Population and Labour force- Population and Employment, Economically Active Population, Work Participation

4.4 Women and Development- Indicators of Status of Women, Inter-relation between Status of Women and Demographic Change

4.5 Population Policy in India- Shift from Population Control from Welfare and Empowerment; Strategies for Population Control and Human Development, Challenges to National Population Commission

Basic Reading List

1. Bogue, D.J. (1971), Principles of Demography, John Wiley, New York
2. Bhende, Asha A., Tara Kanitkar (2013) *Principles of Population Studies,* Himalaya Publishing House, Mumbai
3. Mujumdar P. K (2013) ―Indian‘s Demography: Changing Demographic Scenario in India‖, Rawat Publications
4. Sinha V.C.,Easo Zacharia (1986) ‗Principles of Demography‘ Allied Publishers, 2nd Edition
5. Srinivasan Krishnamurthy (2017) ―Population Concerns in India: Shifting Trends, Policies and Programs‖ Sage Publications
6. Srinivasan, K. and A. Shariff (1998), India: Towards Population and Demographic Goals, Oxford University Press, New Delhi

Reports

1. Census of India, Census Commissioner and Registrar General of India, Government of India, New Delhi, Latest Census
2. Family Welfare Programme in India, Year Book 2012, Government of India
3. National Family Health Survey, Government of India & IIPS, Mumbai, Recent Reports
4. National Population Policy 2000, Government of India
5. United Nations (1973) ―Determinants and Consequences of Population Trends‖

Recommended Books

1. Agarwala S.N. (1972), ―India‘s Population Problem‖, Tata McGraw-Hill Co
2. Bose, A. (1996), ―India‘s Basic Demographic Statistics‖, B.R. Publishing, New Delhi
3. Chakraborti Rajagopal D (2004) ―The Greying of India: Population Ageing in the Context of Asia‖ Sage Publications
4. Chenery H., T.N. Srinivasan (Eds.) (1989),‖ Handbook of Development‖ Economics,Vol.1 & 2 Elsevier, Amsterdam
5. Choubey, P.K. (2000), ―Population Policy in India‖, Kanishka Publications, New Delhi
6. Dasgupta Sukti, Sher Singh Verick (2016) ―Transformation of Women at Work in Asia: An Unfinished Development Agenda‖ Sage Publications
7. Easterlin Richard A (1987) ―Population and Economic change in Develo0ping Countries‖, National Bureau of Economic Research, University of Chicago Press
8. G Giridar (Ed) (2014) ―Population Aging In India‖ Cambridge University Press
9. Gulati, S.C. (1988), ―Fertility in India: An Econometric Study of a Metropolis‖, Sage, New Delhi. Economics
10. Seth Mira (2001) ―Women and Development: The Indian Experience‖, Sage

11. Simon,J.L.(1992), ―Population and Development in Poor Countries‖, Princeton University Press.
12. Srinivasan, K. (1998), ―Basic Demographic Techniques and Applications‖, Sage, New Delhi
13. Kute S & Rithe M, Demography, (2017), Prashant Publication, Jalgaon MS, India.

Recommended Journals:

Antyajaa – Indian Journal of Women and Social Change - Sage
Demography – Springer
Economic and Political Weekly
Journal of Population Research - Springer
Journal of Demographic Economics - Cambridge
Management and Labour Studies- Sage
Population and Development Review – Wiley Online
Population Studies – Taylor and Francis Online

ELECTIVE COURSE
SEMESTER III
CAPITAL MARKETS

Subject Code: 23-EC-214C
Subject: Capital Markets (4 Credit Course)

Total Lectures = 48

PREAMBLE

Finance Systems and Markets are specialized areas in Economics and Finance. Financial Markets discuss market structures, financial institutions, financial markets, financial instruments and services. The subject discusses the capital markets in the Indian as well as the international context with reference to the changing structure, role of regulatory bodies, self-regulation, development of various new instruments and institutions.

Course Objectives:

- To develop an understanding of the financial system in the theoretical context.
- To interpret the developments in the capital markets w.r.t. institutions and instruments and compare and contrast with International Capital Markets

Course Outcome:

- Ability to interpret and analyze the scenario in Indian and Global markets.
- Ability to discuss and debate on the changing scenario in global market.

1 Introduction **12**

1.1 Structure of Capital Market-
- 1.1.1 Government Securities Market and Industrial Securities Market;
- 1.1.2 Primary and Secondary Markets,
- 1.1.3 Equity, Debt & Derivatives Market

1.2 Developed and Underdeveloped Capital Markets
1.3 Regulation of Capital Markets-Securities & Exchange Board of India (SEBI)-Objective & Role

2 Constituents & Instruments of Capital Market **12**

2.1 Government
2.2 Stock Exchanges- Meaning & Types
2.3 Financial Institutions
2.4 Commercial banks
2.5 Credit Rating Agencies- Purpose & Role
2.6 Other Institutions – Mutual Funds, Merchant Bankers, Underwriters, etc.
2.7 Portfolio Investors (Foreign Institutional Investors)
2.8 Instruments in the Capital Market- Equity, Debt & Derivatives- Types; Hybrid Instruments

3 Stock Exchanges **12**

3.1 Stock Exchanges- Meaning and Types
3.2 Stock Exchanges-Operations and Trading, Settlement
3.3 Stock Market Indices- Meaning & Calculation of Stock Indices (BSE/NSE)
3.4 Demutualization of Stock Exchanges
3.4 Dematerialization of Stocks/Shares

4 Indian Capital Market Changing Scenario **12**

4.1 Changes in the Indian Capital Market Pre and Post Liberalization
4.2 Emergence of Financial Services- Venture Capital, Lease Finance, Angel Finance, Crowd Funding, Pension Funds
4.3 Globalization of Capital Markets – Instruments, Intermediaries and Risk Management
4.4 Risk Management and Financial Crisis in Emerging Market Economies

Basic Reading:

1. Brandl Micheal (2019) _Money, Banking, Financial Markets and Institutions' Cengage Learning
2. Bhole, L. M., Jitendra Mahakud (2017) _Financial Institutions and Markets' Tata McGraw Hill, ND
3. Fabozzi Frank J., Steven V. Mann, Moorad Choudhry (2002) _The Global Money Markets' John Wiley & Sons
4. Frederic Mishkin and Stanley Eakins (2006) _Financial Markets and Institutions', Pearson 5th Edition
5. Madura Jeff (2014) _Financial Institutions and Markets' Cengage
6. Saunders Anthony and Cornett Marica Millon (2017) ―Financial Markets and Institutions - An Introduction to the Risk Management Approach‖ McGraw Hill Education 3rd Edition

Recommended Readings:

1. Bhole, L. M. (2000) _Indian Financial System' Chugh Publications, Allahabad
2. Batra G.S. ―Financial Services and Markets‖, New Delhi: Deep and Deep Publications Pvt. Ltd., Latest Ed.
3. Das S. C. (2015) _The Indian Financial System: Markets, Instruments, Institutions, Services and Regulations' PHI Learning
4. Kothari Rajesh. ―Financial Services in India Concept and Application‖, New Delhi, Sage Publications. 2010.
5. Gurusamy S (2004) ―Financial Services and Markets‖, Vijay Nicole Imprints
6. Meir Kohn (2013) _Financial Institutions & Markets; OUP
7. Machiraju H.R. (2006) _Indian Financial System, Vikas Publications, New Delhi
8. Pathak, Bharati (2009) _The Indian Financial System, Pearson Education

Recommended Journals:

Indian Journal of Research in Capital Markets-
Journal of Capital Markets- Elsevier
Journal of Capital Market Studies- Emerald Insights

ELECTIVE COURSE
SEMESTER III
INDUSTRIAL ECONOMICS

Subject Code: 23-EC-214C
Subject: Industrial Economics (4 Credit Course)

Total Lectures = 48

PREAMBLE

The main objective of this paper is to make the students aware of the importance of industrial sector in economic development. The paper explores the emergence of Industrial economics as a separate area of study; the theories of location are discussed and debated in the present context and analyzed with reference to the development of the industrial sector. The study is essential to understand the dynamics of the changes in the Industrial sector in India as well as around the world. The paper exposes the students to the current challenges to the industrial sector – growth, productivity, changing policy and performance.

Course Objectives:

- To provide an understanding of Industry, Industrial sector and growth and its relation to various economic issues and challenges.
- To demonstrate the practical and the applied aspects of Industrial economics and the study of Industry and its relation to Economics.

Course Outcome:

- Ability to develop, demonstrate and examine various topics under Industrial Economics.
- Ability to evaluate and examine subject areas in economics bringing out the relation to industry and industrial development.

1 Introduction **10**

1.1 Industrial Economics – Emergence, Meaning and Definition
1.2 Scope and Importance of Industrial Economics
1.3 Classification of Industries
1.4 New Empirical Industrial Organization Approach

2 Theories of Industrial Location **14**

2.1 General Determinants of Industrial Location
2.2 Theories of Industrial Location
  2.2.1 Alfred Weber‘s Theory of Industrial Location
  2.2.2 Sergeant Florence‘s Theory of Industrial Location
2.3 Policy of Industrial Location in India
2.4 Need for Balanced Regional Development

3 Industrial Productivity and Growth **10**

3.1 Industrial Productivity - Norms and Measurement
3.2 Factors affecting Productivity and measures to improve Productivity,
3.3 Public Enterprises- Efficiency, Productivity and Performance
  (Case for/against India)
3.4 Skill Development and Industrial Productivity
3.5 Industrial Growth in India: Cause for Concern, Challenges to Private Sector
3.6 Policy Measures to enhance Industrial Growth

4 Industrial Policies in India 14

4.1 Industrial Policy in India – Progress since 1991
4.2 Developments in Industrial Policy – Special Economic Zones, _Make in India‘, Public Private Partnership
4.3 Changing Role and Performance of Public and Private Sector in India
4.4 Developments in Policy for MSMEs since 1991
4.5 Development in FDI Policy, Emergence of Indian Multinational Companies
4.6 Globalization of Labour Markets and Impact of Emerging Economies

Basic Reading List:

1. Barthwal R.R. (2019), _Industrial Economics,‘ New Age Publications
2. Das Keshab (2011) _Micro and Small Enterprises in India: The Era of Reforms‘ Routledge India
3. Flanagan Robert J. (2006) _Globalization and Labor Conditions: Working Conditions and Worker Rights in a Global Economy, OUP
4. Hajela, P.D. (1998), Labour Restructuring in India: A Critique of the New Economic Policies, Commonwealth Publishers, New Delhi
5. Jaya Prakash Pradhan (2008) _Indian Multinational in the World Economy: Implications for Development‘, Bookwell Publications
6. Khanna Tarun (2008) _Billions of Entrepreneurs: How India and China are Reshaping their Future and Yours‘ Penguin India
7. Gupta Parul (2019) _Industrial Relations and Labour Laws for Managers‘ Sage Pub.
8. Sharma RC (2016) _Industrial Relations and Labour Laws‘ PHI Learning
9. Sinha P.R.N., Indu Bala Sinha (2017) Industrial Relation Trade Unions and Labour Legislation Pearson Publication. New Delhi
10. Saumitra Mohan (2018) ―Indian Policy and Development: A Manual for National Schemes and International Policies‖ McGraw Hill Education

Recommended Readings:

1. Agarwal Aradhana (2012) _Social and Economic Impact of SEZs in India‘ Oxford University Press
2. Amit Kumar (2013) _SMEs in India in post-1990s Era: Challenges and Opportunities, LAP Lambert Academic Publishing
3. Barthwal R.R. (1985), _Industrial Economics,‘ Wiley Eastern Ltd., New Delhi.
4. Desai, B. [1999], _Industrial Economics in India,‘ HPH
5. Divine, P.J. and R.M. Jones et.al. (1976), _An Introduction to Industrial Economics,‘ George, Allen and Unwin Ltd., London.
6. Kumar V Pratap, rajesh Chakrabarti (2018) Public-Private Partnerships in Infrastructure: Managing the Challenges (India Studies in Business and Economics) Springer
7. Kuchhal, S.C. (1980), Industrial Economy of India, Chaitanya Publishing House, Allahabad.
8. Singh, A. A.N. Sandhu. [1988],‘Industrial Economics,‘ HPH
9. Vepa R. K, (1988) Modern Small Industry in India, Sage Publication
10. Venkataratnam, C.S. (2001), Globalization and Labour- Management Relations: Dynamics of Changes, Sage Publications/Response Books, New Delhi.

Recommended Journals:

Applied Economics- taylor & Francis Online
International Journal of Economics and Business research- Inderscience
International Journal of Industrial Organization- Elsevier
The Journal of Industrial Economics- Wiley
The Journal of Industrial Economics- Scimago

M.A. ECONOMICS PART- II

SEMESTER IV

CORE PAPERS
(COMPULSORY PAPER)

1. **MACRO ECONOMIC ANALYSIS IIEC**
2. **GROWTH & DEVELOPMENT II EC**
3. **RESEARCH PROJECT**
4. **RESEARCH METHODOLOGY**

CORE COURSE
SEMESTER IV
MACRO ECONOMIC ANALYSIS - II

Subject Code: 23-EC-221
Subject: Macro Economic Analysis – II (4 Credit Course)
Total Lectures = 48

PREAMBLE

Macroeconomics or aggregative economics analysis establishes the functional relationship between various aggregates of the economy. Aggregative analysis assumed such a great significance in recent times that a prior understanding of macroeconomic theoretical structure is considered essential for proper comprehension of different issues and policies. Macroeconomics now is not only a scientific method of analysis but also a body of empirical economic knowledge. The course equips the students at the postgraduate level to understand systematic facts and theoretical developments for empirical analysis,

Course Objectives:

- To provide a thorough understanding of the principles of macroeconomics and the application of macroeconomic concepts in various contexts.
- To discuss the modern developments in macroeconomics.

Course Outcome:

- Ability to analyze and demonstrate knowledge of the basic theories/laws in economics- general equilibrium psychological law of consumption, etc.
- At the end of the course, the student should be able to evaluate macroeconomic concepts, models and its use in real life situations.

1. Aggregate Demand and Aggregate Supply Analysis 12

1.1 Aggregate Demand Curve (with price flexibility)-Derivation of aggregate demand curve-shift in aggregate demand curve and multiplier effect

1.2 Aggregate Supply curve (with variable prices)-shift in aggregate supply curve-long-run aggregate supply curve –Derivation of Aggregate supply curve-

1.3 Macroeconomic equilibrium: AS-AD Model-Friedman‘s Natural Rate Hypothesis-Economic Fluctuations

1.4 Three Models of the Upward Sloping SRAS (short-run aggregate supply curve) –The Sticky Wage Theory, The Sticky Price Theory and The Misperceptions (Fooling) Theory

2. The IS-LM Curves Model 12

2.1 Introduction-The Structure of the Model

2.2 Derivation of IS Curve and LM Curve –Shifts in IS Curve and LM curve, causes in shifts in IS and LM Curve.

2.3 Simultaneous Equilibrium in Goods Market and Money Market-Extension IS-LM model with government sector Fiscal policies.

2.4 Extension of IS-LM model with Labor Market and flexible prices.

3. Inflation-Unemployment Trade-Off: Phillips Curve and Rational Expectations Theory 12

3.1 Inflation and Unemployment-Phillips curve-Explanation of Phillips curve.

3.2 Causes of shifts in Phillips Curve- Long-run Phillips curve and adaptive expectations – Long-run Phillips curve: Rational expectations.

3.3 Relation between short-run Phillips curve and long-run Phillips curve.

3.4 Stagflation and Supply-side Economics-stagflation in India-1991-04, causes of stagflation
3.5 Supply-side economics-basic propositions of supply-side economics-Taxation and labour supply, Incentive to save and investment, the tax wedge-tax revenue and Laffer curve, a critical appraisal of supply side economics.

4. The New Classical Macro Economics & the Open Economy Issues 12

4.1 Introduction -Meaning of Rational Expectations- Barrow's view
4.2 The New Classical Model
4.3 The Role of the Monetary and Fiscal policy
4.4 Rational Expectations and the Real Business Cycles
4.5 Criticism of the Rational Expectations Hypothesis.
4.6 Open Economy-Balance of Trade-Balance of Payments-Mundel-Fleming Model, Exchange Rate Regimes.

BASIC READING LIST:

15. August Swanenberg (2005) _Macroeconomics Demystified‘ A Self Teaching Guide, McGraw Hill Education
16. Ackley, G. (1978), Macro Economics: Theory and Policy, Macmillan, New York.
17. Agrawal Vanita, (2010) Macroeconomics: Theory and Policy, Pearson Publication, New Delhi.
18. Ahuja H.L., Macroeconomics: Theory and Practice, S.Chand & Co. New Delhi.
19. Blackhouse, R. and A. Salansi (Eds.) (2000) Macroeconomics and the Real World (2 Vols.), Oxford University Press, London. Dornbusch,
20. Campbell R. McConnell, Stanley L. Brue, (2001) Macroeconomics: Principles, Problems and Policies‘, McGraw Hill, Inc., New York.
21. Froyen Richard T (2006) _Macroeconomics– Theories and Policies‘ Pearson Education; 8th edition
22. Gupta S.B. (1997) _Monetary planning for India‘ OUP
23. Jha, R. (1991), Contemporary Macroeconomic Theory and Policy, Wiley Eastern Ltd., New Delhi.
24. Mankiw Gregory (2007) _Macroeconomics‘ Worth, New York
25. Rao, V.K.R.V. (1983) India's National Income : 1950 to 1980, Sage Publications, New Delhi
26. Gupta, S.B. (1995), Monetary Planning in India, OUP, New Delhi.
27. Sampat Mukherjee (2013), _A Global Text-Macroeconomics‘, New Central Book Agency
28. Soumyen Sikdar (2006) _Principles of Macroeconomics‘ Oxford University Press

29 Bhise V.B , Khandare V.B & Babar , (2014) Macro Economics , Chinmay Publication Aurangabad.

Recommended Readings:

16. Branson, W.A. (1989), Macroeconomic Theory and Policy, (3rd Edition), Harper and Row, New York.
17. Culbertson, J.M. (1968), Macroeconomic Theory and Stabilization Policy, McGraw Hill, Kogenkosh, Tokyo.
18. Duesenberry, J.S. (1949), Income Saving and the Theory of Consumer Behaviour. Harvard University Press, Harvard.
19. Edey, M. and A.T. Peacock (1967), National Income and Social Accounts, Hutchinson University Library, London
20. Fisher, Dornbusch, Schamalensee (1988) _Economics‘ McGraw Hill International Edition ; 2nd edition

21. Friedman, M. (1957), The Theory of Consumption Function, Princeton University Press Princeton.
22. Friedman, M. (1956), Studies in the Quantity Theory of Money, The University of Chicago Press, Chicago
23. Glahe, Fred, R. (1973), Macroeconomics: Theory and Policy, Harcourt Brace Javanovich, Inc., New York.
24. Harris Lawrence (1980) _Monetary Theory' McGraw Hill Inc.
25. Keynes, J.M. (1936), _The General Theory of Employment Interest and Money', Macmillan, London.
26. Ruggles, R. and N. Ruggles (1956), National Income Accounts and Income Analysis, McGraw Hill New York.
27. Shapiro, E. (1996) Macroeconomic Analysis, Galgotia Publications, New Delhi.
28. D.Wrightsman _An Introduction to Monetary Theory and Policy' The Free Press New York 1983

Recommended Journals:

Applied Economics- Taylor & Francis Online
Journal of Macroeconomics-Elsevier
Macroeconomics and Finance in Emerging Market Economies- Taylor & Francis Online
The Indian Economic Journal- Sage Journal

CORE COURSE
SEMESTER IV
GROWTH & DEVELOPMENT - II

Subject Code: 23-EC-222
Subject: Growth & Development – II (4 Credit Course)

Total Lectures = 48

PREAMBLE

The course makes an attempt to provide an introduction to the economics of Growth and Development and at the same time provide an understanding of the analytical rigour of the subject. Growth and Development-I is a core course that covers meaning and concept of Economic Growth and Development, measuring the economic growth and development, theories of economic growth and development, poverty, inequality and unemployment and role human capital in economic development . Growth and development-I will try to clear the concepts regarding the economic growth and development and provides basic knowledge to the students to get engaged in the activities.

Course Objectives:

- To enable learning and understanding of the basic concepts and process to measure the growth and economic development etc.
- To analyze and evaluate the obstacles in the process of economic growth and development

Course Outcome:

- Ability to analyze and demonstrate knowledge of the economic growth and development theories of economic growth and development
- Ability analyze, evaluate and apply the growth and development concepts, role of human capital, etc. in real life situations

1. Sectoral Development: An Overview **12**

1.1 International agreements and Agriculture in India
1.2 Agriculture Productivity, Agriculture Price Policy, Land Holding and Cropping Pattern
1.3 Industrial Production Trends at National and International Level, Role Of MSMEs, Government Policies for Industrial Development
1.4 Growth of Services Sector in India, ICT and Services sector, International Comparison.

2. Technology and Development **12**

2.1 Role of Technology and Development
2.2 Capital Formation and Technical Progress as Sources of Growth
2.3 Technological Strategy of Development
2.5 Economics of R&D, Invention and Innovation, Relation to Development
2.6 Technology Centered Development

3. Environment and Development **12**

3.1 Sustainable Development, Sustainability Performance and Reporting
3.3 Environment and Rural-Urban Development
3.4 Industrialization and Environment Protection
3.5 Climate change and Agriculture

4. Development Strategies **12**

4.1 The Role of the Government in the Developmental process
4.2 The Market versus Detailed Centralized Planning
4.3 Approaches to Poverty Alleviation and Employment Generation
4.4 Policy of Export Promotion & Import Substitution
4.5 Policy of Infrastructure Development

Basic Reading List:

1. Basu Kaushik (1998) Analytic Development Economics: The Less Developed Economy Revisited', OUP
2. Behrman, S. and T.N. Srinivasan (1995), Handbook of Development Economics, Vol. 3, Elsevier, Amsterdam.
3. Felix Raj, Sampat Mukherjee, Mallinath Mukherjee, Amitava Ghose, Ranjanendra N. Nag (2007) ―Contemporary Development Economics From Adam Smith to Amartya Sen‖, New Central Book Agency Private Limited
4. Gillis, M., D.H. Perkins, M. Romer and D.R. Snodgrass (1992), Economics of Development, (3rd Edition), W.W. Norton, New York.
5. Kindleberger, C.P. (1977), Economic Development, (3rd Edition), McGraw Hill, New York. Economics
6. Meier Gerald M. and James E. Rauch, ―Leading Issues in Economic Development‖ Oxford University Press, 2006
7. Ray Debraj (1998) ―Development Economics‖, Oxford University Press
8. Solow Robert M. (2000) ―Growth Theory An Exposition‖ Oxford University Press
9. Thirwal, A.P. (1999), (6th Edition), Growth and Development, Macmillan, U.K.
10. Todaro, M.P. (1996), (6th Edition), Economic Development, Longman, London.

Recommended Readings:

1. Barro Robert J. and Xavier Sala-i-Martin (2004) ―Economic Growth‖ Prentice Hall of India Brown, M. (1966), On the Theory and Measurement of Technical Change, Cambridge University Press, Cambridge, Mass.
2. Dasgupta, P. (1993), ‗An Enquiry into Well-being and Destitution', Clarendon Press, Oxford.
3. Gillis, M., D.H. Perkins, M. Romer and D.R. Snodgrass (1992), Economics of Development, (3rd Edition), W.W. Norton, New York.
4. Meier, G.M. (1995), Leading Issues in Economic Development, (6th Edition), OUP
5. Nayyar Deepak (2019) ‗Resurgent Asia' OUP
6. Todaro Michael P. (1981) ―Economics for A Developing World‖, Longman, London.

Recommended Journals:

Economic Development and Cultural Change- Chicago Press
Journal of Development Economics-Elsevier
IMF Economic Review- Palgrave Macmillan
Oxford development Studies- Rutledge
Review of Development Economics-Wiley
Review of World Economics-Springer
Review of Economic Dynamics- Elsevier

CORE COURSE
SEMESTER IV
RESEARCH PROJECT
(Only for Internal Students)

Subject Code: 23-EC-223
Subject: Research Project (4 Credit Course)
Total Lectures = 48

PREAMBLE:
Students who complete their post-graduation in Economics are mentally equipped to pursue research in the same discipline. It is generally accepted that research is nothing but extension and application of knowledge in a certain specialized field. Therefore regular students who do their post-graduation, as internal students will be given an opportunity to get exposed to a few elements of social research and also they are expected to complete a small research project under the expert guidance and supervision, Elementary knowledge of research methodology shall consolidate and deepen their understanding of various branches of Economics. Preparing a small dissertation is intended to train them in scientific thinking and art of systematic presentation. It is essentially a job-oriented exercise to enable them to take up the exciting field of social and economic research.

Part I: Internal IV Semester students shall submit a dissertation of minimum 8000 words & maximum 10,000 words in three copies to the Head of the Department on or before 30thApril. The dissertation shall be prepared under the guidance of an internal postgraduate recognized teacher.

Part II: An internal supervisor shall assess each dissertation for out of 50 marks, based on the methodology, analysis, contents and quality of the dissertation.

Part III: A viva voce examination of each candidate shall be held where he/she will have to make a presentation of the dissertation and defend the research. A panel of two referees shall be formed out of whom one shall be an internal examiner.

The viva voce shall carry 50 marks. Internal & external examiners shall give out of 25 marks each. The copies of dissertation and the record of the viva voce examination shall be maintained by the centre for two more academic years for inspection. The Marks obtained for project work shall be included in the statement of marks of all the regular internal students.

Scale of Remuneration will be as per the University Guidelines.
External examiner will be appointed by the University.

SEMESTER IV

ELECTIVE PAPERS

(Choose Any ONE Paper)

01 - ECONOMETRICS
02 - PUBLIC POLICY
03 - ECONOMICS OF ENVIRONMENT
04 - FORIGN EXCHANGE MARKET

ELECTIVE COURSE
SEMESTER IV
ECONOMETRICS

Subject Code: 23-EC-224A
Subject: Research Project (4 Credit Course)

Total Lectures = 48

PREAMBLE

Application of economic theory needs a reasonable understanding of economic relationships and relevant statistical methods. The syllabus of econometrics is to equip the students with an understanding of theoretical econometrics and the relevant applications of the econometric methods. This course covers various econometric methods applicable for testing empirical relationships in economics and those needed for applied economic research. An introductory module on time series methods has also been included in this course, which constitutes an important tool for analysis in economic studies.

Course Objectives:

- To apply econometric theory with the help of mathematical modeling and the use of statistical tools in order to solve economic problems.
- To demonstrate the practical and the applied aspects of econometrics involved in conducting empirical studies.

Course Outcome:

- Ability to develop analytical and quantitative understanding, demonstrate and examine problem solving aptitude.
- Ability to evaluate and examine subject areas in economics with the help of econometric modeling.

1. Introduction: **04**

1.1 What is Econometrics?
1.2 Statistical Background and Econometrics
1.3 The Methodology of Econometrics
1.4 Review of Statistical Inference – Statistical Estimation and Hypothesis Testing

2. Simple Regression Analysis: **14**

2.1 The Two-Variable Linear Regression Model
2.2 The Ordinary Least-Squares Method and its Properties
2.3 Test of Significance of Parameter Estimates
2.4 Test of Goodness of Fit and Correlation
2.5 Analysis of Variance – One way and Two-way Analysis

3. Multiple Regression Analysis: **10**

3.1 The Three-Variable Linear Regression Model
3.2 Tests of Significance of Parameter Estimates
3.3 The Coefficient of Multiple Determination
3.4 Test of the Overall Significance of the Regression
3.5 Partial-Correlation Coefficients

4. Violations of Classical Assumptions and Remedies: **06**

4.1 Multicollinearity
4.2 Heteroscedasticity
4.3 Autocorrelation

5. Further Techniques and Applications in Regression Analysis **10**

5.1 Functional Forms
5.2 Dummy Variables
5.3 Simultaneous-Equations Models
5.4 Identification using Rank and Order Condition

6. Introduction to Time-Series Methods **04**

6.1 Stationary Time Series – Strict Stationarity, Weak Stationarity
6.2 Non-stationary Series
6.3 Concept of Unit Root Process and Testing
6.4 Introduction to Forecasting using Time Series Models

Basic Reading List

1. Enders Walter (2018) _Applied Econometric Time Series‘, (4th ed.) Wiley India
2. Gujarati, D. N., Porter, D. C. & Gunasekaran, S. (2009). Basic Econometrics. (5th ed.). Tata McGraw Hill
3. H. Stock James, W. Watson Mark (2017) _Introduction to Econometrics‘ Pearson Education, Third Edition
4. Maddala G. S., Kajal Lahiri (2012) _Introduction to Econometrics‘, John Wiley & Sons.

Recommended Books:

1. Dominick Salvatore and Derrick Reagle (2011) Schaum's Outline of Statistics and Econometrics, Second Edition (Schaum's Outlines).
2. Dougherty, C. (2011) Introduction to Econometrics (4th ed). Oxford University Press.
3. Gujarati Damodar (2017) _Econometrics by Example‘, Palgrave Macmillan, 2nd edition
4. Jeffrey M. Wooldridge (2008) _Introductory Econometrics: A Modern Approach‘ South Western, Second Edition
5. Koutsoyiannis A. (2001) _Theory of Econometrics‘ Palgrave Macmillan, Second Edition
6. Nachane, Dilip M. (2008). Econometrics: Theoretical Foundations and Empirical Perspective (1st ed.). Oxford Textbooks

Recommended Journals

1. Journal of Quantitative Economics, The Indian Econometric Society
2. Quarterly Journal of Economics, Oxford Academic.
3. Econometrica, The Econometric Society
4. Journal of Econometrics - Elsevier
5. The Econometrics Journal, The Royal Economic Society

ELECTIVE COURSE
SEMESTER IV
PUBLIC POLICY

Subject Code: 23-EC-224B
Subject: Research Project (4 Credit Course)

Total Lectures = 48

PREAMBLE

Public Policy is a specialized area in social sciences, with special reference to economics along with political science and sociology; the subject covers the study of public policy, the process and perspectives of policy making and the analysis and evaluation of Public Policy. The study of Public Policy provides an understanding of the various aspects of policy making on theories, concepts, process, methods, analysis and evaluation. The subject discusses public policy in historical perspective, the concepts of public policy, the methodologies for implementation as well as evaluation along with the impact of globalization on public policy.

Course Objectives:

- To develop an understanding of public policy in the theoretical as well as practical context.
- To discuss and debate the various aspects of public policy and policy making

Course Outcomes:

- Ability to analyze and evaluate the subject with reference to various aspects of Public Policy.
- Ability to develop an understanding of the public policy, its perspectives and processes and to be able to construct intellectual dialogue on the policy making and policy analysis and evaluation

1. Introduction to Public Policy **08**

1.1 Concept, Meaning and Definitions of Public Policy
1.2 Historical Emergence and Relevance of Public Policy
1.3 Nature and Scope of Public Policy; Process of Policy Making
1.4 Perspectives of Policy Making, Impact of Globalization on Policy making

2. Concepts of Public Policy **08**

2.1 Institutionalism
2.2 Process: Policy as a Political Activity
2.3 Public Choice
2.4 Strategic Planning

3. Policy Implementation and Evaluation **10**

3.1 Concept of Policy Implementation and Methods/Techniques of Policy Implementation
3.2 Concept of Policy Evaluation and Methods/Techniques of Policy Evaluation

4. Economics of Public Policy **12**

4.1 Types of Public Policy Analysis – -Empirical, Normative, Retrospective and Prospective; -Descriptive and Prescriptive
4.2 Actors in Public Policy Analysis --Government, Media, Civil Society -Multinational Agencies, Transnational Agencies, International Donor Agencies
4.3 Constraints in Public Policy Analysis- Economic Constraints, International

Constraints, Social and Cultural Constraints, Political Constraints/Feasibility
4.4 Emerging Trends – Ombudsman, Local Bodies, Whistle Blowers, Citizens Organizations

1 5. Globalization and Public Policy 10
2 5.1 Globalization of Economic Activity
3 5.2 Reforming Institutions – The State, The Market and Public Domain
4 5.3Global Public Policy – Global Trade, Global Financial Markets and Global Crime
5 5.4 Globalization and Interdependence, Organizations and Accountability

Basic Reading List:

1. Anderson James. E., (2010) Public Policy-Making: An Introduction‖, Cengage Learning, 7th Edition
2. Birkland Thomas A., (2005), An Introduction to The Policy Process: Theories, Concepts, And Models of Public Policy Making, Armonk;
3. Chandler. Dye Thomas (2008), Understanding Public Policy, Singapore, Pearson Education
4. Chakrabarti Rajesh, Kaushiki Sanyal (2016) ―Public Policy in India‖ OUP India
5. Mathur Kuldeep (2015) Public Policy and Politics in India: How Institutions Matter‖ OUP India
6. McCool, Daniel C. (ed.), (1995), ―Public Policy Theories, Models, and Concepts: An Anthology‖, NJ: Prentice-Hall
7. Moran Michael, Martin Rein, Robert E. Goodin (2018) ―The Oxford Handbook of Public Policy‖ OUP
8. Saumitra Mohan (2018) ―Indian Policy and Development: A Manual for National Schemes and International Policies‖ McGraw Hill Education

Recommended Books:

1. Ashford, Doug (ed.), (1992), ―History and Context in Comparative Public Policy‖, Ithaca, NY: University of Pittsburgh Press.
2. Bergerson, Peter J. (ed.), (1991), ―Teaching Public Policy: Theory, Research and Practice‖, Westport, RI: Greenwood Press
3. Dahl, Robert and Charles Lindblom, (1976), ―Politics, Economics and Welfare‖, New York, Harper
4. Dror.Y, (1989), ―Public Policy making Re-examined‖, Routledge, 2nd Edition
5. Hill Michael, (2005), The Public Policy Process, Harlow, UK; Pearson Education, 5th Edition
6. Houghton Bardach, Eugene (1977), ―The Implementation Game: What Happens After a Bill Becomes a Law‖, Cambridge, MA: MIT
7. Howlett, Michael, and M. Ramesh, (1995), ―Studying Public Policy: Policy Cycles and Policy Subsystems‖, OUP, Toronto
8. Jones, C.O., (1970), ―An Introduction to the Study of Public Policy‖, Belmont, Prentice - Hall
9. Lerner, D. and H.D.Lasswell (eds.), (1951), ―The Policy Sciences‖, Stanford University Press
10. Lindblom, C.E., and E.J., Woodhouse, (1993), ―The Policy making Process‖, 3rd ed., Prentice - Hall
11. Nachmias, David, (1979), ―Public Policy Evaluation: Approaches and Methods‖, New York: St. Martin's Press
12. Jay M. Shafritz (ed) (1998), ―International Encyclopedia of Public Policy and Administration‖, Westview Press

13. John, Peter, (2012), ―Analysing Public Policy‖, Routledge, 2nd Edition
14. M.E. Sharpe Brewer, Gary D., and Peter de Leon (1983), ―The Foundations of Policy Analysis‖, Homewood, IL.: The Dorsey Press
15. Bellinger William K (2015) ―The Economic Analysis of Public Policy‖ Routledge, 2nd Edition

Recommended Journals

Indian Journal of Public Policy and Administration - Sage
International Journal of Public Policy – Inderscience
Journal of Asian Public Policy –Taylor and Francis Online
Journal of Public Policy – Cambridge
Journal of Public Policy and Administration – Science Publishing Group
Science and Public Policy – Oxford Academic Journals

ELECTIVE COURSE
SEMESTER IV
ECONOMICS OF ENVIRONMENT

Subject Code: 23-EC-224C
Subject: Research Project (4 Credit Course)

Total Lectures = 48

PREAMBLE

Environmental economics has emerged as an important sub-discipline of economics in recent times as humanity struggles to respond to the environmental crisis that challenges the very existence of human beings. Environmental economics focuses on the relationship between human behavior, economic systems as well as mechanisms and environmental quality. It attempts to explore fundamental questions of how the economic system shapes economic incentives in ways that lead to environmental degradation as well as improvement. It focuses on the nature of environment as a social good and the relationship between environment and economic development. Environmental economics explores economic principles, economic theories and various analytical tools of economics for environmental protection, regulation and policy making. This curriculum introduces post graduate students of economics to the field of environmental economics and equips them with analytical tools to comprehend various environmental issues.

Course Objectives:

- To develop an understanding of the economics of environment in the theoretical as well as practical context.
- To discuss various analytical tools to comprehend various environmental issues.

Course Outcome:

- Ability to analyze and evaluate the subject with reference to various aspects of the economics of environment.
- Ability to develop an understanding of the economics of environment and various analytical tools to comprehend environmental issues

1 Introduction 12

1.1 Economics of Environment – Meaning, Nature, Scope and Significance
1.2 Environment as an Economic and a Social Good – Exhaustive and Renewable Common Property Resources
1.3 Economic Development and Environment – Trade-off, Environmental Kuznets Curve & Limits to Growth
1.4 Sustainable Development

2 Environmental Challenges 12

2.1 Environment and Agricultural Development – Technological Change –Use of Water, Fertilizers, Pesticides – Groundwater and Forest Depletion
2.2 Environment and Industrial Development – Pollution, Urbanization
2.3 Global Environmental Issues – Depletion of Ozone Layer, Green House Effect, Global Warming, Climate Change, Loss of Bio-diversity

3 Environmental Regulation – Theories and Analytical Tools 12

3.1 The Economic Theory of Efficient Pollution Control – Marginal Abatement Cost (MAC) & Marginal Environmental Damage (MED)
3.2 Externalities and Market Failures – Coase Theorem

3.3 Environmental Regulation – Command and Control Regulation versus Market Based Instruments – Emission Taxes and Charges, Environmental Taxes and Subsidies, Resolutions through Direct Negotiations, Emissions Trading
3.4 Environmental Value Assessment – Environmental Value, Revealed Preference Method, Stated Preference Method, Cost-Benefit Analysis

4 Climate Change, Environmental Agreements and Policies 12

4.1 Climate Change – Greenhouse Gases, Accumulation of Emissions and Process of Global Warming,
4.2 Kyoto Protocol – Emission Reduction Targets, Kyoto Mechanisms, Limitations of Kyoto Protocol, Carbon Credits
4.3 Paris Agreement – Aims, Nationally Determined Contributions, Effects on Global Temperature, Mechanisms and Criticism
4.4 India‘s Environmental Policy, Environment Protection Laws, National Green Tribunal

Reading List:

1 Baumol, W.J. & Oates, W.E. (1997), The Theory of Environmental Policy, Prentice Hall, Englewood-cliffs
2 Bhattacharya, R. N. (2006), Environmental Economics: An Indian Perspective, Oxford University Press, New Delhi
3 Field, Barry & Field, Martha (2016), Environmental Economics: An Introduction, McGraw-Hill Education, New York.
4 Managi, Shunsuke & Kuriyama, Koichi (2017), Environmental Economics, Routledge, London and New York
5 Singh, Katar & Shishodia, Anil (2010), Environmental Economics: Theory and Applications, Sage Publications, New Delhi
6 Smith, Stephen (2011), Environmental Economics: A Very Short Introduction, Oxford University Press, New York
7 Ulaganathan, Sankar (2006), Environmental Economics, OUP, New Delhi

Recommended Books:

1 Ali, S.A. (1979), Resources for Future Economic Growth, Vikas Publishing House, New Delhi.
2 Charles Peering (1987) Economy and Environment Cambridge University Press, New York.
3 Dorfman, R & N. Dorfman (Eds.) (1977), Economics of the Environment. W.W. Norton, New York.
4 Hanley, Nick; Shogren, Jason & White, Ben (2004), Environmental Economics in Theory and Practice, McMillan India Limited, Delhi

Recommended Journals:

- Journal of Environmental Economics and Management
- Review of Environmental Economics and Policy
- Environmental and Resource Economics
- Ecological Economics
- Annual Review of Resource Economics
- Land Economics

ELECTIVE COURSE
SEMESTER IV
FOREIGN EXCHANGE MARKET

Subject Code: 23-EC-224D
Subject: Research Project (4 Credit Course)
Total Lectures = 48

PREAMBLE

The course makes an attempt to provide an introduction to the foreign exchange market and at the same time provide an understanding of the analytical rigour of the subject. Foreign exchange market is an elective course that covers meaning and concept of foreign exchange market, transactions in foreign exchange market, exchange rate mechanism and risk management of the foreign exchange market. Foreign exchange market will try to clear the concepts regarding the currency market and provides basic knowledge to the students to get engaged in the activities.

Course Objectives:

- To enable understanding of the concepts and transactions in the foreign exchange market such as spot and forward transactions, etc. and the risks associated.
- To enable understanding of the foreign exchange market activities at national and international level.

Course Outcome:

- Ability to analyze and demonstrate knowledge of the foreign exchange market transactions, exchange rate mechanism and exchange risk in economics.
- At the end of the course, the student should be able to evaluate Foreign exchange market concepts, market structure, transactions and its use in real life.

1. Introduction **12**

1.1 Foreign Exchange and Foreign Currency- meaning & Definitions
1.2 Structure of Foreign exchange Market: Market Segments, Market Players,
1.3 Features & Functions of Foreign Exchange Market
1.4 Constituents of Foreign Exchange Market- Central Bank, Commercial Banks, Non-Banks, Individuals & Firms, Speculators, Arbitrageurs, Forex Dealers, Forex Brokers

2. Foreign Exchange Transactions **12**

2.1 Sport and Forward Transactions- Meaning & features
2.2 Financial Derivatives- Swaps, Options and Futures- Meaning
2.3 Hedging- Meaning
2.4 Arbitrage- Meaning

3. Exchange Rate Mechanism **12**

3.1 Exchange Rate Determination: The PPP Theory, the BOP Theory
3.2 Fixed and Flexible Exchange Rates, Official and Free Market Rates
3.4 Relation between Rate of Interest and Foreign Exchange Rate

4. Risk Management **12**

4.1 Nature of Risk in Foreign Exchange Market,
4.2 Foreign Exchange Settlement Exposure and Foreign Exchange Settlement Risk
4.3 Types of Risks in Foreign Exchange Market –
4.3.1 Market Risk, Credit risk, Liquidity Risk, Replacement Risk, Interest Rate Risk
4.3.2 Operational Risk, Systemic Risk, Legal Risk, Country Risk, Sovereign Currency Risk
4.5 Intervention in Foreign Exchange Market
4.6 Role of RBI in Foreign Exchange Market in India; Developments since 1991

Basic Reading:

7. Anthony Steve (2002) _Foreign Exchange in Practice: the New Environment' Palgrave
8. Brandl Michael (2019) _Money, Banking, Financial Markets and Institutions' Cengage Learning
9. Bhole, L. M., Jitendra Mahakud (2017) _Financial Institutions and Markets' Tata McGraw Hill, ND
10. Fabozzi Frank J., Steven V. Mann, Moorad Choudhry (2002) _The Global Money Markets' John Wiley & Sons
11. Frederic Mishkin and Stanley Eakins (2006) _Financial Markets and Institutions', Pearson 5th Edition
12. Frederic Mishkin (2019) _The Economics of Money, Banking and Financial Markets' Pearson Education India, 11th edition
13. Luca Cornelius (2007) _Trading in Global Currency Markets' Penguin, USA
14. Madura Jeff (2014) _Financial Institutions and Markets' Cengage
15. Gupta SL (2017) _Financial Derivatives- Theory, Concept and Problems' PHI Learning
16. Srivastava Rajeev (2014) _Derivatives and Risk Management' OUP

Recommended Readings:

9. Batra G.S. ―Financial Services and Markets‖, New Delhi: Deep and Deep Publications Pvt. Ltd., Latest Ed.
10. Das S. C. (2015) _The Indian Financial System: Markets, Instruments, Institutions, Services and Regulations' PHI Learning
11. Gurusamy S (2004) ―Financial Services and Markets‖, Vijay Nicole Imprints
12. Hull John C, Sankarshan Basu (2018) ―Options, Futures and Other Derivatives‖, Pearson Education, 10th Edition
13. Kothari Rajesh. ―Financial Services in India Concept and Application‖, New Delhi, Sage Publications. 2010.
14. Meir Kohn (2013) _Financial Institutions & Markets; OUP
15. Chandra P. (2017), _Investment Analysis and Portfolio Management', McGraw Hill Education, Fifth Edition

Recommended Journals:

International finance- Wiley Online
Journal of International financial Markets, Institutions and Money- Elsevier
Journal of International Money and Finance

Progressive Education Society's

Modern College Of Arts, Science and Commerce, Ganeshkhind, Pune – 411 016 (Autonomous)

Syllabus for

M. A. II- History

Introduction:

Syllabus for Master of Arts in History second year

M.A. degree will be awarded to students who complete a total of 64 credits in two years taking four courses per semester (4 x 4=16 credits). Each course will be of 4 credits.

- A Student may take three courses (twelve credits) per semester from the parent department and therefore one course of four credits from any other department per semester. In case a student wishes to take all courses from the parent department he/she may also do so.
- All courses are open to all students from outside the department. Eligibility for registering for each course will be decided by the departmental committee.
- For the students doing M.A. degree in History the courses for divided into compulsory and Elective. Every student has to take three core courses and one elective course each semester.

Programme Objectives:

1. Demonstrate Language and Communication Skills (Oral and Written) which can beapplied in personal and professional spheres
2. Display the ability to engage in social interactions across the board
3. Adhere to values and ethics inculcated through the curricula in profession and personallife
4. Develop an understanding about the need and role as citizens and taking up individual responsibilities.
5. Gain knowledge and skills essential for employability

Programme Specific Outcomes (PSOs):

Cultivate Research Qualities among the Students

In depth Study of the Subject from macro to micro level

Inculcate Socio- cultural and Moral Values among the Students

Trace out the roots of Contemporary Society from the Past

Develop over all personality of the students

Examination Pattern:

CIE- 50 Marks- Assignment, Written Exam, Book/ Article Review, PPT & Poster Presentation

ESE- 50 Marks - Written Exam

Suggested internal assessment tools for courses:

The concerned teacher shall announce the units for which internal assessment will take place. A teacher may choose one of the methods given below for the assessment.

1. Library notes
2. Students Seminar
3. Short Quizzes / MCQ Test
4. Home Assignments
5. Tutorials/ Practical
6. Oral test
7. Research Project
8. Group Discussion
9. Open Book Test
10. Study Tour
11. Written Test
12. PPT presentation
13. Field Visit
14. Industrial Visit
15. Viva

Teaching Methodology:

1. Classroom Teaching
2. Guest Lectures
3. Group Discussions
4. Power Point Presentations

5. Visit to Institutions / Industries
6. Research Papers & Projects
7. E-content

Subject List

SEMESTER III

Sr. No.	Subject Type	Subject Code & Title	Credits			Total No.of Lectures
			Theory	Practical	Total	
1	Core Course-1	23-HI231 Cultural History of Maharashtra	4		16	60
2	Core Course-2	23-HI232 Intellectual History of the Modern World	4			60
3	Core Course-3	23-HI233 Economic History of Modern India	4			60
4	Elective Courses	23-HI233 East Asia: Japan (1853 – 2000)	4			60

SEMESTER IV

Sr. No.	Subject Type	Subject Code & Title	Credits			Total No.of Lectures
			Theory	Practical	Total	
1	Core Course-1	23-HI241 Modern Maharashtra: History of Ideas	4		16	60
2	Core Course-2	23-HI242 Debates in Indian Historiography 3.World After World War II (1945 – 2000)	4			60
3	Core Course-3	23-HI243 World After World War II (1945 – 2000)	4			60
4	Elective Courses	23-HI244A History of Modern India (1857 – 1971)	4			60

Syllabus

Subject Code: 23-HI231
Subject: Cultural History of Maharashtra
Total Lectures=60

Unit	Cultural History of Maharashta	No of lecture 60
I	**UnitI:** Defining the term 'Culture' a. Cultural History to Cultural Studies b. Material Culture and Cultural Material c. Critical theories and New Cultural Studies	15
II	**UnitII:** Material Culture of Early Maharashtra a. Ecological, Geological and Archaeological settings of Early Maharashtra b. Cultural fusion-Caves of Ajanta, Ellora, Panhale Kaji, Junnar and Karle Bhaje c. Satavahana's Material Culture	15
III	**Unit III:** Maharashtra as a place of cultural fusion a. Indo-Islamic Contacts and Mutual Cultural Impacts b. Religious and Philosophic cults- Shakta, Nath, Mahanubhav, Varkari, Sufi, Ramdasi and Datta c. Marathi Muslim, Khristi and Bene Israeli culture	15
IV	**Unit** Marathi cultural spheres a. Modernity and Cultural Production-Printing, Public sphere and Literature in Princely States (Under Sharphoji Raje Bhonsle, Sayajirao Gaikwad, Shahu Maharaj etc.) b. New Cultural Narratives-Satyashodhak, feminist and Dalit publics c. Marathi Natak d. Bombay Film industry	15

Reference books:

1Ballhatchet, Kenneth, Social Policy and Social Change in Western India: 1817-1830, Oxford University Press, London, 1961.
2. Bhagvat, A.K., Maharashtra: A Profile, Pune, 1977.

3. Joshi, S.N., Shivaji and Facets of Marathi Culture, Sage Publications India.
4. Mate, M.S., Maratha Architecture, University of Pune, Pune, 1959

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Subject Code 23-HI232

Subject : Intellectual History of the Modern World (4 Credit)

Total Lectures = 60

Unit	Intellectual History of the Modern World	No of lectures 60
1	**Unit I.** Humanism and Renaissance a. Philosophy b. Art and Architecture c. Literature	**10**
II	**Unit II.** Protestant Reformation and Counter-reformation a. Lutheranism b. Calvinism c. Anglicanism	**10**
III	**Unit III.** Revolution in Scientific thinking a. Copernican Revolution b. Galilean Revolution c. Newtonian Revolution	**10**
IV	**Unit IV.** Enlightenment and the French Revolution a. Liberty b. Equality c. Fraternity d. Rational Modernity	**10**
V	**Post-enlightenment Ideas** **a. Liberalism** **b. Capitalism** **c. Colonialism** **d. Nationalism** **e. Marxism**	**10**
VI	**Twentieth Century Ideas** **a. Democracy** **b .Totalitarianism** **c. Existentialism** **d. Feminism** **e. Post-modernism**	**10**

Reference Books :

1. Anderson, P, Lineages of the Absolutist State
2. Ashley (ed.), M., The Limits of Enlightened Despotism: A History of Europe (1648-1815), Prentice- Hall, 1973.

3. Barry, Peter, Beginning Theory: An introduction to literary and cultural theory, Manchester
4. Civilization, 2 vols., Macmillan, 1986
5. Craig, A.M., Graham, W.A., Kagan, D., Ozment, S., and Turner, F.M., The Heritage of World ed., 1948, Eurasia Publishing House Pvt. Ltd., New Delhi (Indian Ed.), 1994 (7th Indian Reprint)
6. Hause, S. and Maltby, W., The Essentials of Western Civilization, Wadsworth, USA,2001.
7
7. Modell, S., A History of the Western World, 2 vols., Prentice-Hall Inc., New Jersey, 1974
8. New, J.F., The Renaissance and the Reformation: A Short History, New York, 1969. Parry, J.H., The Age of Renaissance, London,1963.
9. Phukan, Meenaxi, Rise of the Modern West, Macmillan India Ltd., New Delhi, 1998
10. Russell, Bertrand, History of Western Philosophy, Routledge, London, 2000.
11. Smith, A.G.R., Science and Society in the Sixteenth and Seventeenth Centuries, London, 1972.
12. Smith, B.G., Changing Lives: Women in European History since 1700, Lexington, Mass., 1989.
13. Swain, J.E., A History of World Civilization, The McGraw Hill Book Company Inc., 2nd University Press, Manchester and New York, 1995.

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Subject Code: 23-HI233

Subject: Economic History of Modern India (4 Credit Course)

Total Lectures=60

Sr. No	Economic History of Modern India	No of lectures 60
I	Unit I: European economic interests in India and colonial economy a) Mercantilist phase b) Free trade phase c) Financial imperialism phase	**15**
II	Unit II: Agrarian settlements a) Permanent settlement b) Ryotwari system c) Mahalwari system d) Commercialization of agriculture and its effects	**15**
III	Unit III: Industry a) De-industrialization b) Development of modern industry: Textile, Mining, Iron and Steel, Shipping c) Railways d) Labour Issues and Factory Acts 1894-1942	**15**
IV	Unit IV: Trade Internal and foreign Fiscal System Banking	**15**

Reference Books :

1. Bagchi, A.K., Private Investment in India, 1900-1939, Cambridge, 1972.
2. Charlesworth, Neil, British Rule and the Indian Economy 1880-1914, London, 1983.
3. Chandra Bipan, The Rise and Growth of Economic Nationalism in Indian : Economic
4. Dharma Kumar (ed.), The Cambridge Economic History of India. Vol. II. (1750 to 1970), Cambridge, 1982.
5. Gadgil D.R., The Industrial Evolution of India in Recent Times: 1860-1939, OUP, Dehli, Fifth edition, Fifth impression, 1982.
6. Policies of Indian National Leadership,1880-1905, Peoples Publishing House, New Delhi, 1991 (reprint).
7. Ray, Rajat K., Industrialization in India: Growth and Conflict in the Private Corporate
8. Roy, Tirthankar, The Economic History of India :1857-1947,OUP,New Delhi,2002.
9. Tomlinson, B.R., The Economy of Modern India, 1860-1970, Cambridge, 1993

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Subject Code: 23-HI234A

Subject : East Asia: Japan (1853-2000) (4 Credit Course)

Total Lectures=60

Units	East Asia: Japan (1853-2000)	No of lectures 60
1	1. Feudal Japan 2. Meiji Restoration	15
2	3. Modernization and Rise of Japan a) Sino-Japanese War b) Anglo-Japan Pact c) Russo-Japanese War d) Japan and World War I e) Washington Conference	15
3	5. Decline of Constitutionalism	10
4	6. Militarism, World War II and US Occupation	10
5	7. Economic Resurgence of Japan and Foreign Policy	10

Reference Books :

1. Clyde and Beers
2. Hall , D.G.E. – History of Southeast Asia.
3. Pannikkar, K.M. – Asia and Western Dominance.
4. R. Layman- Japan's last bid for victory: The Invasion of India 1944
5. R.H.P. Mason- History of Japan
6. Reischauer, E.O. – Japan
7. Totman Conard- A History of Japan
8. https://vishwakosh.marathi.gov.in/18944/

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Subject Code: 23-HI234B

Subject: Social & Religious Reform Movements in South India

(4 Credit Course)

Total Lectures=60

Unit	Social & Religious Reform Movements in South India	No. of lectures 60
I	A brief survey of socio-religious reform movements in 19th century India	15
II	2. Movement of Veeresalingam Pantulu and Alluri Sitaramarajulu in Andhra Pradesh	15
III	3. Social Legislation in Mysore	15
IV	4. Sri Narayana Movement in Kerala Non-Brahmin Movement in Tamilnadu a) EV. Ramaswamy Naicker (Periyar) b) Justice Party c) Annadurai	15

Reference Books

1. BR. Sunthankar, Maharashtra 1858-1920.
2. D. Triveni, History of Modern Andhra SBD Enterprises, Delhi, 1986.
3. Joseph Mathew, Ideology, Protest and Social Mobility: Case Study of Mahars And Pulayes. (Inter India Publication, New Delhi 1980.
4. P. N. Chopra, Ed. Social and Cultural History of India: State Series, Sterling Publishers, New Delhi, 1978,
5. S. Gopalkrishnan, Political Movement in South India, 1914-1929, New Era Publication, Madras, 1981.
6. Sumit Sarkar, Modern India, 1885-1947.
7. Swapna Swame, Dalit Movement in South India, B.R. World Books, New Delhi, 2004,

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SEMESTER IV

Subject Code: 23-HI241

Subject: Modern Maharashtra: A History of Ideas (1818-1960) (4 credit course)
Total Lectures= 60

Units	A History of Ideas (1818-1960)	No of lectures 60
1	**Unit 1.** Critical Reappraisal of Religions a. Missionary b. Prarthana Samaj, Satyashodhak Samaj, Arya Samaj c. Reformist Critiques of Hinduism, Islam, Jain and the Parsee Religion	**15**
2	**Unit II.** Social Thought a. Caste Critiques of Mukta Salave, Jyotirao Phule,Shahu Maharaj, V. R. Shinde, V.D. Savarkar, B. R. Ambedkar. b. Critiques of Patriarchy-Tarabai Shinde, Jyotirao Phule, Rukhmabai, B.R. Ambedkar c. Critiques of conversion - Shripati Sheshadri, Pandita Ramabai and Mass Conversion to Buddhism 1956.	**15**
3	**Unit III.** Economic Thought a. Char June Arthashastreeya Granth b. Lokhitwadi, Nowroji, Ranade, Tilak and Economic Nationalism c. Satyashodhak Thought, Gandhian Thought, Industrialists' Plans d. Panjabrao Deshmukh, B. R. Ambedkar and Nehruvian Concepts of economic progress	**10**
4	**Unit IV.** Cultural Thought a. Cultural Nationalism-Chiplunkar, Chapekar, Jinnah, Tilak, Golvalkar, Savarkar. b. Alternative Cultural Thoughts-Mukundrao Patil, Ganpati Maharaj Ajaat, Prabodhankar Thakre. c. Critical Ideas in Literature and Popular Culture- Satyashodhaki Jalse, Marathi Farces and Plays, Tamasha, Rashtreeya Kirtan, and Mele, Film Industry, Literature. d. Rationality and knowledge Making- Agarkar to Karve, Deccan College to BARC	**10**
5	Unit V Political Thought a. Reformist Legislation- Education, Press, women, caste. b. Nationalism, Electoral Politics c. Politics of representation, Separate Electorates d. Politics of Linguistic and Cultural Identity	10

Reference Books:

1. Ballhatchet, Kenneth, Social Policy and Social Change in Western India: 1817-1830, Oxford University Press, London, 1961.
2. Kumar, Ravinder, Western India in the Nineteenth Century, Routledge and Kegan Paul, London, 1968.
3. Lederle, Matthew, Philosophical Trends in Modern Maharashtra, Popular Prakashan, Bombay, 1976. Phadke
4. Paranjpe, Shrikant, Dixit, Raja and Das, C.R. (ed.), Western India: History, Society and Culture, ItihasShikshakMahamandal, Maharashtra, Pune, 1997.
5. Satyanarayana, K. and Susie Tharu, The Exercise of Freedom, Navayana, 2013.
6. Stokes, Eric, English Utilitarians in India, Oxford University Press, New Delhi, 1989
7. Zealliot, Elenor, Ambedkar's World, Navayana Publications, 2013.
8. Ganachari A. G., Nationalism and Social Reform in Colonial Situation, Kalpaz Publication, New Delhi, 2005.
9. Desai A. R., Socail Background of Indian Nationalism, Popular Prakashan, Bombay, 2010.
10. Kumbhojkar S.(Ed.), 19th Century Maharashtra: A Reassesment, Cambridge Scholar Publishing, 2009.

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Subject Code: 23-HI242

Subject: Debates in Indian Historiography (4 Credit Course)

Total Lectures = 60

Units	Debates in Indian Historiography	No of lectures 60
1	Unit I: Why study Debates in Indian Historiography? a. Orientalism and epistemic violence b. Nationalist Response to Colonial Historiography c. Marxist and Subaltern Interpretations	10
2	Unit II: Harappa Civilisation a. Naming Debate – Indus, Harappa or Sindhu-Saraswati? b. Debate about the Vedic Horse in Harappa c. Debate about the decline	10
3	Unit III: The Aryan Debate a. Aryan Invasion or Migration? b. Out of India Thesis c. Aryan Race Fallacy	10
4	Unit IV: Debate on Patriarchy a. Uma Chakravarti, b. Kumkum Sangari.	10
5	Urban Decay and Feudalism Debate a. Urban Decay or Urban Shift? b. Was there Feudalism in Indian History? c. How Feudal was Indian Feudalism?	10
6	Debates about the Indian National Movement a. Tara Chand and R.C. Mujumdar b. Bipan Chandra and Sumit Sarkar	10

References:

Alam, M., and Subramanyam, S. (ed.), The Mughal State, OUP, 2000.

2. Alavi, Seema, The Eighteenth Century in India, OUP, New Delhi, 2002.

3. Aloysius, G. Nationalism Without a Nation,

4. Habib, Irfan, Essays in Indian History : Towards a Marxist Perspective, Tulika, New Delhi, 1995.

5. Hilton, Rodney, etc., The Transition from Feudalism to Capitalism.

6. Gadgil D.R., The Industrial Evolution of India in Recent Times: 1860-1939, OUP, Dehli, Fifth edition, Fifth impression, 1982.

7. Kosambi, D.D., Culture and Civilization of Ancient India in Historical Outline, Vikas, 1981.

8. Kosambi, D.D., Myth and Reality

9. Kulke, H. (ed.) The State in India, 1000-1700, OUP, 1998.

10. Marshall, P.J. (ed.) The Eighteenth Century in India – Evolution or Revolution?, OUP, 2002.

11. Mukhia, H., Perspectives on Medieval India, Delhi, 1994.

12. Said, Edward, Orientalism, Penguin, 1978.

13. Shah, K.K. and MeherjyotiSangle (ed.), Historiography: Past and Present, Rawat Publishers, Jaipur,2005.

14. Sharma, R.S., Aspects of Ancient Indian Political Ideas and Institutions, Manohar, reprint, 1999. Sharma, R. S., Indian Feudalism, Calcutta, 1965.

15. Sharma, R.S., Urban Decay in India, MunshiramManoharlal, Delhi.

16. Thapar, R., Ancient Indian Social History: Some Interpretations, Orient Longman, reprint, 1996. Thapar, R., Early India, Penguin, 2003.

17. Thapar Romila (ed.) The Aryan Debate, National Book Trust.

Marathi

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Subject Code: 23-HI243

Subject: World after World War II (1945-2000) (4 Credit Course)

Total Lectures = 60

Units	World after World War II (1945-2000)	No of lectures 60
1	Unit I. Cold War: Origin and Nature, Issues a) Berlin Crisis (1948) b) Korean War c) Cuban Crisis d) Military Alliances: NATO, CENTO, SEATO, ANZUS, Warsaw Pact	10
2	Unit II. Non-Aligned movement	10
3	Unit III. Issues in West Asia a) Oil Politics b) Arab-Israel conflicts c) Palestine issue d) Suez Crisis e) Kuwait – Iraq War and its Impact	10
4	Unit IV Developments in South-east Asia a) Vietnam War	10
5	Unit V. Towards a Uni-polar World (From Cold War to Uni-Polar World) 19 a) Reunification of Germany b) Disintegration of the USSR and its consequences c) Geopoltics, Terrorism and Arm Industries	10
6	Unit VI : Globalisation and its Impact a) European Union b) BRIC	10

Reference Books :

1. Buzan Barry and Richard Little, International Systems in World History, OUP, 2000.
2. Cornwall R.D., World History in 20th Century, Longman, London, 1976.

3. Halle, Cold War a History. Knapp Wilfrid , A History of War and Peace, Oxford , 1967.

4. Langsam W.C., The World Since 1919.

5. Nanda B.R. (ed.) , Indian Foreign Policy, Nehru Era.

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Subject Code: 23-HI243

Subject: History of Modern India (4 Credit Course)

Total Lectures = 60

Units	History of Modern India	No of lectures 60
1	Unit I Key concepts in Modern India a. Capitalism b. Colonialism c. Modernity d. Rule of Law e. Individualism f. Utilitarianism g. Liberalism h. Indian Renaissance i. Indian nationalism j. Socialism k. Communalism l. Leftist Thought	10
2	Unit II. Indian Revolutionary Movement a. In India b. In foreign countries	10
3	Unit III. Issues and Movements in Modern India a. National Movement: a brief survey b. Land issues and Peasant movements up to 1920 c. Labour movements d. Tribal movements e. Dalit movement f. Gender Issues	10
4	Unit IV Towards Freedom: 1920-1947 a. Gandhian Movement b. Indian National Army c. Naval Mutiny: 1946	10
5	Unit V. Attainment of Independence a. Transfer of Power b. Merger of States	10
6	Unit VI : India after Independence a. Salient features of Indian Constitution b. Economic Development i. Mixed Economy ii. Five Year Plans c. Foreign Policy 22 i. Non-aligned Movement ii. India-Pakistan Relations, 1947-1971 iii. India-China War, 1962.	10

Reading list

1.Chandra, Bipan, Essays on Contemporary India, Har-Anand Publications, New Delhi,1993.

2. Chandra, Bipan, Mukherjee, Mridula, Mukherjee, Aditya, Panikkar, K.N. and Mahajan, Sucheta, India's Struggle for Independence, Penguin Books (India) Ltd., 1990.

3. Chandra, Bipan, Mukherjee, Mridula, and Mukherjee, Aditya, India After Independence. Penguin Books (India) Ltd., New Delhi, 2000.

4. Desai, A.R., Social Background of Indian Nationalism, Popular Prakashan, Bombay,1984.

5. Nanda, B.R. (ed.), Indian Foreign Policy: Nehru Years, New Delhi.

6. Sarkar, Sumit, Modern India: 1885-1947, Macmillan India Ltd., Madras, 1986.

7. Tara Chand, History of Freedom Movement, Vol. I – IV, Publications Division, Ministry of Information and Broadcasting, Government of India, New Delhi, 1983.

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Subject Code: 23-HI244B

Subject: Pune Through the Ages (4 Credit Course)

Total Lectures = 60

Units	Pune Through the Ages	No of lectures 60
1	Unit I. Early Pune a. Antiquity and geography of Pune b. Archaeological – Pataleshwar, Shaikh Salla Durgah c. Epigraphical- Prabhavati Gupta and Nagav inscription	15
2	Unit II. Kasbe Pune a. Pune under the DakhaniSultanats b. Pune Under Ch.Shivaji c. Fairs, Festivals and Culture	15
3	Unit III. Urban Pune a. Urbanisation of Pune: Centre of political power b. Social and Economic Compositions c. Urban Growth: Buildings and monuments	10
4	Unit IV Colonial Pune a. Elphinstein and Policy of Pacification 24 b. Reform movemenst, Literature and culture c. Military establishments d. Institutionalisation of public life	10
5	Unit V. Post Colonial Pune a. Establishment of University of Pune b. Industrialisation c. Emergence of Suburbs d. Cosmopolitan Pune	10

Readings:

1. DiddeeJaymala and Gupta Samita, Pune : Queen of the Deccan, Elephant Design Pvt, Ltd, Pune, 2000.
2. Gadgil D.R., Poona: A Socio-economic survey, 2 parts, Gokahale Institute of Politics and Economics, Pune, 1945/ 1952.
3. Gokahle B.G., Poona in the Eighteenth Century: An Urban History, OUP, Delhi , 1998.
4. Kosambi Meera, Bombay and Poona: A Socio-ecological study to two Indian cities: 1650-1900, Stockholm, 1980.
5. Mahajan Dr. S.G., Pune city: Its History, Growth and Development (758 to 1998 A.D.) : A Bibliography of Information Sources , ManasanmanPrakashan , Pune , 2000.

6. Poona District Gazetters, Bombay State Gazatteer, Poona District, Vol. XX, District series, Govt, Central Press , Bombay, 1954.
7. Poona look and outlook
8. D. Parsanis, Poona in bygones days

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Progressive Education Society's

Modern College Of Arts, Science and Commerce, Ganeshkhind, Pune – 411 016 (Autonomous)

Syllabus for

M. A. Psychology Part II

Introduction:

MA Psychology Part II has 2 specializations, Clinical Psychology and Industrial and Organisational Psychology.

Programme Objectives:

1: Know the etiology of mental disorder

2: Identify the classification of the symptoms of mental disorder

3: Understand the causes, criteria of abnormal behavior

4: Know an overview of the key concepts, topics and issues in personnel psychology

5: Understand the potential characteristics of employee

6: Identify the effective development and training programs

7: Examine the process of performance evaluation

Programme Specific Outcomes (PSOs):

1. To explain what is psycho diagnostics and its basics

2. To enable to discuss and assess the behavioural and clinical problems of the clients and making diagnosis, and estimating prognosis

3. To enable oneself in writing psychological report

4. To get acquainted with different clinical measures apart from paper pencil testing

5. To acquaint the students with the nature of Organizational Behaviour (OB)

6. To understand how behaviour of an individual is shaped by various factors in Indian culture, society, and organization.

7. To equip the student with the knowledge of important OB processes such as Leadership and motivation

Examination Pattern:

There will be equal weightage for Internal and External exam. 50:50.

Suggested internal assessment tools for courses:

The concerned teacher shall announce the units for which internal assessment will take place. A teacher may choose one of the methods given below for the assessment.

1. Library notes
2. Students Seminar
3. Short Quizzes / MCQ Test
4. Home Assignments
5. Tutorials/ Practical
6. Oral test
7. Group Discussion
8. Open Book Test
9. Written Test
10. PPT presentation

Teaching Methodology:

1. Classroom Teaching
2. Guest Lectures
3. Group Discussions
4. Power Point Presentations
5. Research Papers & Projects
6. E-content

Subject List

SEMESTER III

Sr. No.	Subject Type	Subject Code & Title	Total No. of Lectures		
			Theory	Total	
1		**Advanced Social Psychology** 22-PS 231	4	16	36
2		Psychopathology-1 22-PS 232	4		36
3		Psycho-diagnostics 22-PS 233	4		36
4		Project-Clinical Base 22-PS 234	4		36
5		Personnel Psychology 22-PS 235	4		36
6		Organizational Behaviour 22-PS 236	4		36

SEMESTER IV

Sr. No.	Subject Type	Subject Code & Title	Total No. of Lectures		
			Theory	Total	
1		**Counselling: Skills and Area** 22-PS 241	4	16	36
2		Psychopathology-2 22-PS 242	4		36
3		Psychotherapies 22-PS 243			

4		Project- 22-PS 244	4		36
5		Human Resource Management 22-PS 245	4		36
6		Organisational Development 22-PS 246	4		36

Syllabus

Subject Code: 22-PS 231

Subject: Advanced Social Psychology (4 Credit)

Total Lectures = 36

Unit		No of lectures
1	**Culture and Cultural Psychology** 1.1 What is Culture and Cultural Psychology? 1.2 Culture ,Self and Personality 1.3 Culture and Social Behavior 1.4 Culture, Cognition and Morality 1.5 Culture, Emotions and Mental Health	**12**

II	**From Culture to Identity** 2.1Stereotypes and Biases 2.2 Stigma and Stereotype threats 2.3 Intergroup contact, conflict, cooperation and collaboration 2.4 Biculturalism, Multiculturalism and Intersectionality 2.5 Bridging Political Divides	**12**
III	**Cross Cultural Psychology (12)** 3.1 What is Cross Cultural Psychology 3.2 Enculturation and Acculturation 3.3 Comparisons across cultures: similarities and differences 3.4 Theoretical Perspectives	**11**
IV	**Applications of Cultural and Cross Cultural Psychology (12)** 4.1 Multicultural Family Therapy-Basic Principles 4.2 Conducting research in multicultural and cross cultural settings 4.3 Counseling and Intervention for immigrants-Basic Principles	**11**

Reference Books:

1. Handbook of Culture and Psychology (2019) Eds Matsumoto and Hwang, OUP
2. Handbook of Culture and Psychology (2020) Eds Cohen and Kitayama Guilford Press

Subject Code: 22-PS 232

Subject: PSYCHOPATHOLOGY-1 **(4 Credit Course)**

Total Lectures =

Sr. No	Topic	Lectures
I	**Psychopathology: An Overview** 1.1. What do we mean by abnormality- Indicators 1.2. Definition of mental disorder 1.3. Historical and contemporary views 1.4. Diagnosing Psychological Disorders: DSM-5 and ICD-11	**12**
II	**Panic, Anxiety, Obsessions Disorders** 2.1. Panic disorder, phobia- causes, symptoms and treatment 2.2. Anxiety disorders - causes, symptoms and treatment 2.3. Obsessive-compulsive and related disorders 2.4. DSM-5: Criteria for Panic, Anxiety, Obsessions Disorders	**12**
III	**Mood Disorders and Suicide** 3.1. Mood disorders- structure and types, depression, mania- causes, treatment 3.2. Depressive Disorders- causes, symptoms and treatment 3.3. Suicide- types, causes, symptoms and treatment 3.4. DSM-5 criteria for depressive disorders	**11**
IV	**Eating Disorders and Substance Related Disorders** 4.1. Anorexia Nervosa, Bulimia Nervosa- causes, symptoms and treatment 4.2. Obesity- Risk and Causal factors 4.3. Alcohol related disorders, Drug abuse- Treatment 4.4. DSM-5 criteria for eating disorders and alcohol use disorders	**11**

Reference Books :

- Barlow, David H.; Durand, Mark V.; Hofmann, Stefan G. (2018). Abnormal Psychology: An Integrative Approach (8th Edn). Cengage Learning
- Butcher, James N.; Hooley, Jill M.; Mineka Susan (2020). Abnormal Psychology (17th Edn.). Pearson
- Comer, Ronald J; Comer, Jonathan S. (2018). Abnormal Psychology (10th edn). Worth Publishers
- Dozois, David J. A. (2019). Abnormal Psychology: P E R S P E C T I V E S (6th Edn). Pearson
- DSM-5 (2013) Diagnostic and Statistical Manual of Mental Disorders (5th Edn). American Psychiatric Association
- Hooley, Jill M.; Butcher, James N.; Nock, Matthew K.; Mineka Susan (2017). Abnormal Psychology (17th Edn). Pearson ICD-11 (2018). New International Classification of Diseases (ICD-11). The World Health Organization (WHO). Geneva
- Kearney, Christopher A.; Trull, Timothy J. (2018). Abnormal Psychology & Life: A Dimensional Approach (3rd Edn). Cengage Learning
- Morrison, James (2014). DSM-5® Made Easy: The Clinician's Guide to Diagnosis. THE GUILFORD PRESS
- Nevid, Jeffrey S.; Rathus Spence A.; Greene Beverly (2018). Abnormal Psychology: In a Changing World (10th edn). Pearson
- Nolen-Hoeksema, Susan (2013). Abnormal Psychology (6th Edn). McGraw-Hill
- Sadak, B. J.; Sadok V. A.; Ruiz Petro (2015). KAPLAN & SADOCK'S Synopsis Of Psychiatry: Behavioural Sciences/Clinical Psychiatry (11th Edn). Wolters Kluwer
- Sue David, Sue Derald Wing, Sue Diane, Sue Stanley (2016). Understanding Abnormal Behavior (11th Edn). Wadsworth Publishing

Subject Code: 22-PS 233

Subject: PSYCHO-DIAGNOSTICS

Total Lectures =

Unit	Topic	No of lecture

I	**Basics of Psycho diagnostics in Psychological Setting** 1.1 Basic principles of psychodiagnostics 1.2 Difference between psychometrics and psychodiagnostics and its relationship with treatment 1.3 Data gathering, clinical judgment and data synthesis 1.4 Assessment: Principles and techniques, explaining assessment results	12
II	**Stress and Coping** **Use of various tests in different setting** 2.1 Contexts of different setting: General medical setting, psychiatric, educational, & legal setting 2.2 Intellectual functioning: Wechsler Adult Intelligence Scale-III, Stanford-Binet (4th ed.) Kaufman Assessment Battery for Children, Million Adolescent Personality Inventory or Personality Inventory for Children, Beck Depression Inventory, Wechsler Memory Scale-III, 2.3 Emotional functioning and level of psychopathology: General patterns and severity Symptom Checklist 90-Revised, Brief Symptom Inventory, Vineland Adaptive Behaviour Scale, AAMD Adaptive Behaviour Scale 2.4 Career Assessment Inventory, Kuder Occupational Interest Survey, Dyadic Adjustment Scale, Family Environment Scale, Taylor Johnson Temperament Analysis	11
III	**Psychological testing in clinical and severe disorders** 3.1 Mental Status Examination: Mini-Mental Status Examination (MMSE) & Cognitive Functioning & its criteria: Structured Clinical Interview for DSM 5, Diagnostic Interview Schedule, Structured Interview for DSM 5 Personality Disorders, Diagnostic Interview for Children and Adolescents	11

	3.2 Content of thought Processes: Thematic Apperception Test & Children's Apperception, Test & Sentence completion tests 3.3 Personality & other clinical measures: MMPI- I, 2, & RF, NEO-PI-R, Million Clinical Multiaxial Inventory-III, Hamilton Rating Scale for Depression & State-Trait Anxiety Inventory, STAXI - 2 3.4 California Verbal Learning Test, Bender Visual Motor Gestalt Test, Draw a person Intellectual ability test for children	
IV	**Clinical Report** 4.1 Behavioural observation, Synthesis of information from different sources, context of clinical assessment 4.2 Clinical analysis questionnaire, IPDE 4.3 Psychological clinic, formats of report writing, Prognosis and risk 4.4 Behavioural assessment: Cognitive behavioural assessment, psychophysiological assessment (GSR, EEG, Biofeedback)	11

Reference books:

- Anastasi, A., & Urbina, S. (2005). Psychological Testing. 7th edn. Pearson Education:
- Butcher, James N.; Hooley, Jill M.; Mineka Susan (2020). Abnormal Psychology (17th Edn.). Pearson
- Ettinger, Alan B.; Weisbrot, Deborah M.; Gallimore, Casey E. (2019). Synopsis of Neurology, Psychiatry, and Related Systemic Disorders. Cambridge University Press
- Gary Groth- Marnat (2003). Handbook of Psychological Assessment , 4th edition: John Wiley & Sons, Inc.
- Irving B. Weiner & Roger L. Greene (2008). Handbook of Personality Assessment: John Wiley & Sons, Inc.,
- Kaplan, H. I., Sadock, B. J., & Grebb, J. A. (1994). Kaplan and Sadock's synopsis of psychiatry: Behavioral sciences, clinical psychiatry (7th ed.). B. I. Waverly Pvt. Ltd.
- Kapur, M. (1995). Mental health of Indian children. Sage.
- Kellerman, H. & Burry, A.(1981). Handbook of diagnostic testing: Personality analysis and report writing. Grune & Stratton

- Lezak, M.D. (1995). Neuropsychological assessment. Oxford University Press.
- Rychlak, F. (1973). Introduction to personality and psychopathology. Houghton Miffin.
- Sundberg, N.D., Winebarger, A.A.& Taplin, J.R. (2002). Clinical psychology: Evolving theory, practice and research.: Prentice-Hall.
- Wolberg Lewis R., The technique of Psychotherapy 4th edition : International Psychotherapy Institute E-Books, www.freepsychotherapybooks.org
- Wolman, B.B. (1975) . Handbook of clinical psychology. McGraw-Hill.

Subject Code: 22-PS 234

Subject: RESEARCH PROJECT

Total Lectures:

	GENERAL INSTRUCTIONS: 1. Each batch of project should consist of maximum 8 students and a separate batch will be formed if this number exceeds even by one. 2. Workload for each batch will be equivalent to 8 lecture periods. 3. Students should select a problem pertinent to their specialization area in consultation with concerned faculty. 4. Sample size should be minimum 30 in each group, e.g.: Normal and maladapted. 5. Project report should be written in APA format followed with plagiarism's guidelines provided by SPPU. 6. Eligibility for the Project Examination is subject to Certification of Project by the teacher-in-charge and HOD.	
	a. DISSERTATION SUBMISSION The student will submit a bound hard copy of the dissertation to the Department by the end of the semester, along with a soft copy on a CD/DVD/Pen drive. The final dissertation will have a word limit of 5000-	

	8000 words and will be typed in one and a half spacing on one side of the paper. The APA style shall be followed for the writing of dissertation.	
	PROJECT ASSESSMENT– 100 MARKS Project assessment will be based on presentation of the project before the internal and external examiners. There will be 50 marks for continuous (internal) assessment and 50 marks for End of Semester Examination (ESE). a) Continuous (Internal) Assessment of project-50 marks 1. Term Paper 1: Introduction, Definitions of main concepts, rationale, and significance of the topic of research project -15 marks 2. Term Paper 2: Review of literature-15 marks 3. Presentation of project report in the classroom -20 marks (Expert teacher appointed by HOD will give marks to each student)	

Subject Code: 22-PS 235

Subject: PERSONNEL PSYCHOLOGY

Total Lectures = 24

Sr. No	Topic	Lectures
I	**PERSONNEL PSYCHOLOGY: INTRODUCTION** 1.1. Overview of personnel psychology - Cascio 1.2. Staffing: Screening and selection methods - cascio 1.3. Job analysis: meaning, purpose and methods - amodt 1.4. Job evaluation: determining internal and external pay equity, sex and race equity am	**8**
II	**COMPETENCY MAPPING** 2.1. The art of finding talent, Competency mapping: Introduction, necessity - sanghi 2.2. Competency models and related issues 2.3. Competency framework formation 2.4. Writing and assessing competencies	**8**
III	EMPLOYEE DEVELOPMENT 3.1. Employee training: Characteristics of Effective Training Practice - cascio 3.2. Designing training programs 3.3. Learning enhancement techniques 3.4. Assessment methods	**8**
4	PERFORMANCE MANAGEMENT 4.1. Managing for maximum performance. – cascio 4.2. Methods of Performance-Appraisal 4.3. Evaluation of performance: Factors - 4.4. Proactive career management	

Reference Books:

- Aamodt, Michael G. (2016). Industrial/Organizational Psychology: An Applied Approach (8th Edn). Cengage Learning
- Bisen Vikram and Priya (2010). Industrial Psychology. New Age International (P) Limited, Publishers
- Cascio, Wayne F. (2010).Managing Human Resources: Productivity, Quality of Work Life, Profits (8th Edn). McGraw-Hill
- Cascio, Wayne F.; Aguinis Herman (2014). Applied Psychology in Human Resource Management (7th Edn). Pearson
- DeCenzo, David A.; Robbins, Stephen P.; Verhulst, Susan L.(2016). Fundamentals of Human Resource Management (12th Edn). Wiley
- Sanghi Seema (2016). The handbook of competency mapping: Understanding, designing and implementing competency models in organizations (3rd Edn). Sage

Subject Code: 22-PS 236

Subject : ORGANIZATIONAL BEHAVIOUR

Total Lectures=30

Units	Topic	Lectures (30)
1	**FUNDAMENTALS OF ORGANIZATIONAL BEHAVIOUR** 1.1. Nature of Organizational Behaviour; History of OB in India, The Indian mind set, Models of OB; Autocratic, Custodial, Supportive, Collegial, System 1.2. Trends & Challenges of OB: Globalization, Diversity,	4

	Ethics 1.3. Culture: Dimensions according to Hofstede, Trompenaar, Pareek (OCTAPACE). 1.4. Organization Structure and Design: Classical and Contemporary Designs (Matrix, Vertical, Horizontal, Network). •	
2	**MOTIVATION IN ORGANIZATION** 2.1. Motivating by Meeting Needs and Managerial Applications: Maslow, Adlerfer, Herzberg, and McClelland. 2.2. Motivating by Setting Goals: Goal setting theory and setting effective performance goals. 2.3. Motivating by Being Fair: Distributive justice, Equity theory, procedural justice, interactional justice, and organizational justice. 2.4. Motivating by Altering Expectations and by Structuring Jobs: Quality of Work Life model, job enrichment and job enlargement, Hackman & Oldham's job characteristics model. Motivation and well-being, Understanding people's needs and using this data for motivating others	**6**
3	**LEADERSHIP AND EMPOWERMENT** 3.1. Behavioral Approach to Leadership Style. 3.2. Contingency Approach to Leadership: Fiedler's contingency model; Hersey & Blanchard's situational leadership model; path goal model; and Vroom's decision making model. 3.3. Emerging Approaches to Leadership: Transactional leadership, transformational leadership; substitutes and enhancers for leadership; and self & super leadership. 3.4. Empowerment and Participation: Meaning, process, and programs. •	**8**

4	**COMMUNICATION, CONFLICT AND STRESS** 4.1. Organizational Communication: Meaning, functions, directions types (formal-informal, electronic) and techniques for improving communication skills 4.2. Conflict: Nature, Levels, Sources, Effects; Strategies for conflict resolution; Work-family conflict 4.3. Work stress: Sources, consequences, managing stress (individual and organizational approaches). 4.4. Employees Counselling. •	**7**

Reference Books :

- Greenberg, J. and Baron R.A. (2005) Behavior in organizations. N.D.: Pearson Edu.
- Gupta, R. K. (1991). Employees and organization in Indian context: The need for moving beyond American and Japanese models. Economic and Political Weekly, 26(21), 68-76.
- Hersey, P.& Blanchard ,K.H. (1982) . Management of organizational behaviour utilizing human resources (4th ed.).Prentice-Hall
- Ivancevich, J.M. Konsopaske R. & Matteson M.T. (2005) Organizational behaviour and management. New Delhi : Tata McGraw-Hill
- Luthans, F. (2013) Organizational behaviour: An Evidence – based Approach (12thEd.) ND : McGraw-Hill Edu (India) Pvt. Ltd.

Semester IV

Subject Code: 22-PS 241

Subject: COUNSELLING PROCESS AND SKILLS

Total Lectures=30

Unit	Topic	No. of lectures

I	**Counselling: Nature and goals** 1.1. Defining counselling, stages of counselling process, role of counsellors 1.2. Approaches to counselling and helping, the helping relationship, the helping process 1.3. Development of counsellor –counselee relationship, counselling goal setting process 1.4. Counselling in India	2
II	**Basic Counselling Skills** 2.1. Building relationship, core conditions, in-depth exploration 2.2. Nature and importance generic skills of Counselling, Micro and macro skills of Counselling 2.3. Inside and outside skills of counselling, Self-monitoring skills as a counsellor 2.4. An Indigenous Model of Counselling	5
III	**Specific Counselling Skills** 3.1. Paraphrasing and reflecting feelings, asking questions, self-disclosing, facilitating problem solving 3.2. Interviewing skills, listening, asking questions, monitoring 3.3. Training clients in relaxation 3.4. Improving client‘s self-talk and self-perceptions, terminating helping	3
IV	**. Models of Counselling Skills** 4.1. Nature and importance of counselling skills and working alliance 4.2. Rogers model of counselling skills, Carkhuff model of counselling skills, IPR model of counselling training 4.3. Indian models of Counselling: the role of detachment and	5

	self-surrender 4.4. Modern trends in counselling	

Reference Books

- Berman, Pearl and Shopland Susan (2005). Interviewing and Diagnostic Exercises for Clinical and Counselling Skills Building. Lawrence Erlbaum
- Chen, Mei-whei and Giblin, Nan J. (2018).Individual Counselling and Therapy: Skills and Techniques (3rd Edn).Taylor and Francis
- Dryden, Windy; Feltham, Colin (2006). Brief Counselling : A Practical Integrative Approach (2nd Edn). Open University Press
- Feltham, C., & Hanley, T; Winter L. A. (2017). The Sage handbook of Counselling and psychotherapy(4th Edn). Sage Publications.
- Gibson, Robert L. and Mitchell, Marianne H. (2015). Introduction to Counseling and Guidance (7th Edn.). Pearson
- Gladding, S. T. (2018). Counselling: A Comprehensive profession (9th Edn). Pearson
- Jones, R. N. (2012). Basic Counsellings Skills: A helper's manual (3rd Ed.). Sage Publications.
- Palmer Stephen and Bor Robert (2008). The Practitioner's Handbook: A Guide for Counsellors, Psychotherapists and Counselling Psychologists. Sage
- Patterson, L.E. and Welfel, E. R. (2000). The Counselling Process (5th Edn). Wadsworth
- Rao, S. N. (2006). Counselling and Guidance (2nd Edn). Tata McGraw Hill
- Singh, K. (2007). Counselling skills for managers. New Delhi: Prentice Hall of India.
- Soundararajan, Radhika (2012). Counselling: Theory, Skills and Practice. Tata Mcgraw Hill Education Private Limited.

Subject Code: 22-PS 242

Subject PSYCHOPATHOLOGY-2

Total Lectures=30

Units	Topic	Lectures
1	Personality Disorders 1.1. Cluster-A- Characterised by odd and eccentric behaviours 1.2. Cluster-B- Characterised by dramatic, emotional and erratic behaviors 1.3. Cluster-C- Characterised by anxious or fearful behaviours 1.4. DSM-5 Personality assessment	**2**
2	Sexual Dysfunctions, Gender Dysphoria, Paraphilic Disorders 2.1. Sexual Dysfunctions- Causes, symptoms and treatment 2.2. Gender Dysphoria - Causes, symptoms and treatment 2.3. Paraphilia- Causes, symptoms and treatment 2.4. DSM-5 criteria for different sexual dysfunctions, gender dysphoria and paraphilia •	**8**
3	Schizophrenia Spectrum And Other Psychotic Disorders 3.1. Schizophrenia- Introduction and historical perspective 3.2. Positive and negative symptoms of schizophrenia 3.3. Other psychotic disorders 3.4. DSM-5 criteria for schizophrenia	**6**

4	Neurodevelopmental, Neurocognitive And Sleep-Wake Disorders 4.1. ADHD, LD, Autism 4.2. Major and mild Neurocognitive disorders – Parkinson's, Huntington's, Alzheimer's disease 4.3. Sleep-wake disorders 4.4. DSM-5 criteria for neurocognitive disorders	**8**

Reference Books:

6. Barlow, David H.; Durand, Mark V.; Hofmann, Stefan G. (2018). Abnormal Psychology: An Integrative Approach (8th Edn). Cengage Learning
7. Butcher, James N.; Hooley, Jill M.; Mineka Susan (2020). Abnormal Psychology (17th Edn.). Pearson
8. Comer, Ronald J; Comer, Jonathan S. (2018). Abnormal Psychology (10th edn). Worth Publishers
9. Dozois, David J. A. (2019). Abnormal Psychology: P E R S P E C T I V E S (6th Edn). Pearson
10. DSM-5 (2013) Diagnostic and Statistical Manual of Mental Disorders (5th Edn). American Psychiatric Association
11. Hooley, Jill M.; Butcher, James N.; Nock, Matthew K.; Mineka Susan (2017). Abnormal Psychology (17th Edn). Pearson ICD-11 (2018). New International Classification of Diseases (ICD-11). The World Health Organization (WHO). Geneva
12. Kearney, Christopher A.; Trull, Timothy J. (2018). Abnormal Psychology & Life: A Dimensional Approach (3rd Edn). Cengage Learning
13. Morrison, James (2014). DSM-5® Made Easy: The Clinician's Guide to Diagnosis. THE GUILFORD PRESS

Subject Code: 22-PS 243

Subject: PSYCHOTHERAPIES

Units	Topic	Lectures
1	Introduction to Psychotherapies and Psychoanalytic Approach 1.1 Nature, Definition and Objectives of Psychotherapies, Therapeutic Process 1.2 Basic Psychotherapeutic Skills, Characteristics of Good Therapist and Client 1.3 Psychoanalytic Therapies: Classical & Modern 1.4 Transactional Analysis	**2**
2	PSYCHOTHERAPIES - I 2.1 Basic assumptions and various forms of behavior therapy 2.2 Systematic Desensitization, eye movement desensitization & Flooding, Implosive Therapy 2.3 Aversive Therapy, Biofeedback Technique, Assertiveness Training, Psychodrama 2.4 Autogenic Psychotherapy, Brief therapy, Core process psychotherapy	**8**
3	PSYCHOTHERAPIES - II 3.1 Cognitive Therapies: A) REBT, B) Mind-fullness & REBT C) Beck's Cognitive Therapy, 3.2 Roger's Client Centered Therapy 3.3 Gestalt Therapy, Empty Chair Technique 3.4 Logo Therapy & Reality Therapy	**6**

4	PSYCHOTHERAPIES – III 4.1 Lazarus Multimodal Therapy 4.2 Eastern Therapies: A) Vipassana, Zen Buddhisum, B) Islam & Sufism, C) Yoga Therapy 4.3 Family Therapy, Group therapy, Feminist Psychotherapy 4.4 Recent trend in Psychotherapies, Narrative, Play, Art, Music & Dance Therapies(Arts Based Therapies) etc.	**8**

References:

- Ajay, S.(1989). Psychotherapy: East and West. Hinsdale, Penn.: Himalayan International Inst.
- Beck, A.T. (1976). Cognitive therapy and behavior disorders. Cliffs, N.J.: Prentice-Hall.
- Brown, C & August-Scott, T (2007) "Narrative Therapy". Sage Publications.
- Butcher J.N; Mineka Susan; and Hooley Jill M. (2014) Abnormal Psychology (15th Ed.) Dorling Kindersley(India) Pvt.Ltd. of Pearson Education.
- Capuzzi, D., & Gross, D.R. (2008). Counseling and Psychotherapy: theories and interventions 4thEdn. Pearson Education: India.
- Corey, G. (2008). Theory and practice of group counseling. Thomson Brooks/Cole: Belmont CA
- Corsini, R.J. & Wedding, D. (Eds.) (1995). Current psychotherapies. Itasca, Ill.: F.E. Peacock.

Subject Code: 22-PS 244

Subject: PRACTICUM

Total Lectures:

	GENERAL INSTRUCTIONS: (a) Each batch of practicum should consist of maximum 8 students and a separate batch will be formed if this number exceeds even by one. (b) Workload for each batch will be equivalent to 8	

	lecture periods. (c) Each student should study clinical cases in a hospital / clinic / correctional institution / NGO set up; one teacher supervisor should accompany a group of students. (d) Eligibility for the Practicum Examination is subject to Certification of Practicum by teacher-in-charge and HOD.	
	a. Continuous (Internal) Assessment and Distribution of Marks (50 Marks). 1. Presentation of one case report and viva (latest by five weeks from the commencement of the semester)-15 marks. 2. Hypothetical case (one) analysis-10 marks. 3. Presentation of another case and viva (latest by ten weeks from the commencement of the semester)-15 marks. 4. Overall performance (e.g. regularity, sincerity, quality of work etc.) and variety of disorders.- 10 marks	
	b. Semester-End Examination (SEE)-50 Marks. 1. External Examination will be conducted by two examiners, one internal and one external, appointed as per the rules of Savitribai Phule Pune University. 2. Each batch will consist of only 8 students 3. Duration of examination for each batch will be 4 hours. 4. Hypothetical problems will be prepared by the External Examiner. 5. Marks for Viva and Exercise Report will be given by both examiners and average marks will be considered as final marks of the candidate. 6. There will be no presentation of cases before the external examiner. 7. Assessment of analyses of hypothetical case analyses will be done by External Examiners only. 8. Remuneration for External Examination will be equally divided between the two examiners. 9. Those who are appointed as external examiners for any of our university exam will not take up other	

	activities or programs in the same time. If they are found to be missing during this important task this matter is cognizable as an administrative offence.	

Subject Code: 22-PS 245

Subject: HUMAN RESOURCE MANAGEMENT

Total Lectures:

Units	Topic	Lectures
1	INTRODUCTION TO HUMAN RESOURCE MANAGEMENT 1.1. Nature, Scope and Context of HRM 1.2. HR Challenges in Global and Indian Scenario 1.3. HR for Corporate Excellence 1.4. Contemporary Issues in HR, International HR ,e-HR	**2**
2	DEVELOPMENT OF HUMAN RESOURCE 2.1. Training :Assessing training needs, development and evaluation of training programmes 2.2. Training Methods: Classroom instructions, On-the-job training, apprenticeship, business games and in-basket training 2.3. Career development and planning, succession planning. 2.4. Buying , borrowing and building talent	**8**
3	IMPLEMENTING HR 3.1. Impact of Attitudes: OCB job satisfaction ,Employee Engagement, job involvement, 3.2. Ethical Issues in HRM 3.3. Knowledge Management and HR : Meaning and need, knowledge management process , Knowledge	**6**

	management deficits , 3.4. Human Resource Information System (HRIS): Uses, major function, steps in implementing HRIS, evaluation of HRIS.	
4	INDUSTRIAL RELATIONS AND STRATEGIC HR 4.1. Industrial Relation : Labour relation, trade unions, resolving disputes 4.2. Collective Bargaining 4.3. HR Audit : Concept and Methodology of HR Audit 4.4. Strategic HR and HR Score card	**8**

READINGS:

- Beardwell Julie and Thompson Amanda (2017). Human Resource Management: A Contemporary Approach (8th Edn). Pearson (ecopy)
- Cascio, W.F. (2006). Managing human resources: Productivity, quality of work life, profits. Tata Mc-Graw-Hill
- Decenzo, D.A. and Robbins, S.P. (1988). Personnel / human resource management. (3rd ed.). Prentice Hall
- Dessler, G. (2008). Human resource management, 10th ed. Dorling Kindersley India Pvt. Ltd.
- French, W.L.; Bell, C.H.; & Zawacki, R.A. (2006). Organization development and transformation: Managing effective change. Tata Mc-Graw Hill.
- Ivancevich, J.M.; Konopaske, R. & Matteson, M.T. (2005). Organizational behaviour and management. Tata McGraw Hill.
- K. Ashwathapa (2008). Human Resource Management. 5th edition. Tata McGraw-Hill
- Noe, R.A.; Hollenbeck, J. R.; Gerhart, B. & Wright, P.M. (2006). Human Resource Management. N.D.: Tata McGraw Hill
- Pareek U. and Rao T.V. (2003). Designing and Managing Human Resource System. Oxford and IBH
- Pattanayak B. (2005) Human Resource Management. 3rd Edn. Prentice Hall
- Rao T.V. (1999). HR Audit: Evaluating the human resource functions for business improvement. N.D. : Response Books [A Division of SAGE Pub.]

- Robbins, S.P.; Judge, T.A.; & Sanghi, A. (2009). Organizational behaviour. N.D.: Pearson Prentice Hall.
- Schultz, D. and Schultz, S. E. (2006). Psychology and work today. 8th ed.N.D.: Pearson Edu.

Subject Code: 22-PS 246

Subject: ORGANIZATIONAL DEVELOPMENT

Total Lectures:

Units	Topic	Lectures
1	FOUNDATIONS OF ORGANIZATIONAL DEVELOPMENT 1.1. Meaning and Nature of OD, Values, assumption and beliefs in OD, Systems theory of OD. 1.2. Approaches to OD: Laboratory training stem, survey research & feedback stem; action research stem; Socio-technical and socio-clinical stem 1.3. Organizational Change: Meaning, forces for change, Resistance to change, overcoming resistance to change, Change Management. 1.4. Theories for Planned Change 1.4.1. Lewin`s three- step model. 1.4.2. Kotter`s eight- step plan. 1.4.3. Burke-litwin Model. 1.4.4. Porras & Robertson.	**2**
2	PROCESS OF OD INTERVENTION 2.1. OD Diagnosis: Diagnosis of the system and process. Six-Box model. 2.2. Programme management component: phases, a model for change management, Parallel learning structures. 2.3. OD Interventions: Nature, guidelines, classifications.	**8**

	2.4. OD Interventions for Indian organization.	
3	TYPES OF OD INTERVENTIONS I 3.1. Team Intervention : characteristics of effective team, formal team building meeting , formal group diagnostic meeting , process consultation method, Gestalt approach 3.2. Techniques and Exercises used in Team Building , Role-focused OD intervention 3.3. Third-Party Peace-making Intervention, Walton's approach, principled negotiations, two person conflict management organizational mirroring & partnering. 3.4. Structural Interventions: self-managed teams MBO, Quality Circles, total quality management, re-engineering.	**6**
4	TYPES OF OD INTERVENTIONS II 4.1. Comprehensive OD Interventions I: search conference, future search conference, confrontation meeting, strategic management activities. 4.2. Comprehensive OD Intervention II: real time strategic change, stream analysis survey feedback method, appreciative inquiry. 4.3. Grid Organizational Development, Schein`s cultural analysis. 4.4. Emerging trends in OD in 2020 and beyond/ Future trends in OD: New Behaviour. Technologies-Managing change in Digitalization, Use of Mobiles, Breakthrough of AI.	**8**

READINGS:

- Cascio, W.F. (2006). Managing human resources: Productivity, quality of work life, profits 7 th ed. N.D.: Tata McGraw-Hill
- Dessler, G. (2008). Human resource management, 10th ed. Dorling Kindersley India Pvt. Ltd.
- French, W.L. & Bell, C.H. (1999). 6th ed. Organizational development: Behavioral science interventions for organization improvement. Prentice-Hall.
- French, W.L.; Bell, C.H.; & Zawacki, R.A. (2006) Organizational development and transformation: Managing effective Change. Tata McGraw Hill
- Greenberge, J. & Baron, R.A. (2005). Behaviour in organizations (8th ed). Pearson Education.
- Ivancevich, J.M.; Konopaske, R. & Matteson, M.T. (2005). Organizational behaviour and management. Delhi: Tata Mc-Graw Hill.
- McGill, M. E. (1997). Organizational development for operating managers. (AMA-OH) A division of American Management Assn.
- McShane, S.L. & Von Glinow, M.A.(2000). Organizational Behaviour: Emerging realities for the workplace revolution. Tata McGrawHill.
- Pareek, U. and Rao, T.V. (2003). Designing and managing human resource systems. Oxford & IBH.
- Ramanarayan, S.; Rao T.V. & Singh K. (eds) (1988) Organizational development: interventions and Strategies (2007 reprint):Response Book (a division of Sage Publication)
- Robbins, S.P.; Judge, T.A.; & Sanghi, A. (2009). Organizational behaviour. N.D.: Pearson Prentice Hall .
- Schultz, D. and Schultz, S. E. (2006). Psychology and work today. 8th ed. N.D.: Pearson Edu.

Progressive Education Society's

Modern College Of Arts, Science and Commerce, Ganeshkhind, Pune – 411 016

(Autonomous)

Syllabus for

M. A. Sociology Part II

Introduction:

Sociology is a fascinating and diverse field of study, examining the dynamics of social life, social change and the underlying factors that drive and shape human behaviour. Sociology explores the causes and consequences of contemporary concerns such as poverty and wealth creation, social inclusion and exclusion, prejudice and discrimination, behaviour patterns, emerging trends of population, migration, social movements and development. Sociologists seek a critical understanding of the social institutions and processes that shape our lives. At this juncture, when technology is bringing rapid change in society and human life Sociology as a discipline provides holistic view to engage with society of 21st century.

Reach of Sociology as a discipline is associated with fields like development, sustainability, gender, education, public policy and legal studies, health, environment, human resource, globalization, peace and conflict, technology, public sociology, sociology of aging, tribal studies, media, cultural studies.

Sociology provides strong base for critical thinking, analysis, articulation and research.

Sociology as a leading social science discipline provides national and international opportunities in various professional, academic and research fields. Courses in Sociology are popular among students it offers you a real-world perspective to help you progress better

Programme Objectives:

PO1: To develop critical thinking among students

PO2: To display the ability to engage in social interactions across the board

PO3: To engage, design and evaluate research in an Interdisciplinary way

PO4: To understand individual responsibility towards civic and sustainability related issues

PO5: To participate in policy engagement and advocacy

Programme Specific Outcomes (PSOs):

PSO1: Understanding the central concepts developed by the theorists to analyze and evaluate the Social world.

PSO2: Design and evaluate empirical sociological research.

PSO3: Acquaint students with contemporary trends in Sociology.

PSO4: Use Sociological education outside of the classroom, particularly in careers or further education.

Examination Pattern:

There will be equal weightage for Internal and External exam. 50:50.

Suggested internal assessment tools for courses:

The concerned teacher shall announce the units for which internal assessment will take place. A teacher may choose one of the methods given below for the assessment.

1. Library notes
2. Short Quizzes / MCQ Test
3. Home Assignments
4. Written Test
5. PPT presentation
6. Research Project
7. Group Discussion
8. Field Visit
9. Students Seminar
10. Classroom Participation

Teaching Methodology:

1. Classroom Teaching
2. Guest Lectures
3. Group Discussions
4. Power Point Presentations
5. Research Papers & Projects
6. E-content

Subject List

SEMESTER III

Sr. No.	Course Type	Program Code & Title	Credits			Total No. of Lectures
			Theory	Practical	Total	
1	Compulsory	23-SO231 - Contemporary Social Theories	4	NA	16	48
2		23-SO232 - Sociology of Development	4	NA		48
3	Elective (Any Two)	23-SO234A - Sociology of Gender	4	NA		48
4		23-SO234B - Sociology of Environmental Sustainability	4	NA		48
5		23-SO234C - Social Movements: Dimensions And Trends	4	NA		48

SEMESTER IV

Sr. No.	Course Type	Program Code & Title	Credits			Total No. of Lectures
			Theory	Practical	Total	
1	Compulsory	23-SO241- Sociology of Globalization	4	NA	16	48
2		23-SO242- Health and Society	4	NA		48
3	Elective (Any Two)	23-SO244A- Sociology of Law and Policing	4	NA		48
4		23-SO244B- Ethnicity and Nationalism In India	4	NA		48
5		23-SO244C- Dissertation	4	NA		48
6		23-SO244D- Sociology of Human Rights	4	NA		48
7		23-SO244E – Sociology of Social Work	4	NA		48

Syllabus

Subject Code: 23-SO231

Subject: Contemporary Social Theories **(4 Credit)**

Total Lectures = 48

Unit	Contemporary Social Theories	No of lectures
1	**The Crisis of Sociology and the Critique of Positivism** 1. Alvin Gouldner 2. C. Wright. Mills	**08**
II	**Marxism from 30s to 70s** 1. Frankfurt school, 2. Althusser (Theory of Ideology) 3. Gramsci (Hegemony, Civil Society)	**12**
III	**PostStructuralism:** 1. Foucault 2. Derrida	**12**
IV	**Recent Trends in Sociological Theory:** a) Post-modernism: Jameson, Baudrillard, Lyotard b) Jurgen Habermas, Anthony Giddens and Pierre Bourdieu	**16**

Reference Books:

Essential Readings:

1. Adams and Sydie (ed.) (2001), Sociological Theory, Vistar Publication, New Delhi.
2. Appelrouth S. and Edles L.D. (2008), Classical and Contemporary Sociological Theory, London: Print Forge Press. P. No. 631-648, 683-710, 719-743, 753-785.
3. Bryan Turner, Chris Rojek and Craig Calhoun (ed) (2005), The Sage Handbook of Sociology, London: Sage Publication.

4. Calhoun, Craig and et.al. (ed.) (2007), Contemporary Sociological Theory- Second edition, London: Blackwell Publication. P. No. 231, 243, 277, 363, 370, 388.

5. Cuff, E.C, Sharrock, W.W, and Francis, D.W., Perspectives in Sociology, New York: Tylor and Franscis. P. no.184-201, 238-247, 258-279, 282-306, 316-337.

6. Dillon, Michele (2010). Introduction to Sociological Theory- Theory, Concepts and their Applicability to the Twenty-First Century, London: Wiley-Blackwell Publication,. P. No. 181, 214, 350-60, 405-426, 427-48.

7. Elliot, Anthony (ed.) (2010), The Routledge Companion to Social Theory, London: Routledge publication. P.No. 73, 86, 117.

8. Giddens A. and Turner J. (1988), Social Theory Today, California: Stanford University Press.

9. Ritzer George. and Barry Smart (ed.) (2001), Handbook of Social Theory, London: Sage Publication. P.No. 179, 201, 308, 324, 439,

10. Ritzer George (ed.) (2005), Encyclopedia of Social Theory, London: Sage Publication.

11. Seidman Steven (1994), Contested Knowledge- Social Theory in the Post modern Era, London Blackwell Publication.

12. Wolfgang J. Mommsen (ed.) (1994), The Polity Reader in Social Theory, Polity Press.

References:

1. Bourdieu Pierre (1990), In other words – Essays Towards a Reflexive Sociology, Stanford: Stanford University Press.

2. Bourdieu Pierre (1990), The Logic of Practice, Cambridge: Polity Press.

3. Cassell Philip (ed) (1987), The Giddens Reader, London: Macmillan Publication

4. Giddens Anthony (1984), The Constitution of Society. Outline of a Theory of Structuration, California: University of California Press

5. Goode Luke, Jurgen Habermas (2005), Democracy and the Public Sphere, London: Pluto Press.

6. Habermas Jurgen (1987), The Theory of Communicative Action, Vol. 1 and 2 Cambridge: Polity Press.

7. How Alan (2003), Critical Theory, Palgrave Macmillan.

8. Lemert Charles (1995), Sociology After the Crisis, New York: Westview Press

9. Smart Barry (2002), Michel Foucault, Routledge, London.

10. Steven Loyal (2003), The Sociology of Anthony Giddens, London: Pluto Press.

Marathi References:

1.तोष्णीवाल सुभाष (२०११) समाजशास्त्रीय सिद्धांतातील नाव-प्रवाह. नागपूर, मंगेश प्रकाशन

2. कुलकर्णी पी. के. प्रगत समाजशास्त्रीय सिद्धांत, नागपूर, मंगेश प्रकाशन

3. बनसोडे प्रशांत (२०१५) पंचनामा सांस्कृतिक भांडवलशाहीचा. पुणे. मनोविकास प्रकाशन (प्रकरण पहिले पान १५-२२)

4. गर्गे स. मा. (२०१७) भारतीय समाजविज्ञान कोश, खंड ६. पुणे. मेहता पब्लिशिंग हाउस

Subject Code: 23-SO232

Subject: - Sociology of Development **(4 Credit Course)**

Total Lectures = 48

Sr. No	Topic	Lectures
I	**Understanding Development – History and basic concepts** 1. Historical context of the idea of development – post II world war and end ofcolonialism, making of the Third World and desire for development 2. Basic concepts and indicators – Social change, Growth and Development, Social Development, Human Development Index, Gender Development Index, Millennium Development Goals, Sustainable development and Sustainable development Goals	**12**
II	**Perspectives on Development** 1. Modernization theory – Main tenets and arguments, limitations of modernization 2. Dependency theory – Main tenets and arguments, experience of Latin America 3. The Capability Approach 4. Doing Development – Experiences of Asia and Africa	**12**
III	Alternative approaches and epistemological critiques of development 1. Mahatma Gandhi's views on Development 2. Schumacher – Small is Beautiful 3. Feminist critique of development 4. Post-development perspective	**12**
IV	**Strategies and models of development – towards new paradigms** 1. Development and State – State driven development, role of planning 2. Civil society, NGOs and Community Development 3. Neo-liberalism and capitalist development 4. New paradigm of degrowth	**12**

Reference Books :

Essential Readings:

1. Amin Sameer (1976) Unequal Development. Sussex. Harvester Press
2. Blewitt John (2008) Understanding Sustainable Development London. EarthscanDatt and Sundaram, 2008, Indian Economy, S. Chand & Co., New Delhi
3. Desai A.R., 1971, Essays on Modernization of Underdeveloped Societies, Thacker and Co., Bombay
4. Dube S. C. 1998 Development and Modernization Zed Books Publishers Eade D. & Ligteringen E., 2006, Debating Development – NGOs and the future, Rawat Publications, Jaipur
5. Escobar Arturo, 1995, Encountering Development: the making and unmaking of the third world, Princeton University Press, Princeton
6. Harrison D.H., 1988, The Sociology of Modernization and Development, London Routledge, Kegan Paul
7. Hettne, Bjorn. 1995. Development Theory and Three Worlds. Harlow:Longman Scientific and Technical Publishers. 2nd rev.edn. ch: 4: 'Dimensions of Another Development
8. Kaviraj, Sudipta, 2010, The Trajectories of the Indian State, Ranikhet: Permanent Black
9. Kothari Uma, A Radical History of Development Studies: Individuals, Institutions and ideologies, David Philip, Zed books, New York.
10. Nederveen-Pieterse, Jan. 2001. Development Theory: Deconstructions/Reconstructions.New Delhi:Vistaar Publications. Chs.: 1, 6, 7 & 10
11. Payne Anthony and Phillips Nicola (2018) Development. Jaipur, Rawat Publication Preston P.W., 1982, The Theories of Development, London Routledge, Kegan Paul
12. Sachs Jeffery 2015 The Age of Sustainable Development Columbia University Press New York
13. Singh Shevbahal (2010) Sociology of Development. Jaipur, Rawat Publication
14. Webster Andrew, 1984, Introduction to the Sociology of Development, London McMillan
15. Wood Charles, Robert Bryan(ed), 2005, Rethinking Development in Latin America, Penn
16. Wolfgang Sachs (Ed) (1992) The Development Dictionary, Orient Longman. (Relevant issues of the Journal – Down to Earth, CSE, Delhi.)

References

1. Desai, Meghnad. 2005. Development and Nationhood: Essays in the Political Economy of South Asia. New Delhi: Oxford University Press. Chs: 11, 12 & 14.

2. Parfitt, Trevor. 2002. The End of Development: Modernity, Post-Modernity and Development. London: Pluto Press. chs: Introduction, 2, 4 & 5.

3. Rahnema, Majid and Victoria Bawtree (eds). 1997. The Post-Development Reader. London: Zed Books. Chs: 7, 9, 11, 30 & Afterword.
4. Schech, Susanne and Jane Haggis (eds). 2002. Development: A Cultural Studies Reader. Oxford: Blackwell Publishers. chs: 1, 9 & 10.
5. Wolfgang Sachs(ed) 1992, The Development Dictionary; Orient Longman.
6. Patil R. B. (Ed) (2014) Sustainable Developmnent: Local Issues and Global Agendas. Jaipur. Rawat.

Marathi References

1. गोडबोले अच्युत विकासनीतीः सर्वनाशाच्या उंबरठ्यावर पुणे –अनर्थ (२०१९), मनोविकास प्रकाशन

2. गर्गे स भारतीय (२०१७) .मा .समाजविज्ञान कोश खंड ६मेहता पब्लिशिंग .पुणे . हाउस

3. धनागरे दसमाजशास्त्र संशोधन .विकास प्रक्रिया आणि पर्यावर्णाचे प्रश्न (१९९६) .ना . .पत्रिका

4. पाटील प्रतिभा व इतर महात्मा गांधी आणि ग्रामीण विकास (२०१०), औरंगाबाद . एज्युकेशनल पब्लिशर्स

5. रेणवीकर माधवीव .िकासाचे समाजशास्त्र, मुंबई प्राची प्रकाशन .6. विकासाच्या प्रक्रियेतील स्त्री प्रश्न .पुणे .WSC SPR.

Web links

https://www.orfonline.org/research/the-asia-africa-growth-corridor-bringing-together-old

partnerships-and-new-initiatives/

http://www.networkideas.org/events/jan2003 / Ethiopia Conference Jomo.pdf

शाश्वत विकास म्हणजे काय? - भाग १३– https://www.maayboli.com/node/75247

Subject Code: 23-SO234A -

Subject: Sociology of Gender

Total Lectures = 48

Unit	Topic	No of lecture
I	**Introduction to Sociology of Gender** 1. Conceptualizing Gender- Sex, Gender, Gender Roles - Stereotypes, Gender Inequality/ Power and Hierarchy, Sexual division of labor, Patriarchy, Politics of Body, Construction of Sexuality , Understanding masculinities 2. Gender Debates- Race, Caste, Class, Nationalism, State, Citizenship, Development 3. Feminist Thought- Liberal Feminism, Marxist Feminism, Socialist Feminism, Radical Feminism, Post-Modernist Feminism, Black Feminism, Dalit Feminism	12
II	**Gender, Family and Labour Markets** 1. Family as a Gendered Institution, Family as a site for violence 2. Women as 'Izzat'/Honour, Honour Killings 3. Women and work, gender stereotyping of jobs, glass ceiling 4. Globalisation and newer forms of gender based exploitation, women and unorganised sector 5. Violence at the workplace and public spaces	12
III	**Gendering Education and Health** 1. Gender in School, Higher Education 2. Gendering Health: Perspective, Policy, and Programmes	12
IV	**Women's Movement and Resistance** 1. Rewriting History 2. Women's Movement- Campaigns, Organizations, Issue 3. Women's Movement and emergence of Women's Studies	12

Reference books:

Essential Readings

1. Bhasin, K. (2000). *Understanding Gender*. New Delhi: Kali for Women
2. Bhasin, K. et al (eds). (1993). *Against all Odds: Essays on Women, Religion and Development in India and Pakistan.* N. Delhi: Kali for Women
3. Bhasin, K. and Khan, N. (1986). *Some Questions about Feminism and its Relevance in South Asia.* N. Delhi: Kali for Women
4. Chakravarty, U. (2003). *Gendering caste through a feminist Lens*. Calcutta: Stree
5. Chanana, K. (1998). *Socialization, Education and Women: Explorations in Gender*
6. *Identity*. New Delhi: Orient Longman
7. Chanana, K. (2001). *Interrogating Women's Education*. Jaipur and New Delhi: Rawat

8. Publications
9. Choudhary, M. (1993). *Indian Women's Movement: Reform and Revival*. N. Delhi: Radiant
10. Datar, C. (1995). *Struggles against Violence*. Calcutta: Stree
11. Flavia, A. (2008). *Law and Gender Inequality: The Politics of Women's Rights in India*. N. Delhi: Oxford University Press
12. Gandhi, N. and Shah, N. (1992). *Issues at Stake: Theory and Practice of women's Movement in India.* N. Delhi: Kali for Women
13. Geetha, V. (2002). *Gender*. Calcutta: Stree-Samya Pub
14. Geetha, V. (2007). *Patriarchy*. Calcutta: Stree-Samya Pub
15. Ghadially, R. (Ed.) (2007). *Urban Women in Contemporary India.* New Delhi: Sage
16. IGNOU : Kits on Women in Indian Contexts. N. Delhi
17. Jhabwala, R.& Sinha, S (2002). Liberalization and the woman worker. *Economic and*
18. *Political Weekly*. 37 (23): 2037-44
19. John, M. (ed.). (2008). *Women's Studies in India: A Reader*. N. Delhi: Penguin
20. Kumar, R (1992). *History of Doing*. New Delhi: Kali for Women
21. Menon, N. (ed.) (2007). *Sexualities.* N. Delhi: Women Unlimited
22. Menon N. (2012) Seeing Like a Feminist. Penguin/Zubaan
23. Ramachandran, V. (2004). *Gender and Social Equity in Primary Education*. New Delhi:
24. Sage Publication
25. RCWS. Part-I, II, III. *Feminist Concepts, Contribution to women's studies series.* Mumbai
26. Rege, S. (2003). Sociology of Gender. New Delhi: Sage
27. Rege, S. (2006). *Writing Caste/Writing Gender*. New Delhi: Zubaan
28. Shrivastava, S. (2004). *Sexual Sites, Seminal Attitudes: Sexualities, Masculinities and Culture in South Asia.* N. Delhi: Sage Publications

29. Standing, G. (1999). Global Feminization Through Flexible Labour: A Theme Revisited.
30. *World Development*, 27(3), 583-602.
31. Swaminathan, P. (Ed.) (2012). *Women and Work*. New Delhi: Orient Black Swan& EPW
32. Tong, R. and Fernandes Botts, T. (2017). *Feminist Thought: A More Comprehensive Introduction.* 5th edn. New York: West view Press
33. Uberoi, P. (1994). *Family, Kinship and Marriage in India*. New Delhi: Oxford University Press
34. Xaxa, V. (2004). Women and Gender in the Study of Tribes in India. *Indian Journal of Gender Studies.* Oct. Vol. II (3): 345-67

References

1. Basu, A. (1999). *Women's Education in India.* In Ray and Basu (Ed.) From Independence Towards Freedom. New Delhi: Oxford University Press
2. Choudhari, M. (2003). *Feminism in India*. New Delhi: Women Unlimited
3. Chowdhary, P. (2007) *Contentious Marraiges/Eloping Couples: Gender, Caste and Patriarchy in Northern India*. N. Delhi: Oxford University Press
4. Davis, K.; Evans, M.; Lorber, J. (Ed.) (2006). *Handbook of Gender and Women's studies.* UK: Sage
5. Freedman, J. (2002). *Feminism*. New Delhi: Viva Books
6. Karat, B. (2005). *Survival and Emancipation, Three essays Collective*
7. Khullarmala (Ed.) (2005) *Writing the Women's Movement- A Reader*. New Delhi: Zubaan
8. Kimmel, M. (2008). *The Gendered Society*. NY: Oxford University Press
9. PUDR report. (2003). Courting Disaster.
10. Shramashkati Report. (1987). *Self Employed Women and Women in the Informal Sector in India.* New Delhi: GOI
11. Wharton, A. (2005). *Sociology of gender*, London: Blackwell

मराठी संदर्भ

1. भसीन कमला मराठी अनुवाद श्रुती) लिंगभाव समजून घेताना (२०१०) तांबेलोकवांग्मय गृह (, मुंबई

2. भागवत, विद्युत) .२००९ ('स्त्री प्रश्न'ची वाटचाल परिवर्तनाच्या दिशेने प्रतिमा प्रकाशन : .पुणे

3. भागवत विद्युत स्त्रियांच्या कर्तेपणाचा इतिहास (२००२), स्त्री अभ्यास केंद्र, पुणे

4. भागवत विद्युत स्त्रीवादी सामाजिक (२००८) विचार डायमंड प्रकाशनपुणे .

5. भागवत विद्युत स्त्रीवादी पद्धतीशास्त्र स्वैर अनुवाद क्रांतीज्योती सावित्रीबाई फुले श्री (२०१०) अभ्यास केंद्र, पुणे

6. भागवत, रेगे आणि पलसानेमुंबई .खी जीवनाची गुंतागुंत विकास अध्ययन केंद्र .(१९९४) .,

7. भागवत आणि रेगे) (.संपा)२००० ('समकालीन भारताचे कळीचे प्रश्न श्री अभ्यास केंद्र . पुणे विद्यापीठ, पुणे .8. रेगे शर्मिला दलित स्त्रीवादी भूमीदृष्टीच्या दिशेने विभिन्नत्वाच्या (२००४) .संकल्पनेची चिकित्सा

8 संपाशोध बाई मानसाच्या जीवाचा ., स्वधर, अक्षर प्रकाशन, मुंबई

9. रेगे शर्मिला)२००४एक संकल्पनात्मक आढावा परिवर्तनाचा वाटसरू : मार्क्सवादी स्त्रीवाद (डिसेंबर,

10. देहाडराय स्वाती आणि तांबे अनघा खिया (२००९) (संपा), लिंगभाव आणि विकास . कांतीज्योती सावित्रीबाई फुले स्त्री अभ्यास केंद्र, पुणे

11. देहाडराय स्वाती आणि तांबे अनघा भारतातील स्त्रियांचे सामाजिक (२००९) (संपा) सक्षमीकरण,

क्रांतीज्योती सावित्रीबाई फुले स्त्री अभ्यास केंद्र, पुणे

12. साठे निर्मला आणि कुलकर्णी वंदना सामर्थ्य आहे चळवळीचे (१९९९), आलोचना, पुणे

13. सुमंत यशवंत .फेब्रुवारी .मिळून सान्याजणी .श्री मुक्तीची पहाट (१९९९) पुणे

14. सुमंत यशवंत पुणे .एप्रिल .मिळून सान्याजणी .उजाडले पण सूर्य कुठाय (१९९९)

15. सुमंत यशवंत .स्त्रीवादः उदारमतवादी आणि मार्क्सवादी आणि समाजवादी (१९९९) पुणे .मे .मिळूनसान्याजणी

16. गुप्ता चारू मराठी अनुवाद सुरेश खोले आणि) .पुरुषत्वाच्या प्रतिमा (२०१६) सुरज पवारहरिती प्रकाशन (, पुणे

17. पलसाने वंदना (.संपा) भागवत आणि रेगे .खिया आणि काम .(२०००)'समकालीन भारताचे कळीचे प्रश्न' स्त्री अभ्यास केंद्र.पुणे .पुणे विद्यापीठ .

18. गांधी नंदिता आणि शाह नंदिता) स्त्री संघर्षाची रूपे ( )Translation of Issues at Stake).

19. गुंडी एनमौज प्रकाशन .मुंबई .मिळून साऱ्याजणी .स्त्रीमिती (संपा) (२०१०) .

20. रानडे प्रतिभा स्त्री प्रश्नांची चर्चा :एकोणिसावे शतक .(२००५), पुणे पद्मगंधा प्रकाशन .21. जाधव निर्मला ताराबाई शिंदे .स्त्रीवादी चर्चाविश्व एक अन्वयार्थ (२०१५) (.संपा)स्त्री अभ्यास केंद्रबाबासाहेब आंबेडकर मराठवाडा विद्यापीठ ., औरंगाबाद

Subject Code: 23-SO234B -

Subject: Sociology of Environmental Sustainability

Total Lectures = 48

Sr. No	Topic	Lectures
I	**I. The Sociology of Sustainability and Sociology of Environment: An Introduction** 1. Sociology of Environment, Sociology of Sustainability: Nature, scope and relevance 2. Concepts: Sustainability, Environment, Social Ecology, Development, 3. Three Pillars of Sustainability: Economic, Social and Environmental 4. Approaches: Gandhian, Social Constructionism, Realism, Appropriate Technology,Eco-feminism, Deep Ecology, Political Ecology, Usurping resources for 'Development'	**12**
II	**Conditions and Issues of Environment and Sustainability** 1. Conditions of Un-sustainable Environment: Capitalism to Neoliberal Globalization (Failure of Green Revolution) 2. Sustainability and Planetary Boundaries. (Issues of energy, water, air, land, climate change, and loss of biodiversity) Anthropocene 3. Issues of development induced social injustice (communities, gender, livelihoods, culture, indigenous knowledge, and marginalization)	**10**
III	**Steps towards Sustainability: Global Level** 1. Policies and Action Plan: Brundtland Commission- 1987, Rio 1992, The Kyoto protocol, Millennium Development Goals, The World Summit on Sustainable Development 2002, Paris Agreement, Sustainable Development Goals; 2. Major International Environmental laws: Right to Environment as Human Right, – International Humanitarian Law and Environment, Environment and Conflict Management, Law on International Watercourses 3. Civil society Initiatives and Movements, Green's Party, Civil Society Coalition onSustainable Development (CSCSD), Alter Globalization Movement	**12**
4	**Steps towards Sustainability: Indian National and Local Level** 1. Policies and Programmes: Article 48 of Directive Principles, National Environment Policy 2006, National Action Plan on Climate Change and India SDG Index. 2. Legislations and Community Participation– Wildlife Protection Act, 1972; JFM, Forest Conservation Act, 1980, , Panchayats Extension to Scheduled Areas (PESA) Act 1996, Recognition of Forest Rights Act, 2006, Coastal Regulation Zone	**14**

	3. Civil society Initiatives and Movements in India: Chipko Movement, Narmada Bachaav Movement; Sustainable Energy experiments, Participatory, Community based Alternative Practices 4. Lessons of Corona Pandemic and Future of Sustainability in India.	

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2. Bell M. and Mayerfeld (1998) Sociology for New Century. An Invitation to Environmental Sociology, Pine Forge press.
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4. Chakrabarti,T. (2014) Environment and Sustainable Development- India. Springer
5. Gadgil, M. and Guha R. (1996) Ecology and Equity: The use and Abuse of Nature in Contemporary India, New Delhi: OUP.
6. Gole P. (2001) Nature Conservation and Sustainable Development in India, Jaipur and New Delhi: Rawat Publications.
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10. Kumar S. (2002) 'Environmental Problems and Gandhian Solutions', Deep-Deep Publication.
11. Munier N. (2005) Introduction to Sustainability Road to a Better Future. New York. Springer
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13. Pal B. P, Environmental conservation and Development, Dehradun: Natraj Publishers.
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18. Shiva V. (1988) 'Staying Alive', New Delhi: Kali for Women.
19. Shiva V. (1991) Ecology and the Politics of Survival New Delhi: U.N University Press and Sage Publications.
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22. Vezzoli, C. and Manzini E. 2008. Design for Environmental Sustainability. London, Springer-Verlag

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3. Alan Irwin (1995) Citizen Science A Study of People, Expertise and Sustainable Development Environment and Society
4. Barry J. (1999) Environment and Social Theory. London. Routledge
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Video resources:

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2. गर्गे सभारतीय समाजवि (२०१७) .मा .ज्ञान कोश, खंड ६, पुणे, मेहता पब्लिशिंग हाउस

3. पाटील प्रतिभा व इतर पब्लिशर्स .औरंगाबाद .महात्मा गांधी आणि ग्रामीण विकास (२०१०) एज्युकेशनल

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content/uploads/2018/10/Marathi_SDG_Booklet_25Jan 17.pdf

Subject Code: 23-SO234C

Subject : Social Movements: Dimensions And Trends

Total Lectures= 48

Units	Topic	Lectures (48)
1	**I. Introduction to Social Movements(10)** 1. Defining Social Movements, Nature 2. Social Movement: Change, Reform and Revolution 3. Types : Old Movement and New Movement	10
2	**Theories of Social Movements** 1. Structural –Functional 2. Marxist 3. Resource Mobilization Theory 4. New Social Movement 5. Framing Perspective	14
3	**Social Movements in India** 1. Issues of Liberation, Equity and Security: 2. Women's Movements, Peasant Movements, Labour Movements and EnvironmentalMovements 3. Identity Politics and Social Movements: 4. Religious and Caste Movements, Regional and Tribal Movements	14
IV	**Globalization and Alter-Globalization** 1. WSF, Occupy, Arab Springs 2. Lokpal, New Labour Protests, Students Protests	10

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मराठी संदर्भ :

22. शहा, घ) .2002) सामाजिक चळवळी आणि सरकार, पुणे .डायमंड प्रकाशन :
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24.पवार प्र डायमंड पब्लिकेशन .पुणे .समकालीन राजकीय चळवळी (२०११) .
25. जोगदंड पीप्रतिशब्द .मुंबई .सिद्धांत आणि व्यवहार :दलित चळवळ (२००६) .
.प्रकाशन
26. देवगावकर एसनागप .परंपरागत आणि नवीन :सामाजिक चळवळी (२००९) .ूर .
.साईनाथ प्रकाशन

Semester IV

Subject Code: (23-SO241)
Subject: Globalization: Exploring Debate and Implications
Total Lectures=48

Unit	Topic	No. of lectures
I	**Making sense of globalization** a. Meaning, understanding various intellectual positions – globalists, sceptics,internationalists b. Political economy and historical roots, from development to globalization c. Before and after Bretton Woods, Neo-liberalism and global financial institutions(GATT, IMF, World Bank, WTO….) d. Dimensions of globalization – economic, political and cultural	12
II	**Debates and approaches to globalization** a. Anthony Giddens – globalization as intensification of modernity b. Hirst and Thompson – globalization as a necessary myth c. Arjun Appadurai – globalization - disjuncture and difference d. Manuel Castells – Network society	14
III	**Globalization and global inequalities** a. Labour in a global economy - New International division of labour, labour in knowledgeeconomy b. Transnational Migration – transnational communities and families, issues of race andethnicity c. Globalization, gender and sexualities d. Globalization, climate change and social justice	12
IV	**Alternatives and responses** a. Global social movements b. Transnational Civil Society c. Lessons learnt for COVID-19	10

Reference Books;

Essential Readings:

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Rowman &Littlefield Publishers
https://www.youtube.com/watch?v=9-4V3HR696k
Youtube video: “Hidden Faces of Globalization”, parts I and II
https://www.youtube.com/watch?v=8Bhodyt4fmU&list=PLm4RGa6Hu1YmUXG4Ub5IjjIoWd Z4Dybmp

https://www.youtube.com/watch?v=a0IBM7_BvTw

Subject Code: 23- SO242
Subject: Health and Society
Total Lectures=48

Units	Topic	Lectures
I	**Introduction** Concepts and Definition - Health, Medicine, Illness, Sickness, Disease and Social Epidemiology	
II	**Theoretical perspectives on health and medicine within Sociology** a. Functional approach b. Conflict approach c. Integrated approach d. Labeling approach e. Feminist approach	**10**
III	**Socio-Cultural Dimensions of Health** a. Social causes of Sickness-Attitudes , Beliefs, Values, Superstitions b. Addiction and Society c. Health Issues related to women (Tribal, Urban and Rural)	**12**
IV	**Contemporary Issues in Health** a. National health policy b. Role of NGO in health sector c. Impact of globalization on health sector i. Privatization, Patents and poor ii. Right to health iii. Health insurance iv. Issues of Gender and Reproductive Health v. Consumer Protection Act d. Covid 19: Global Pandemic-Issues and challenges e. Public Health	**14**

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Essential Readings: /References

1. Albrecht, Gary L. and Fitzpatrick, R. 1994. Quality of life in health care:Advances in medical sociology . Mumbai: Jai press.
2. Basu S.C. 1991. Hand book of preventive and social medicine 2nd edition,Current Books International , Calcutta.
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30. https://amp.scroll.in/article/971826/k-sujatha-rao-interview-india-must-learn-from-covid-19-boost-public-healthcare-and-surveillance

Subject Code: (23-SO244A)
Subject: Sociology of Law and Policing
Total lectures = 48

Units	Topic	Lectures
I	**Introduction-Concept and Relevance** a. Law: Concept and relevance through historical periods b. Law and social control c. Law and Social Transformation: Concept and Models on Social Transformation d. Culture and Law	12
II	**Theories and Perspectives** a. Classical theories and Perspectives Structural –Functional, The Durkheimian Perspective, The Weberian, The Marxian, Conflict Perspective b. Contemporary Perspectives Michael Foucault; Modern Law as Social Control, Pieree Bourdieu: Law and PowerPolitics, Niklas Luhman: Law as a Social System	12
III	**Inequality, Crime and Legal Provisions In India** a. Laws around Gender Inequality: Patriarchal System and Gender Inequality, LegalProvisions, Hetero normativity, Homophobia b. Laws around Access to resources and Livelihoods: Land, Water, Forests, Air, Right toLivelihood, Right to Food, Right to Work c. Child Abuse and Crime Against Children: Domestic Violence, Labour Exploitation; Legal measurements against Child Abuse d. Law and Social Stratification, Caste System, Communalism and Inequality; Crimeagainst SCs, STs, and minorities	12
IV	**State and Law Enforcement** a. Social Surveillance, Technologies of surveillance b. Violence, Custodial deaths, c. Over emphasis on force and torture	12

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1. Aubert V (ed.) (1969) *Sociology of Law*. London: Penguin.
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Roeben V (eds) *Theorising the Global Legal Order*. Oxford
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Subject Code: (23-SO244B)

Subject: Ethnicity and Nationalism in India

Total lectures = 48

Units	Topic	Lectures
I	Concept and theories of ethnicity a. Concepts—Ethnicity, Pluralism (centripetal and centrifugal forces), Multiculturalism,ethnic consciousness and identity, ethnic resurgence b. Perspectives on ethnicity- i) Classical Sociological Perspective ii) Functionalism iii)Elite Theory iv) Neo-Marxist v) Sociobiology vi) Anti foundationalism approaches vii) Communal perspective c. Processes of ethnicization—caste, race, religion, class and gender	**12**
II	. Nations, Nationalism and Nation-State a. Defining the terms: Nation, Nationalism, Nation-States b. Emergence of Nationalism in India- • Nation and nationalism- Western roots • Historical and contemporary notions of nation and nationalism in India c. Many Voices of Nation in India	**10**
III	Nation Building in India a. The nature of cultural diversity in India b. Secularism in India • Mapping the concept • Crisis of secularism in India c. Ethnic (sub-national movements) resurgence Concept of sub nationalism, secessionism Problems in nation-building- Tamil nationalism, Jharkhand, Punjab, Bodoland,Kashmir, Telangana, Chhattisgarh.	**16**

IV	Diaspora: Issues of ethnicity and identity (10) a. Defining diaspora b. Concepts and intersections- Home and memory, Migration, Transnationalism, Hybridity, Citizenship, diaspora and Gender, diaspora and films, literature and performance c. Indian diaspora: issues of identity	**10**

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Essential Readings:

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9. Stone and Dennis (2002). Race and Ethnicity, Blackwell, UK.
10. Vanaik A. and Brass P.(2002). Competing Nationalisms in South Asia, Orient Longman,India.

Subject Code: **(23-SO244C)**

Subject: Dissertation (4 credits)

Total lectures = NA

Subject Code: (23-SO244D)
Subject: Sociology of Human Rights

Total lectures = 48

Units	Topic	Lectures
I	Conceptual and Philosophical Background of Human Rights Meaning, characteristics and generational classification Natural rights theory, Marxist and Liberal theories, Feminist perspective Universal Declaration of Human Rights (UDHR) and debates (Are Human Rights Universal? & Critique of dichotomy & a case for integrated approach) Major Human Rights Issues in India Rights of Vulnerable Groups: Dalits, Tribals, Minorities, Poor (the bottom billion) Rights of Women and Children Rights of the Disabled	**14**

II	Major Human Rights Issues in India Rights of Vulnerable Groups: Dalits, Tribals, Minorities, Poor (the bottom billion) Rights of Women and Children Rights of the Disabled	**10**
III	Unit III. Contemporary Developments in Human Rights Development and Human Rights (Right to Development) Human Rights and Globalisation Environment and Human Rights Right to Information, Right to Health, Right to Education	**16**
IV	Civil Society, Social Movement and Critique of Human Rights Civil Society and Social Movement Social Movements and Social Construction of Human Rights (Anti-Corruption Movement,Nirbhaya Movement, Anti-globalisation Movement etc.) Emerging "Global Civil Society" Relevance and Critiques of Human Rights Global Relevance of Human Rights A Contemporary Critique of/Attack on Human Rights The Future of Human Rights	**10**

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11. Donnelly, Jack. (2013). Universal Human Rights: In Theory and Practice. Ithaca: CornellUniversity Press
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13. Fraser, Arvonne S. (1999). Becoming Human: The Origins and Development of Women'sHuman Rights. Human Rights Quarterly. 21(4): 853-906
14. Glasius, Marlies. (ed.). Global Civil Society. Sage Publications
15. Goodhart, Michael. (2008). Neither Relative nor Universal: A Response to Donnelly.Human Rights Quarterly. 30(1): 183-193
16. Gudavarthy, Ajay. (2009). Human Rights Movement in India: State, Civil Society and Beyond in Singh, Ujjwal Kumar. (ed.). Human Rights Peace: Ideas, Laws, Institutions and Movements. New Delhi: Sage.
17. Guru, Gopal. (2013). Freedom of Expression and the Life of the Dalit Mind. EPW.
18. Hamm, Brigitte I. (2001). A Human Rights Approach to Development. Human RightsQuarterly. 23(4): 1005-1031
19. Howard-Hassmann, Rhoda E. (2005).The Second Great Transformation: Human RightsLeapfrogging in the Era of Globalization. Human Rights Quarterly. 27(1): 1-40
20. Ignatieff, Michael. (2001). The Attack on Human Rights. Foreign Affairs. 80(6): 102-116
21. Kadragic, Alma. (2006). Globalization and Human Rights. Philadelphia: Chelsea HousePublishers
22. Le, Nhina. (2016). Are Human Rights Universal or Culturally Relative? Peace Review.28(2): 203-211
23. Leib, Linda Hajjar. (2011). Human Rights and the Environment: Philosophical, Theoreticaland Legal Perspectives. Leiden: Martinus Nijhoff Publishers
24. Levin, Leah. (2009). Human Rights: Questions and Answers. New Delhi: NBT
25. McCorquodale, Robert & Fairbrother, Richard. (1999). Globalization and Human Rights.Human Rights Quarterly. 21(3): 735-766
26. Megret, Frederic. (2008). The Disabilities Convention: Human Rights of Persons withDisabilities or Disability Rights? Human Rights Quarterly. 30(2): 494-516
27. Mendelsohn, Oliver & Baxi, Upendra. (eds.). (1994). The Rights of Subordinated Peoples.Delhi: OUP
28. Nickel, James W. (2008). Rethinking Indivisibility: Towards a Theory of SupportingRelations between Human Rights. Human Rights Quarterly. 30(4): 984-1001
29. Pogge, Thomas (ed.). (2007). Freedom from Poverty as a Human Right: Who Owes What tothe Very Poor? Oxford, UK: OUP
30. Ray, Aswini K. (2003). Human Rights Movement in India: A Historical Perspective. EPW.38(32): 3409-3415
31. Santos, Boaventura De Sousa. (2020). Toward new universal declaration of human rights(I). (see opendemocracy.net, accessed on 08/05/2020)
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33. Sengupta, Arjun. (2001).The Right to Development as a Human Right. EPW. XXXVI, July7: 467-480
South Asia Human Rights Documentation Centre. (2005). Introducing Human Rights: An Overview including Issues of Gender Justice, Environmental, and Consumer Law. New Delhi:OUP

34. Stammers, Neil. (1999). Social Movements and the Social Construction of Human Rights.Human Rights Quarterly. 21(4): 980-1008
35. Stein, Michael Ashley. (2007). Disability Human Rights. California Law Review. 95(1): 75-121
36. Toebes, Brigit. (1999). Towards an Improved Understanding of the International HumanRight to Health. Human Rights Quarterly. 21(3): 661-679
37. Tsutsui, Kiyoteru & Wotipka, Christine Min. (2004). Global Civil Society and the International Human Rights Movement: Citizen Participation in Human Rights International Nongovernmental Organizations. Social Forces. 83(2): 587-620
38. Zarsky, Lyuba. (2002). Human Rights and the Environment: Conflicts and Norms in aGlobalizing World. London: Earthscan Publication Ltd.

References:

1. Donnelly, Jack. (1999). Human Rights, Democracy, and Development. Human RightsQuarterly. 21(3): 608-632
2. Encyclopaedia of Britannica Online (for human rights & generational classification)
3. Forsythe, David P. (2009). Encyclopaedia of Human Rights. Oxford: OUP
4. Freeman, Michael. (2011). Human Rights: An Interdisciplinary Approach. Cambridge, UK:Polity
5. Haragopal, G. (1998). Political Economy of Human Rights: Emerging Dimensions.Mumbai: Himalaya Publishing House
6. Jochnick, Chris. (1999). Confronting the Impunity of Non-State Actors: New Fields for thePromotion of Human Rights. Human Rights Quarterly. 21(1): 56-79
7. Kushman, Thomas. (ed.). (2012). Handbook of Human Rights. London: Routledge
8. Moyn, Samuel. (2010). The Last Utopia: Human Rights in History. Cambridge: HarvardUniversity Press
9. Mutua, Makau. (2007). Standard Setting in Human Rights: Critique and Prognosis. HumanRights Quarterly. 29(3): 547-630
10. O'Hare, Ursula A. (1999). Realizing Human Rights for Women. Human Rights Quarterly.21(2): 364-402
11. Osiatynski, Wiktor. (2009). Human Rights and Their Limits. Cambridge, UK: CambridgeUniversity Press

Reports:

Amnesty International Reports
Gender Development Reports Human Development Reports Human Rights Watch Global ReportsIndia Development Reports
The State of Children (UNICEF)World Development Reports

Subject Code: (23 - SO244E)
Subject: Sociology of Social Work
Total Lectures=48

Unit	Topic	No. of lectures
I	**Introduction to social work** Concept definition and history of social work in India Approaches to social work – Welfare approach Development approach, empowerment approach, Social action and Rights based approach	10
II	**Basic Concepts and overview of practice methods related to Social Work.** **Basic concepts:** Social Development, social Advocacy, Participation, Social Security and safety Nets,Social Exclusion (marginalization, exploitation, oppression). **Overview of practice methods**: Social case work, social group work, communityorganization, Social action social research and social welfare administration. (Points to be covered - a. Definition b. Settings where each method is practiced c. Key differences between the methods and application d. underlying philosophy that integrates the methods)	14
III	**Fields of Social Work** Social work and families : women, children, youth and senior citizens Social work in health: physical, mental health and community health Correctional work: Prevention and rehabilitation Social work with communities (rural and urban) : environment, livelihoods andinfrastructure People with Special Needs: differently able, stigmatized groups Corporate social responsibility	14

IV	**Orientation visits to social organizations –** Report Writing & Presentation of Report	10

Reference Books;

Essential Readings:

1. AbhaVijai Prakash, (2000) Voluntary Organization and Social Welfare, ABD Pub.,Jaipur
2. Bhattacharya: Integrated Approach to Social Work in India, Jaipur : Raj PublishingHouse
3. Batra, Nitin (2004) Dynamics of Social Work in India, Jaipur : Raj Publishing House.
4. Barker, R.L. (1999). Milestones in the development of social work and social welfare Washington, DC: NASW Press.
5. Barker, R.L. (1999). Social work dictionary. (4th ed.). Washington, DC: NASW Press.
6. Daniel S. Sanders, Oscar Kurren, Joel Fischer(1981): Fundamentals of Social WorkPractice: A Book of Readings, Wadsworth Pub. Co. Michigan
7. DasguptaSugata (1967): Towards a Philosophy of Social Work in India, Popular BookServices for the Gandhian Institute of Studies
8. DayalParmeshwari(1986): Gandhian Approach to Social Work, Gujarat Vidyapeeth,
9. Desai, Murali (2002) Ideologies and Social Work (Historical and ContemporaryAnalysis), Jaipur :Rawat Publication.
10. Diwakar, V. D. (1991) Social Reform Movement in India, Mumbai : Popular Prakashan
11. Encyclopaedia of Social Work in India (1968): By India Planning Commission, India Committee on Encyclopaedia of Social Work in India, Published by Publications Division, Ministry of Information and Broadcasting,
12. Friedlander, Walter A. (1977) Concepts and Methods of Social Work, New DelhiPrentice Hall of India Pvt. Ltd.
13. Loewenberg Frank M, Dolgoff Ralph (1972): The Practice of Social Intervention:Goals, Roles &Strategies:A Book of Readings in Social Work Practice, Peacock Publishers.
14. Malcolm Payne, Jo Campling (1997): Modern Social Work Theory: [a criticalIntroduction) Lyceum Books.
15. Gangrade K. D(1976): Dimensions of Social Work in India: Case Studies, MarwahPublications
16. Richmond, M. (1922). What is social casework? New York: Russell Sage Foundation
17. Roy, Bailey and Phil, Lee (1982) Theory and Practice in Social Work, London : OxfordPub.Ltd.
18. Wadia A R (1968): History and Philosophy of Social Work in India (Edited), Publishedby Allied Publishers.

Progressive Education Society's

Modern College Of Arts, Science and Commerce, Ganeshkhind, Pune – 411 016

(Autonomous)

Syllabus for

M. COM. Part II

Introduction:

M.Com started in the academic year 2000-2001. The course is revised from 2022-23.

The course for regular students and having CBCS pattern. We offer two special courses named as Advanced Accountancy, Auditing and Taxation and Business Administration. The M. Com (Semester pattern with Credit System) degree Program shall be of 2 years' duration divided into two parts, Part I and Part II, and 4 semesters.

The M.Com. Course will be of Two Years duration consisting of two part. I.e. Part I and Part II. Each part is having Two Semesters. Thus, the M.Com. Course is of Four Semesters. For each Semester, there will be Four Papers of 100 marks each. M.Com. Degree will be of 1600 marks in aggregate.

Programme Objectives:

a. To equip and train Post Graduate students to accept the challenges of business world by providing opportunities for study and analysis of advanced commercial and business methods and processes.

b. To develop independent logical thinking and facilitate personality development.

c. To equip the students to seek suitable careers in management and entrepreneurship.

d. To acquaint students with significance of research in business.

e. To impart skills regarding methods of data collection and their interpretations.

f. To develop communication and analytical skills among students.

Programme Specific Outcomes (PSOs):

Group A: Advanced Accountancy, Taxation and Auditing

PSO1: Students acquires knowledge of techniques, methods systems of accountancy, Auditing and taxation.

PSO2: Students gets the knowledge of accounting standards and its application. PSO3: Develops the ability to solve the problems related to company accounts in various situations.

PSO4: Students understands the GST application and monitoring mechanism.

Group F: Business Administration

PSO1: Students apply the knowledge of thinking critically to solve the business problems.

PSO2: Students understands the professional values and ethics of business.

PSO3: Students demonstrate an understanding of factors affecting on business.

Examination Pattern:

The examination of regular students of M.Com. degree course of the University of Pune admitted in the academic session 2019-20 and after shall be based on: (a) Semester Examination (b) Continuous Assessment (c) Choice Based Credit System, and (d) Semester Grade Point Average and Cumulative Grade Point Average System

For each paper of 100 marks, there will be an Internal Assessment (1A) of 40 marks and the University Examination (UE) of 60 marks/ 3 hours duration at the end of each semester. A candidate who will secure at least 40% marks allotted to each paper will be given 4 credits. A candidate who does not pass the examination is any subject or subjects in one semester will be permitted to appear in such failed subject or subjects along with the papers of following semesters.

The Internal Assessment for each paper will be 40 marks, which will be carried out by the department during the term. The Internal Assessment may be in the forms of written test, seminars, term papers, presentations, assignments, orals or any such others.

There shall be four semester examinations: first semester examination at the middle of the first academic year and the second semester examination at the end of the first academic year. Similarly, the third and fourth semester examinations shall be held at the middle and the end of the second academic year, respectively.

The candidates shall be permitted to proceed from the first semester up to final semester irrespective of their failure in any of the semester examinations subject to the condition that the candidates should register for all the arrear subjects of earlier semesters along with current (Subsequent) semester subjects.

Suggested internal assessment tools for courses:

The concerned teacher shall announce the units for which internal assessment will take place. A teacher may choose one of the methods given below for the assessment.

1. Library notes
2. Students Seminar
3. Short Quizzes / MCQ Test
4. Home Assignments
5. Tutorials/ Practical
6. Oral test
7. Research Project
8. Group Discussion
9. Open Book Test

10. Study Tour
11. Written Test
12. PPT presentation
13. Field Visit
14. Industrial Visit
15. Viva

Teaching Methodology:

1. Classroom Teaching
2. Guest Lectures
3. Group Discussions
4. Surveys
5. Power Point Presentations
6. Visit to Institutions / Industries
7. Research Papers & Projects
8. E-content

Subject List

SEMESTER III

Sr. No.	Subject Type	Subject Code & Title	Credits			Total No.of Lectures
			Theory	Practical	Total	
1	Compulsory	23-COM231 Business Finance	4		16	45
2	Compulsory	23-COM232 Research Methodology For Business	4			45
3	Elective Group A	23-COM233(a) Advanced Auditing	4			45
4	Elective Group A	23-COM233(b) Specialized Auditing	4			45
5	Elective Group F	23-COM234(a) Human Resource Management	4			45
6	Elective Group F	23-COM234(b) Organizational Behavior	4			45

SEMESTER IV

Sr. No.	Subject Type	Subject Code & Title	Credits			Total No.of Lectures
			Theory	Practical	Total	
1	Compulsory	23-COM241 Capital Market & Financial Services	4		16	45
2	Compulsory	23-COM242 Industrial Economics Environment	4			45
3	Elective Group A	23-COM243(a) Recent advances in Accounting, Auditing and Taxation	4			45
4	Elective Group A	23-COM243(b) Project work/ Case Studies in Accounting, Auditing and Taxation	4			45
5	Elective Group F	23-COM244(a) Recent Advances in Business Administration	4			45
6	Elective Group F	23-COM244(b) Project Work/Case Studies in Business Administration	4			45

Syllabus

Semester III

Subject Code: 23-COM231

Subject: BUSINESS FINANCE

Total Lectures=45

Unit	Particulars	No of lecture
I	**Introduction to Business Finance** ▪ Meaning ▪ Objectives ▪ Scope and importance **Time Value of Money:** ▪ Need & Importance ▪ Future value ▪ Present value through discounted cash flow technique ▪ Calculating Time Value using Technology ▪ Introduction of IIR	10
II	**Strategic Financial Planning:** ▪ Meaning - objectives, assumptions, ▪ Steps in financial planning estimating financial requirements of firm ▪ Limitations of financial planning ▪ Capitalization - overcapitalization, undercapitalization, ▪ Theories of capitalization, ▪ Estimating financial needs and Sources of finance.	11
III	**Sources of Long term Finance:** ▪ Ownership securities - equity shares: characteristics, advantage ▪ and disadvantages ▪ Preference shares: characteristics, advantage and disadvantages ▪ Companies Act (Amendment) 2013 ▪ Creditor's securities- debentures: characteristics, classification, procedure of issuing debentures and Bonds. ▪ Company Deposit ▪ Deployment of long term finance	16
IV	**Short Term Finance and The Innovative Capital Market Instruments** ▪ Characteristics of short term finance – short term needs, ▪ Sources of short term finance	8

	▪ Role of working capital ▪ Best management practices of working capital **The Innovative Capital Market Instruments** ▪ Warrants ▪ Secured Premium Notes (SPN) ▪ PCD / NCD with Buyback Arrangements ▪ American Depository Receipts (ADRs) ▪ Global Depository Receipts (GDRs) ▪ Euro Commercial Papers (ECPs) ▪ External Commercial Borrowings (ECBs) ▪ Introduction to reading Balance Sheet ▪ Deployment of Short term finance	

Reference books:

1. Aswath Damodaram: Corporate Finance: Theory and Practice, Wiley International
2. Bhole L.M. and Mahakud Jitendra, 'Financial Institutions and Markets', Tata McGraw-Hill Education, Delhi.
3. Kuchal S.C., 'Corporate Finance', Chaitanya Publishing House, Allahabad
4. Kulkarni P.V., 'Business Finance', Himalaya Publishing House
5. Prasana Chandra, 'Financial Management: Theory and Practice'
6. William L. Maggiuson, Scott B. Smart, Lawrence J. Gitman, 'Principles of corporate finance', Cengage Learning Private Limited, Delhi.
7. Robert Kiyoski - 'CashFlow Quadrant'

Subject Code: 23-COM232

Subject: Research Methodology for Business

Total Lectures= 45

Unit	Particulars	No of lecture
I	• **Conceptual Framework of Business Research** • Introduction -Definition, Objectives, Significance • Types of Research • Criteria of research -features of a Good Research • Steps in Scientific Research Process • Research Methods versus Methodology • **Ethics and Modern practices in Research:** • EthicalIssues in Research – Plagiarism • Role of Computer in Research • Application of Statistical software- Introduction to SPSS	10
II	• **Formulation of the Research Problem, Development of the Research Hypotheses,Research Design& Sampling** • **Research Problem:** Defining the Research Problem,Techniques involved in Defining Research Problem **Review of Literature** • **Hypotheses:** Meaning, Definition & Types of Hypothesis, Formulation of the Hypotheses, Methods oftesting Hypothesis • **Research Design:** Meaning, Nature & Classification of Research Design, Need for Research Design, Phases/Steps in Research Design • **Sampling:** Meaning & definition of Sampling, Key terms in Sampling, Types of Sampling: Probability & • Non-probability, Sampling Errors	12
III	• **Collection and Interpretation of Data** • **Primary Data**: Methods of Data Collection, Merits & Demerits • **Secondary Data**: Internal & External Sources of Data Collection • Factors influencing choice of method of data collection Designing of a questionnaire – Meaning, types of questionnaires, Stages questionnaire designing, • Essentials of a good questionnaire, Schedule • **Measurement& Scaling:** Meaning & Types of Measurement Scale, Classification of Scales • **Processing of Data:** Editing, Coding, Classification & Tabulation. • **Analysis & Interpretation of Data:** Types of Analysis-	13

	Univariate, Bivariate and Multivariate Analysis of Data	
IV	• **Research Report andMode of Citation & Bibliography:** • **Testing of Hypothesis** • **Research Report:** Importance of Report Writing, Types of Research Reports, • Structure or Layout of Research Report • **Mode of Citation & Bibliography:** Author, Date, System, Footnote or Endnote System, Use of Notes.Position of Notes, Citing for the first time, Subsequent Citing, List of Abbreviation used in Citation, Mode of preparing a Bibliography, Classification of Entries, Bibliography Entries compared with Footnotes, Examples of Bibliography Entries • **Test of Hypothesis :** F test, T test, Z test, ANOVA test	10

Reference books:

1. Research Methodology-Methods &Techniques : C. R. Kothari, New Age International Publishers, New Delhi
2. Research Methodology, Dipak Kumar Bhattacharyya, Excel Books, New Delhi
3. Research Methodology-Methods & Techniques , Anil Kumar Gupta, Value Education of India, New Delhi
4. Research Methodology-Concepts and Cases, Deepak Chawla & Neena Sondhi , Vikas Publishing House Pvt.
5. Ltd, New Delhi
6. Research Methods, Ram Ahuja, Rawat Publications, Jaipur
7. Methodology & Techniques of Social Research, P. L. Bhandarkar, T. S. Wilkison & D. K. Laldas, Himalaya Publishing House, Mumbai
8. Legal Research and Writing Methods, Anwarul Yaqin, LexisNexis Butterworths, Nagpur
9. Business Research Methods, Donald R. Cooper & Pamela S. Schindler, Tata McGraw- Hill Edition , New Delhi

Subject Code: 23-COM233(a)

Subject: Advanced Auditing

Total Lectures=45

Unit	Contents	No of lecture
I	**Introduction** • Overview of Auditing • Overview of Standard setting process • Role of Auditing and Assurance Standard Board in India • A Brief Study of Standards on Auditing issued by the ICAI (SQC:1, SA230,SA500,SA 530,SA 570)	12
II	**Audit of Joint Stock Companies** • Preliminaries to the audit of limited company • Audit of share capital transactions • Debentures and other transactions • Audit report with special reference to CARO 2020 • Profit and divisible profit Dividends • Investigation	12
III	**Audit Committee and Corporate Governance** • Corporate Governance: Introduction, Verification of Compliance of Corporate Governance • Audit Committee: Constitution, Powers of Audit Committee • CEO/CFO Certification to Board • Report on Corporate Governance	12
IV	**Computerized Information System (CIS) Environment** • Special aspects of CIS Audit Environment • Need for review of internal control • Use of Computers for Audit purposes Audit tools - Test packs • Computerized audit programme	09

Reference books:

1 Contemporary Auditing, Kamal Gupta, S. Chand Publication

2 Auditing, R. C. Saxena, S. Chand Publication

3 Auditing, Basu, Pearson Publication

4 Modern Internal Auditing, Anil Roy Chaudhary, Kamal Law House

5 Internal Auditing, V. S. Agarwal

6 Guidance Note on Tax Audit u/s 44 AB of the Income Tax Act, The Institute of Chartered Accountants of India

Subject Code: 23-COM233(b)

Subject: Specialized Auditing

Total Lectures= 45

Unit		No of lecture
I	• **Audit Under Tax Laws** • Tax Audit U/s 44 AB of Income Tax Act, 1961- Form 3 CA, 3 CB and 3 CD - Audit under GST Law • Steps to be taken by Auditor - Audit under GST Law – GST Audit Procedure	10
II	• **Internal Audit** • Nature, Scope and Purpose of Internal Audit - Review of Internal Control • Areas of Internal Audit - Purchase, sale, cash, bank transactions - Internal Audit Report.	10
III	• **Audit of Banks** • Salient features of enactments affecting Banks - Bank Audit, its approach Steps in Bank Audit • Checking of Assets and Liabilities - Scrutiny of • Profit & Loss items - Audit Report of Banks - Long Form Audit Report	12
IV	• Audit of Co-operative Societies Introduction to Audit of Trusts • Provisions of Maharashtra State Co-operative Societies Act 2013 and Multistate Co-operative Societies Act 2002. • Special features of Audit of Cooperative Societies. Audit of o Co-operative Consumers Stores, o Salary earners Co-operative Society o Co-operative Housing Societies, o Urban Cooperative Credit Society. • Audit Report of Co- operative Societies • Audit of Trusts	13

Reference books:

1. Contemporary Auditing (Sixth Edition), Kamal Gupta, Tata McGraw-Hill Publishing Co., New Delhi
2. Auditing, R.C.Saxsena, Mrs. N. Padmalata , Himalaya publication, New Delhi
3. Fundamentals of Auditing, S.K.Basu, Pearson Publications, New Delhi
4. Modern Internal Auditing, Anil Roy Chaudhary, Kamal Law House, Kolkatta, New Delhi
5. A Handbook of Practical Auditing, B.N. Tondon, S.sudharaman,S.Sudhaprabhu, S.Chand publications, New Delhi
6. GST Audit & Annual returns, Aditya Singhaniya, Taxman, New Delhi

Subject Code: 23-COM234(a)

Subject: Human Resources Management

Total Lectures=45

Unit	Contents	No. of Lectures
I	**An Overview: Human Resource Management** • Meaning & Definition of HRM • Nature & Scope of HRM • Features & Functions of HRM • Need & Importance of HRM • Principles of HRM • Challenges of HRM	12
II	**Human Recourse Acquisition** • Meaning & Definition of HRP • Features & Objectives of HRP • Need & Importance of HRP • Steps of HRP • Problems & Limitations of HRP • Guidelines for making HRP effective • Difference between Human Resource Planning & Manpower Planning	08
III	**Recruitment and Selection**, **Training and Development** **Part A-Recruitment & Selection** • Meaning of Recruitment and Selection • Difference Between Recruitment and Selection • Various Sources of Recruitment • Interview & Types of Interview • Tests And Types of Test • Part B-Training & Development • Meaning of Training • Importance of Training • Benefits of Training • Training Process & Methodology • Methods of Training • Evaluation & Feedback	13

IV	**PerformanceAppraisal and Merit Rating** Part A-Performance Appraisal • Definition of Performance Appraisal • Methods of Performance Appraisal • Result Based Performance • Appraisal Errors • Ethics in Performance Appraisal • Difference between Performance Appraisal & Merit rating Part B- Merit Rating • Merit Rating • Promotion • Transfer • Job Description • Job Evaluation • Job Enlargement • Job Enrichment • Job Rotation	12

Reference books:

1 A Textbook of Human Resource Management, C.B. Mamoria, S.V. Gankar

2 Personnel Management, Edwin B. Flippo, MacMillan India

3 Human Resource and Personnel Management: Text and Cases, K. Ashwathappa

4 Human Resource Management, V.S.P. Rao

5 Managing Human Resources, Arun Monappa, MacMillan India, 1997

6 Human Resource Management, Ivancevich, J.M. Tata McGraw Hill

Subject Code: 23-COM234(b)

Subject: Organizational Behaviour

Total Lectures=45

Unit		No of lectures
1	**Introduction to Organizational Behaviour.** • Definition and Objectives of Organizational Behaviour. • Conceptual Study of Organizational Behaviour. • Role of Information Technology in Organization. • Impact of Globalization on Organizational Behavior • Five Model of Organizational Behavior • Meaning of Personality, Attributes of Personality • Dimensions of Attitude, Attitude Change	**12**
II	**Organizational Change from People's Perspective** • Concept of Organizational Change • Goals and Types of Organizational Change • Forces of Change • Change Process • Employee Vs Employer Perspective • Study of Models in Managed Change • Change Agents and their Characteristics • Resistance to Change • Overcoming Resistance to Change • Learning organization Vs Organizational learning	**13**
III	**Emotional Intelligence & Job Satisfaction** • Emotional Intelligence- meaning, Characteristics • Importance of Emotional Intelligence in the Workplace • Job Enrichment • Job Satisfaction and outcomes • Meaning and causes of stress, effects of stress and managing stress • Psychological Models for stress management • Case study	**10**

IV	**Group dynamics and Team Building** • Group Dynamics- Concept of Groups, Types of Groups • Concept of Team, Types of Teams and Team Building • Aspects of cross functional team • Challenges faced while working in team in Multinational Companies.	**10**

Reference Books:

1. Organizational Behaviour -Freud Luthans
2. Human Behaviour at Work -J W Newstorm
3. Organisation Behaviour : Text and Cases -Games K, Aswathappa
4. Organisational Behaviour -Dr Mrs Oka & Mrs Kulkarni
5. Introducing Organisational Behaviour- J.Mike Smith (View at google .co.in)
6. Management Process and Organizational Behaviour – Karam Pal

Semester IV

Subject Code: 23-COM241

Subject: Capital Market and Financial Services

Total Lectures=45

Unit	Contents	No of lectures
I	**Capital Market** i Meaning, Functions, Structures, Characteristics, Participants of Capital Market ii Capital Market Instruments • Equity Shares • Preference Shares • Debenture iii Innovative Debt Instruments • Junk Bonds • Naked Bonds • Deep Discount Bonds iv Types of Contracts • Forward Contract • Future Contract • Option Contract v Trends in Capital Market	12
II	**Stock Market** i Stock Exchange: • Organization • Membership • Governing body • Bombay stock exchange • National Stock Exchange ii Primary Market • Functions of primary market • Issue mechanism • Procedure of IPO • Participants • Prospectus iii Secondary Market • Objectives of Secondary Market • Functions of Secondary Markets • Stock Broking • E-Broking • Depository System • Functions of Stock Market iv Benefits Stock Market	12

III	**FINANCIAL SERVICES** i Merchant Banking and Underwriting i. A. Meaning and Functions of Merchant Banking ii Services Rendered A. Mutual funds • Meaning of Mutual Funds • Functions of Mutual Funds • Types of Mutual Funds • Open and Closed Ended Funds • Income Funds • Balanced Fund • Growth Fund • Index Fund B. Credit Rating • Meaning of Credit Rating • Need of Credit Rating • Various Credit Rating Agencies in India • Foreign Direct Invest	12
IV	**Portfolio Management** i Meaning of Portfolio Management ii Objectives of Portfolio Management iii Types of Portfolio Management iv Process in Portfolio Management v Significance of Portfolio Management vi Meaning of Portfolio Manager vii Roles &Responsibilities of Portfolio Manager	09

Reference:

1 Indian Financial System, M. Y. Khan,Tata McGraw Hill Publishing Co. Ltd.

2 Capital Markets Institutions and Instruments, Franck J. Fabozzi, Franco Modigilani, Prentice Hall of India, New Delhi

3 Financial Markets and Institutions, Fredric Mishkin, Stanley Eakins, Pearson Prentice Hall

4 Capital Market in India, Rajesh Chakrabarthi

5 Indian Capital Market, NidhiBothra, Payel Jain, Vinod Kothari & Co.

Subject Code: 23-COM242

Subject: Industrial Economic Environment

Total Lectures=45

Sr. No	Topic	No. of Lectures
I	**Industrial Economic Environment** • Industry: Meaning and Classification • Economic Environment : Meaning and Definitions • Importance of Economic Environment • Factors Affecting Economic Environment • Role of Economic Environment in Industrial Development • Industry 4.0	**10**
II	**Industrial Growth and Pattern in Indian Economy** • Role of Industries in Economic Development of India • Public Sector industries –Role, Problems and Present Situation • Small Scale and Cottage Industries – Meaning, Role and Problems • Multinational Corporations and Indian Economy- Progress and Problems • Industrial Imbalance: Causes and Measures	**10**
III	**Industrial Policies in India** • Meaning of Industrial Policy • Industrial Policy of 1991 – Features and Impact • Special Economic Zone- Progress and Problems • Liberalization, Privatization and Globalization – Meaning, and Nature • Liberalization, Privatization and Globalization: Arguments for and Against • Impact of Globalization on Indian Industry • MRTP and CCI Act • Recent Industrial Policies	**14**
IV	**Major Industries in India** • Industries under informal sector, Agriculture and Allied Industries, Problem, Challenges and Actions, programs for development of Industries under Informal and Agriculture Sector. • Importance of Major Industries in India • Iron and Steel Industry: Progress and Problems • Cotton Textile Industry : Progress and Problems • Sugar Industry : Progress and Problems • Cement Industry : Progress and Problems • Service Industry: Information Technology Industry and Tourism Industry – Progress and Problems • Farmer Producer Committee	**11**

Reference Books :

1. Business Environment, Francis Cherunilam ,Himalaya Publishing House Pvt. Ltd., Mumbai
2. Economics of Environment, Garg M. R, RBSA Publishers, Jaipur
3. Environmental Economics, Singh G. N. Singh G. N. Mittal Publications, New Delhi
4. Industrial Growth in India, Ahluwalia J. J, Oxford University Press, New Delhi
5. Industrial Economics in India, Desai B., Himalaya Publishing House Pvt. Ltd., Mumbai
6. Industrial Economics, Birthwal R. R., Wiley Eastern Ltd., New Delhi
7. Environmental Economics: Theory & Applications., Singh & Shishodia, Sage Publication, New Delhi
8. Economics of Environment of Business (with case studies), Puri V. K., Mishra S. K., Himalaya Publishing House Pvt. Ltd.. Mumbai
9. Indian Economy Its Growing Dimensions., Dhar P. K., Kalyani Publishers, New Delhi
10. Datt & Sundharam's Indian Economy, Gaurav Datt & Ashwini Mahajan, S. Chand & Company Ltd., New Delhi
11. Industrial Economics, Singh A & A.N. Sadhu, Himalaya Publishing House Pvt. Ltd., Bombay
12. Indian Economy- Its Development Experience., Puri V. K., Mishra S. K., Himalaya Publishing House Pvt. Ltd., Mumbai
13. Indian Economy, Tandon B. B., Tandon K. K., McGraw Hill Publishing Company Ltd., New Delhi
14. Indian Economy: Problems of Development & Planning., Agrawal A. N., New Age International, New Delhi
15. India's Economic Policies., Jalan B., Viking, New Delhi
16. Industrial Economics – Indian Perspective, Francis Cherunilam, Himalaya Publishing House.

Subject Code: 23-COM243(a)

Subject: Recent Advances in Accounting and Auditing

Total Lectures=45

Unit	Contents	No of lectures
I	**Recent Trends in Accounting** i.Inflation Accounting: Introduction, Methods, Merits and Demerits ii.Creative Accounting : Introduction, Meaning and Techniques iii.Forensic Accounting : Introduction, Meaning and Definitions and Uses iv.Lean Accounting : Introduction, Meaning and Definitions and Scope	12
II	**Advanced Accounting For Corporates** i. Human Resource Accounting: Introduction, Scope, Objectives, Importance ii.Environmental Accounting: Meaning, Benefits and Scope and Importance iii IPR Accounting: Introduction, Scope, Importance iv ESOP Accounting: Introduction, Scope, Importance	12
III	**Accounting For NGO** i.Introduction ii. Accounting for NGO Grants and Present Practices iii.Applicability of Accounting Standards to NGO's	12
IV	**Technology Based Accounting** i. Cloud Accounting ii. Block Chain Accounting iii. Role of Artificial Intelligence In Accounting iv. Automated Accounting Process v. Role of Big Data in Accounting	09

Reference Books:

1 Journal of Accounting & Finance, Accounting Research Foundation, Jaipur

2 Journal of Indian Accounting Association, Indian Accounting Association, Jaipur

3 Management Accountant, ICWA, Kolkatta

4 The Chartered Accountant, The ICAI, New Delhi

5 The Accounting World, The ICFAI University Press, Dehradun

Subject Code: 23-COM243(b)

Subject: Project work/ Case Studies in Accounting, Auditing and Taxation

Total Lectures= 45

Project Work in Accounting and Taxation A student can select any topic relating to principles practices and procedures of accounting auditing taxation and management accounting. Any topic from the syllabus of the papers studied at M Com. Part One or Part Two under special paper Accountancy & Taxation can be of a use. Pick up any unit studied and try to connect it to commercial word around e.g. in taxation a student has studied taxation of a company, then he can select a topic Tax Planning of a particular company or a study of taxation of an educational institute. On this line following areas have been listed out for project work in Accountancy.

Area of Project Work in Accounting: - Following is the list of topics for project work in accounting.

1. Financial statement Analysis of – a. A Limited Company for 5 years b. Five Companies of five different industries c. Five companies of one industry e.g. Automobile, Engineering, Textile d. Five banks from Private sector/Co-op. sector
2. Study of Working Capital Management of a large Company.
3. Study of Budgetary Control System of four Companies
4. Study of Management Information System of four Companies.
5. Procedure of preparation of Consolidated Balance Sheet by Holding Company having two / three subsidiaries' companies.
6. Valuation of Shares of 10 unlisted Companies.
7. A study of Amalgamation/Merger of procedure of two Companies (Accounting procedure)
8. A comparative study of Accounting System of Hotel industry – Five Star, Three stars, large Hotel and small Hotel.
9. Comparative study of Accounting of Hospitals from Private sector, Trust and Small Hospital.
10. Study of Accounting for Grants to school, colleges, hospitals
11. Human Resource Accounting for Software, Marketing, Consulting Company
12. Social Accounting in Ltd. Company
13. Preparation of Value Added Statements of a Company and its comparison with Conventional Accounting Statement.
14. Preparation of Economic Value Added Statement of a Company and its comparison with Conventional Accounting Statement.
15. A study of Application of Accounting Standards of five Companies.
16. Audit planning of five firms of Auditors.
17. A study internal Audit system of four companies.
18. Tax planning of 10 assesses
19. Tax Planning regarding purchase of House Property.
20. Tax planning of Partnership Firm/ Limited Company.
21. Taxation of Public Trust
22. A study of Perquisites and its impact on Taxable Income Employees from 10 different companies.
23. A study of ten Export Oriented Units from Taxation point of view.
24. Financial viability of five Co-operative Sugar Factories.
25. Comparative Study of Taxable Inco

Subject Code: 23-COM244(a)

Subject : Recent Advances in Business Administration

Total Lectures= 45

Units	Metabolism Topic	No. of Lectures
1	**Recent Development in Business Administration** • Change management – Concept, Significance.Managing change-Important feature • Principals of change Management • Dimensions Approaches towards managing • change • Futuristic and strategic approach toward changing business environment • A study of Change Management Models in MNCs • Case Study	10
2	**CustomerCentric Approach & Total Quality Management** • Customer centric approach – meaningdefinition, strategies, internal and external customers, full 360 view of the customer. • The challenges of becoming a customer- centric company • Best practices to becoming a customer-centric company • Technological adoptions for better customer services • Total Quality Management – Introduction • Principles of Total Quality Management • Implementing TQM Program • Changing TQM Environment • Pitfalls in Implementing TQM	12
3	**Cross- Cultural Management System** • Global management system- Concept,&Significance. • Issues in cross cultural management. • Acquisition & Mergers- Role & importance • Current Trends in acquisitions & mergers onnational & international scenario • Employee leasing- Concept and Practices	11

4	**Turn Around and InnovationManagement** • Turn around Management - Concept &Significance, Techniques prerequisite for success. • Restructuring & Reengineering of business - Concept of innovation, Types of Innovation, Advantages and Significances of Innovation. • Innovation Management models • Case Study in Innovation Management • Role of Government and Private Institutions in promoting innovation	**12**

Reference Books :

1. Change Management - Jeffrey M. Hiatte
2. Theory and Practice of Change Management- John Hayes
3. The Total Quality Management - L. Suganthi, Anand Samual
4. Total Quality Management: Text and Cases, Jankiraman
5. Turnaround Strategy A. K. Mukharji
6. Quantitative Models for Supply Chain Management, Sridhar Tayur, Ram Ganeshan, Kluwer Academic Publishers
7. Introduction to Supply Chain Management, R.B. Handfield, E.L. Nochols, Prentice Hall

Subject Code : 23-COM244(b)

Subject: Project work/ Case Studies in Business Administration

Total Lectures= 45

There is project work for internal students only. **T**here will be a project work carrying 100 marks for internal students only. The students will have to select a subject from any area of the syllabi for Business- Administration. The students will have to work under the guidance of concerned subject teacher. The project work will carry 100 marks out of which 50 marks for synopsis and 50 will be allotted for project viva and project report. Viva to be conducted by Internal teacher and External teacher appointed by the university.

Students can do the projects in following areas:

1. Performance appraisal of company with 720 degree analysis
2. A study of lower/middle/top level management banks/private/public sector employees job satisfaction
3. A study of stress management related to the work in IT sector
4. A Study of cross culture management issues in multinational companies
5. A study of ERP System of a private/public sector organization.
6. A comparative study of the impact of team work in two departments of an organization.
7. A study on overcoming of negative emotions and boosting motivation of managers in private/public sector organization.
8. A study on emotional intelligence amongst female employees at workplace in private/public sector employees.
9. A study of work-life balance of employees in an organization.
10. A study of work culture and work ethics in an organization.
11. A study of impact of Training of employees in an bank/private/public sector organization.
12. A study of impact and role of Job Rotation for the Positive outcome.(A case study)
13. A study on the pros and cons of VRS to employer and employees in an organization
14. A study of the HR environment of two companies.
15. A study on the prospects of manpower planning in organization.
16. A study of the awareness and utility of HRD and HRM in an organization.
17. A study on the problems related to job transfers of employees especially with reference to female employees.
18. An overview of ethics in performance appraisal in an organization.
19. A study of the HR environment of two companies.
20. A Study of the HR challenges in Employing Generation
21. A study of the HR challenges in Indian culture in Multinational companies

Progressive Education Society's

Modern College of Arts, Science and Commerce

Ganeshkhind, Pune – 411 016

(Autonomous)

Syllabus for

M. Sc.- II Biotechnology

Preamble and Introduction

Preamble:

Biotechnology has grown, extensively in last couple of decades. This advanced 'interdisciplinary' life science branch encompasses areas viz. molecular biology, genetics, biochemistry, microbiology, immunology, virology, plant and animal tissue culture, chemistry and engineering. It is a fast emerging "cutting edge" science with distinctive advantages as it finds applications in practically all aspects of life. The subject offers exciting opportunities in various fields from basic research to industry-oriented career. Global and local focus has slowly shifted to using knowledge of life Science for innovative technology development that is being used for betterment of human life. Many fundamental research fields from cell biology to molecular biology, from biochemistry to biophysics, from genetic engineering to stem cell research, from bioinformatics to genomics-proteomics, from environmental biology and to biodiversity, from microbiology to bioprocess engineering, from bioremediation to Insilco drug discovery etc. comes under the umbrella of Biotechnology.

The proposed choice-based credit curriculum and grading system will cater to the existing interdisciplinary nature of biotechnology can also offer many courses to the other branches of life science. The generative power of biological data is effectively harnessed by biotechnology like no other field. Economic and social renaissance is staged on biotechnology especially, since it's biomedical and cutting-edge technological applications are tremendously powerful in shaping this century and exciting biofuture. Keeping in view the expanse and applications of Biotechnology in every field, there is going to be a perpetual demand for resource personnel with Biotechnology specialization. The post graduate program is aimed to cater to this ever-increasing demand and to groom the students to excel in their future career. Education and research sectors require such interdisciplinary trained workforce to develop future generations of science leaders.

Introduction:

MSc in Biotechnology program syllabi is designed to cater to the needs of credit-based semester and grading system. The changing scenario of higher education in India and abroad is taken into consideration while restructuring this syllabus and more oriented towards current need of modern research and industrial sectors. The syllabus encompasses the fundamental academics at one end and latest technologies in life science at the other. Theory courses will help students develop their knowledge sets on various topics of biotechnology, to which, they are introduced at the undergraduate level. Extensive practical courses are designed to supplement the theory courses with hands on experimentation in wet-lab and on fields. Empowerment of students to

face research and industrial outlets is at the center of this syllabus. Students having to select their own courses will develop the depth in specialization and also make them ready to face the upcoming scientific advances in the world without any further training. M.Sc. syllabus has been prepared keeping in vision the undergraduate curriculum. At the undergraduate level, students were introduced to many fundamental topics in life sciences such as molecular biology, developmental biology, fermentation technology, biodiversity, bioinformatics and tissue culture etc. At the post graduate level, they will be also be acquainted with the thrust/new areas of biotechnology like bioinformatics, clinical research, data base management, IPR, Food Technology etc. to give the students the advantage of not only learning these subjects but also give them the edge over others in their employability. A research project/ industrial training modules are incorporated to provide a buffer zone for budding biotechnologists eager to enter the life science sector.

Program Objectives:

- To help the students to build interdisciplinary approach
- To empower students to excel in various research fields of Life Sciences
- To inculcate sense of scientific responsibilities for social and environment awareness.
- To acquaint the students with thrust areas of biotechnology
- To adapt the internationally acknowledged Choice Based Credit System (CBCS) that offers opportunities to learn core subjects and to explore additional avenues of learning beyond the core subjects for complete development of an individual.

Program Specific Outcomes (PSOs):

Program Outcomes:

Knowledge Outcomes:

After successful completion of M.Sc. Biotechnology program, the students should be able:

PO 1: to get substantial knowledge in Biotechnology and allied fields

PO 2: to visualize the current and future trends in science, life sciences and inter-disciplinary fields.

PO 3: to apply the knowledge of biotechnological tools and principles for human and environment welfare

PO 4: to acquire knowledge and competence for clearing examinations such as UGC/CSIR-NET, ARS-NET, GATE, ICMR and DBT JRF for pursuing higher studies

Skill Outcomes:

After successful completion of M.Sc. Biotechnology program, the students should be able:

PO 5: to design, perform experiments, analyze and interpret data for investigating complex problems in subjects covered in the program

PO 6: to develop oral and written skills for effective communication

PO 7: to develop commercially viable processes and technologies in biotechnology related areas

Generic Competence:

The students will be:

PO 8: able to understand the need and impact of biotechnological tools, techniques and solutions to the problems and issues pertaining to environment and society in view and need for sustainable solution

PO 9: aware in social, ethical, and professional issues of contemporary practices in biotechnology and related fields

PO 10: able to undertake the responsibilities as an individual and as a team in a multidisciplinary environment

Program-specific / Course outcomes

Semester 3

23MBT 301 Animal and Stem Cell Technology

The students on successful completion of the course should be able to:

CO1: Different vectors that are used for generating transgenic animals.

CO2: All types of media used for culturing animal cells.

CO3: Various cell lines used for production of therapeutic products.

CO4: Different culture systems such as 2-dimensional culture and 3-dimensional cultures.

CO5: Several animal husbandry techniques such as artificial insemination, embryo transfer technology.

CO6: Understand growth studies such as cell proliferation, cell cycle and mitosis.

CO7: Estimate the viability and cytotoxicity, cell transformation, microscopic examination and passage number

23MBT 302: Bioprocess Engineering

On successful completion of the course, the students should be able to:

CO1 Design bioreactors for the production of various products

CO2. Predict important yield coefficients using the principles of stoichiometry and energetics of microbial growth

CO3. Understand soluble and immobilized enzyme technologies for the production of industrial and medical products

CO4. Evaluate factors that contribute in enhancement of cell and product, process improvement through metabolic manipulations

CO5. Understand the rationale in medium optimization and formulation

CO6. Understand the kinetics of death

CO7. Specify required technologies to effectively utilize genetically engineered microorganisms for bioprocessing

23MBT 303: Bioinformatics and Biostatistics

On successful completion of the course, the students should be able to:

CO1: Understand and use publicly available Databases like PubMed/NCBI/DDBJ/EMBL/UniProt/PDB

CO2: Retrieval of sequences and sequence analysis by: BLAST, FASTA

CO3: Understand and Perform Protein classification, domain identification, signature matching PFAM, Prodom, Prosite

CO4: Understand Phylogenetic analysis

CO5: Understand different data presentation models and hypothesis testing with type I and type II errors

CO6: Statistically design experiments and data analysis

CO7: Analyse variance table (ANOVA) and post hoc tests

CO8: Learn Tukey's test, Dunnet's test, Duncan's test and Mann-Whitney U test.

23MBT 304: Laboratory Course IV (P)

On successful completion, the students should be able to learn and demonstrate:

CO1: Perform initiation of primary cell culture form chick embryo

CO2: Design and perform sub-culturing/establishment of cell line

CO3: Estimate the growth curve analysis of cell line

CO4: Demonstrate cryopreservation of animal cell

CO5: Perform and analyse chromosome spread preparation from animal cell line

CO6: Learn the importance and methods of screening and identification of a production strain from environmental samples.

CO7: Understand the need and methods of maintenance of the production strain

CO8: Learn the concept and methods of medium optimization for laboratory scale production

CO9: Learn Working of lab bench fermenter

CO10: Understand the method of recovery and assay of product formed

CO11: Learn the concept and process of solid-state fermentation

CO12: Understand the working of fermentation process by visit to fermentation industry

CO13: Determine Karl-Pearson's coefficient of correlation from the given data.

CO14: Analyze variants on given data by ANOVA

CO15: Estimate measure of skewness and kurtosis of the given data

CO16: Perform t-test and Chi-square test

CO17: Students will be able to learn the access of various bioinformatics tools for their research purpose.

CO18: Students will learn to analyze the sequence alignment files using BLAST and CLUSTALW tools.

CO19: Students can perform phylogenetic analysis using Phylip or Mega 14 software.

CO20: Students can predict and visualize the protein structure and its various conformations using SWISS Model, MODELLER, CPH, EasyModeler and DeepView software.

23MBT 306: Agricultural Biotechnology (T)

On successful completion of the course, the students should be able to:

CO1. Understand and explore biotechnological tools for large-scale in vitro plant propagation.

CO2. Understand the insights about commercial transgenic plants e.g. golden rice

CO3. Learn and explore marker assisted selection and plant breeding

CO4. Learn about the development of biofertilizers and bioinoculants for plant growth and yield enhancement

MBT 306P: Agricultural Biotechnology (P)

On successful completion, the students should be able to learn and demonstrate:

CO1. Virus indexing methodology

CO2. Plant suspension cultures

CO3. Endosperm culture

CO4. The development of bioinoculants and bioformulations

Semester 4

23MBT 401: Genomics and proteomics

On successful completion of the course, the students should be able to:

CO1. Understand the current methodologies and trends in the field of genomics and proteomics

CO2. Obtain an overview and awareness of typical genomics and proteomics applications.

CO3. Describe and discuss the possibilities and advantages, and the complexity and drawbacks of various genomics and proteomics technologies

CO4. Compare traditional methods with emerging technologies

CO5. Suggest suitable approaches for specified applications and motivate the choice

CO6. Speculate and argue about the future of genomics and proteomics technologies

CO7. Evaluate scientific results in the field of genomics and proteomics

CO8. Concept clearance of protein expression proteomics, structural proteomics, and functional proteomics

CO9. Learn MALDI-TOF, ESI tandem, Ion trap, Peptide mass fingerprinting, protein-protein interaction and protein DNA interaction

CO10. Evaluate, perform and analyse proteomics and protein microarrays, databases and allied bioinformatics tools

CO11. Apply the learned knowledge in health care, disease diagnosis, and identification and characterisation of novel proteins

23MBT 402: Advanced Bio-analytical Techniques

On successful completion of the course, the students should be able to:

CO1: Analyse staining and visualization of cells and subcellular components

CO2: Understand different Electron microscopy techniques such as SEM, TEM, Confocal microscopy and single cell imaging

CO3: Learn detection of antigens using ELISA, RIA, Western bot and stem cell markers

CO4: Analyse Flow cytometry, FISH, GISH and FACS

CO5: Estimate molecular structure determination using X-ray diffraction and X-ray crystallography, and molecular analysis using light scattering, Mass spectroscopy and LC-MS and Surface plasmon resonance methods

CO6: Understand and analyse different advanced chromatographic techniques of HPTLC, HPLC, GLC, GC, and Affinity chromatography

CO7: Learn IF and 2D electrophoresis, capillary electrophoresis, DGGE

CO8: Learn advances in PCR technology, NGS and different automated microbial identification systems

CO9: Apply learned advanced PCR, spectroscopy and microscopy knowledge in clinical research and environmental laboratories

23MBT 405: Pharmaceutical Biotechnology & Drug Designing

On successful completion, the students should be able to:

CO1. Learn and understand the pathogenesis in diseases such as diabetes, cancer, inflammatory disease and infectious diseases

CO2. Learn to identify the targets used for designing drugs against the above diseases

CO3. Learn the mode of action of drugs used for treatment of diabetes, cancer, inflammatory disease and infectious diseases

CO4. Understand the mechanisms involved in developing drug resistance against antibiotic and anticancer drugs

CO5. Judge the gravity of drug resistance on the scale of MDR, XDR and PDR and the alternate treatment methods to combat drug resistance

CO6. Learn the upstream and downstream processes for production of therapeutics at industrial scale

CO7. Learn and practice the molecular docking methods and apply molecular docking for high throughput screening

CO8. Learn about various software used for docking

CO9. Understand the biotechnological approaches for drug discovery and design

CO10. Learn different concepts such as Pharmacodynamics, pharmacokinetics, drug metabolism, Drug tolerance & intolerance, drug allergy, drug induced side effects

CO11. Learn and understand the principles of the new biotechnology-based assays

CO12. Understand the therapeutic potential of plant products

CO13. Learn the process of drug development from target identification to the launch of new drug in the market

CO14. Understand the importance of pre-clinical and clinical studies in the process of drug development

CO15. Understand the regulatory aspects involved in progressing a new drug to market

CO16. Learn the essentials of Indian drug regulations and pharmacopeia

CO17. Understand the role of regulatory authorities in the process of drug development

23MBT 406: Research Methodology & Scientific Communication

On successful completion, the students should be able to:

CO1: Learn applications of different types of research philosophies and research methods in solving issues related to the mankind.

CO2: Understand the critical components required for designing a research proposal and consecutive work flow.

CO3: Learn techniques and applications of primary as well as secondary data collection

CO4: Apply statistical software and other computer programmes to process collected data.

CO5: Students will learn to understand organization of research data using various routinely laboratory practices.

CO6: Students will understand the principles and laws of ethics in conducting an authentic research and consequences of failing to follow.

CO7: Get familiar with different types of research practices like accessing and reading journals, calculating citation index and impact factor and many other.

CO8: Understand importance of different modes of scientific communications in research practices.

CO9: Learn to write and present a report writing for successful completion of this programme.

Examination Pattern:

30:70 [Continuous Internal Evaluation: Formative, Summative and End semester exam (ESE)]
Evaluation of Students:

1) The Internal evaluation will be in form of continuous assessment format of 15 marks and End-Semester examinations will be of 35 marks making total to 50.
2) Student has to obtain 40% marks in the examination of In-Semester and End-Semester assessment. Separate passing is mandatory
4) Internal marks remain unchanged and internal assessment cannot be repeated. If student remain absent during internal assessment examination, he/she will have chance with the permission of the competent authority. But it will not be right of the student. It will be under the discretion of the competent authority and internal departmental assessment committee. In case he/she wants to repeat Internal, he/she can do so only by registering for the said courses.

In-semester Examination: Internal assessment for each course would be continuous and dates for each tutorials/practical tests etc. will be pre-notified in the time table for teaching or placed separately as a part of time table. Department/ College Internal Assessment Committee will coordinate this activity.

Suggested internal assessment tools for courses:

The concerned teacher shall announce the units for which internal assessment will take place. A teacher may choose one of the methods given below for the assessment.

1. Students Seminar

2. Short Quizzes / MCQ Test
3. Home Assignments
4. Tutorials/ Practical
5. Oral test
6. Research Project
7. Group Discussion
8. Open Book Test
9. Study Tour
10. Written Test
11. PPT presentation
12. Field Visit
13. Industrial Visit
14. Viva

Teaching Methodology:

1. Classroom Teaching
2. Guest Lectures
3. Group Discussions
4. Surveys
5. Power Point Presentations
6. Visit to Institutions / Industries
7. Research Papers & Projects
8. E-content

Subject List

Semester III

Course code	Course Title	Credits
Core Compulsory Theory Papers (CCTP)		
23MBT- 301	Animal & Stem Cell technology	4 Credits
23MBT- 302	Bioprocess engineering	4 Credits
23MBT- 303	Bioinformatics & Biostatistics	4 Credits
Core Compulsory Practical Course : CCPP-1		
23MBT - 304	Laboratory Course IV- Animal Biotechnology, Bioprocess engineering &Bioinformatics & Biostatistics	4 Credits
Choice Based Optional Papers: CBOP (any One)		
23MBT - 305	Quality Control, Bio safety & Bioethics	4 Credits
23MBT - 306	Agricultural Biotechnology	4 Credits (2T + 2P)
Total		20 Credits

Subject Code: 2 3 MBT- 301

Subject: Animal and Stem Cell Technology

4 Credit course (Total Lectures:60)

Unit	Topic	Lecture (Total 60L)
I	**Introduction to tissue culture:** • History, basics of animal tissue culture • Importance of maintenance of sterility and use of antibiotics • Detection of Mycoplasma and viral contaminants • Prevention of Cross contamination, eradication of contaminants • Logic of formulation of tissue culture media: natural, synthetic media, seraand substitutes • Introduction to the balanced salt solutions and simple growth medium. • Role of carbon dioxide in animal cell culture • Cell senescence.	5
II	**Various systems of tissue cultures**: Distinguishing features, advantages and limitations. • **Methodology**: i. Primary culture, ii. Explant culture, iii. Suspensionculture. Behavior of cells, properties, utility with different examples • **Cell lines**: Definition, establishment and maintenance, Finite and Continuous Cell line. Normal, Transformed and established cell lines: characteristic features, Contact inhibition, anchorage (in) dependence, Cell and tissue response to various factors	5
III	**Organ culture:** • Methods, behavior of organ explant, and applications of organ culture. • Histotypic and organotypic cultures: methods and applications • Introduction to organ transplants, tissue engineering, bio-artificial organs	5
IV	**Growth studies:** • Cell proliferation, cell cycle, mitosis in growing cells • Cryopreservation of cultured cells • Measurement of viability and cytotoxicity, microscopic examination ofcultures, subculture of cells (monolayer and suspension cells), passagenumber • Cell cloning and types, cell synchronization, Cell transformation • Cell Separation: Various method- advantages and limitations; Scaling up,Cell hybridization	5

V	**Application of animal cell culture**: • For *in vitro* testing of drugs, production of viral vaccines andpharmaceutical proteins, monoclonal antibodies. • Mass production of biologically important compounds. • Propagation of viruses (viral sensitivity of cell lines). • Harvesting of products, purification and assays.	5
VI	**Stem cells technology** –	15
	• Concept, characteristics of adult stem cells, embryonic stem cells, embryonic carcinoma cells, induced pluripotent stem cells • Identification, purifications, assessment of proliferation • Long term maintenance and characterization. • Stem cell self-renewal and pluripotency: molecular mechanisms • Cell cycle regulation in stem cells • Concept of Stem cell niche with examples Neural stem cells,Hematopoietic stem cells, mesenchymal stem cells • Applications of stem cells in therapeutics	
VII	**Transgenic animals:** • Overview of different methods of introduction of a transgene viz. micronuclear injection method, transduction with recombinant viruses,REMI etc. • Targeted gene insertion, gene silencing by RNAi,: • Cre-LoxP recombination for genetic modification • CRISPR/Cas9 for targeted genome editing • Transgenic animals: fish, *Xenopus*, mammals, • Concept of Knockout mice, methods and application • Mouse models for human genetic disorders, neurodegenerative disorders	12
VIII	**Animal husbandry and reproductive biotechnology:** • Overview of livestock breed and their productivity in India • Artificial breeding :-Various methods of semen collection, artificial insemination, estrous synchronization, cryopreservation of germ cells, • *In vitro* fertilization and embryo transfer technology, • Animal cloning: concept and application in conservation	5
IX	**Biosafety issues and Bioethics** associated with Animal Tissue culture, developing transgenic animals and human cloning	3

References:

1. R. Ian Freshney. Culture of Animal cells, 5rd Edition, 2010. A John Wiley & Sons, Inc.,

Publications, USA

2. R.W.Masters. Animal Cell Culture- Practical Approach, 3rd Edithion,2000, Oxford University Press. USA
3. Robert Lanza et al. *Essentials of Stem Cell Biology*", Academic Press, 2nd edition, 2006.USA
4. Text book of Animal Husbandary, 8th edition, (1998) G.C. Banerjee,Oxford and IBH Publishin co.Pvt. Ltd. India
5. Molecular Biotechnology: 4th edition. (2010), Glick B.R., Pasternak J.J., Patten C. L.,

ASM press, USA
6. Gene Transfer to Animal Cells, 1st edition (2005), R. M. Twyman, Taylor & Francis USA.

Subject Code: 23 MBT- 302

Subject : Bioprocess Engineering

4 Credit course (Total Lectures:60)

Sr No	Topic	No. of lectures 60
I	• **Bioprocess development**: An interdisciplinary challenge, Biotechnology & Bioprocess Engineering, Definition of Bioprocess andbioprocess Engineering, over view of bioprocesses with their various components. Aseptic operations and Containment • **Types of Fermentations :** Solid state fermentation, Dual/Multiple, Aerobic, Anaerobic, batch, fed-batch, continuous • **Design of Fermenter/ bioreactors:** Overview of types of Bioreactors, Novel Designs of Bioreactors. • **Kinetics of operation of bioreactors:** Batch, Fed Batch and Continuous processes., Growth Linked and Non growth Linked Products, Kinetic modelling, Model structures, Material balances and energy balances • **Isolation, screening and maintenance** of industrially important microbes • **Strain Improvement:** Product formation and inhibition pathways and their regulations, Strain improvement by: Mutation, Protoplast fusion, parasexual cycle and genetic engineering • **Inoculum Development:** Inoculum Development for bacterial, yeast and mycelial processes, aseptic method of inoculation, achievement andmaintenance of aseptic conditions.	15
II	**Media for industrial fermentations:** Medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, Medium formulation (Statistical design) of optimal growth and product formation, Ingredients for mammalian cell culture and plant cell culture. **Sterilization of media and air**: Thermal death kinetics of microorganisms, Del factor, design organism, Design of sterilization process (batch and continuous), sterilization of bioreactor, feed and liquid waste, sterilization of air, exhaust air, theory of depth filter, designing of depth filters. **Monitoring of process variables:** Types of sensors, Measurement and control of various parameters (pH, Temperature, dissolved oxygen, microbial biomass, inlet and exit gases,fluid flow, Pressure, Foam) P.I. D. control, Computer control of variables. **Scale Up and Scale Down :** Importance, parameters involved	10

III	**Mass transfer, Aeration and agitation of fermentation broth:** • **Mass transfer**: Concept of mass transfer, Molecular diffusion and role in bioprocess, Two–film theory, Convective mass transfer, volumetric mass transfer, Liquid-Solid, Liquid-liquid and Gas- liquid mass transfer equations and significance in bioprocess. • **Aeration** : Oxygen Uptake in cell cultures, Oxygen transfer from Gas bubble to Cell. Gas hold up, KLa importance, Measurement of KLa, Determination of KLa, Factors affecting KLa. • **Agitation:** Design of impellors and their flow patterns. Fermentation Broth rheology–Newtonian and Non Newtonian fluids, Factors affecting broth rheology, Power requirement for mixing Power number, Reynolds number, Flow regimes in fermentation tank (Laminar, turbulent and transition),Correlation between mass transfer coefficient and operating variables.	12
IV	**Downstream Processing:** • Bio separation :- filtration, centrifugation, sedimentation, flocculation; Cell disruption (Physical , Chemical and enzymatic methods); • Extraction(Liquid-liquid, Aqueous two phase, Supercritical fluid); Distillation, • Purification by chromatographic techniques; Reverse osmosis and ultra-filtration; Drying; Crystallization, Whole Broth Processing	8
V	**Industrial Production and Recovery process of:** • Vitamins (Vitamin C), Amino acids (Glutamic acid), Enzymes (Extra and Intra cellular one example each), Antibiotics (Rifamycin), Organic acids (Lactic acid), Recombinant Vaccines, • Biotransformation product(Steroids),Brewing (Beer), Cheese, Exopolysaccharides, Biodiesel.	10
VI	**Quality Control (QC) and Quality assurance(QA)** : • Roles and responsibilities of QC and QA departments, Common Quality control tests, • Standard Operating Procedures (SOP) & Good Manufacturing Practices (GMP) ,Regulations on use and distribution of Biotechnology products.	5

References:

1. Stanbury, P. F., Whittaker, A. and Hall, S., (2016) Principles of Fermentation technology, Springer, Third edition
2. Peppler, H. J.,D. Perlman (1979), Microbial Technology, Vol I and II, Academic Press, Second edition (E book by Elsevier)
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Subject Code: 23 MBT- 303

Subject: Bioinformatics and Biostatistics

4 Credit course (Total Lectures: 60)

Unit	Topic	No. of lectures 60
I	**Major Bioinformatics Resources and Biological databases** • Computers in Biology and medicine, Database concept • NCBI/EBI/EXPASY • Biological literature databases (PubMed) • Nucleic acid sequence databases (NCBI's GenBank + the European Nucleotide Archive [ENA] + the DNA Data Bank of Japan [DDBJ],) • Protein sequence databases (UniProtKb,SwissPort, TrEMBL). • Genome Database: UCSC Genome Browser • Introduction to Python	4
II	**Basic Concepts in Biological sequence Analysis** : • Biomolecular sequence analysis: Overview and Concepts • Pairwise sequence alignment algorithms (Needleman &Wunsch, Smith & Waterman) • Scoring matrices for Protein and Nucleotide sequences (PAM series and BLOSUM series), Gap Penalty and Penalty Scheme • Database Similarity Searches (BLAST, FASTA) • Multiple sequence alignment algorithms, Methods of MSA (Progressive, Iterative, Block-Based Alignment) (CLUSTALW and CLUSTALX,T-Coffee) • Protein profiles and Hidden Markov Model (HMM) • Application of Multiple sequence alignment (Phylogenetic analysis)	8

III	**Structural Bioinformatics** • Major Structural Resources (PDB and PMDB) • PDB File Format • Basic Structure Visualization o Visualization of major secondary structure (helices, beta sheets) and their role in protein structure o Visualization of various interactions : Polar (Hydrogen Bonds), Apolar (Hydrophobic, van der Waals, Pi stacking), Other (Salt Bridges, Coordination with ions) in protein structures and their role. • Protein Structure Classification (SCOP and CATH) • Protein Structure Prediction o Need and Concept of protein structure prediction, protein folding and model generation	6
	o protein secondary structure prediction methods (Alignment-based and Single sequence-based secondary structure predictions o Tertiary structure prediction (Homology modeling and Fold Recognition, ab initio methods) o Ramchandran Plot	
IV	**Computer aided drug design** (CADD) • Introduction to CADD • Identification drug targets using molecular modeling, combinatorial libraries and high-throughput screening(HTS) **Pharmacophore modelling and Chemoinformatics** • Pharmocophore: Definition and classes (HBA, HBD, Aromatic etc.) • Pharmacophore-based screenings of compound library, analysis and experimentalvalidation. • Concept of quantitative drug design using Quantitativestructure-activity relationship models (QSAR models) • Identification of pharmacophore features • Chemical Structure representation: 1D, 2D and 3D structures • Molecular file formats (SMILES, WLN, SDF, MOL,PDB etc) • Compound library formatting and filtering (Physicochemicaland substructure filters)	7
V	**Molecular Modeling** • Introduction to modelling protein ligand interactions • Pose Prediction Strategies in molecular Docking: Rigid body docking, Semi-flexible docking, flexible ligand docking (Conformational search method, Fragmentation method, Database method) • Scoring Functions: Force field-based, Empirical, Knowledge-based • Application in Structure Based Drug Designing: Use of Small-molecule libraries, Natural compound libraries for virtual high throughput screenings. • Commonly used docking software	5
	Biostatistics	

I.	**Introduction:** • Biological variables, parameters of statistical data display. • Types of scales: linear, power, log, circular (with biological examples) • Curves and Equations: Linear, saturating, sigmoid, exponential, logistic, power, multinomial, algebraic, differential, partial differential	4
II	**Sampling, distribution and presentation** • Sampling methods; Types of sampling; random sampling, Probability and non-probability sampling, stratified sampling, etc. • Power analysis and sample size calculations • Statistical data distribution, normal and skewed distribution, coefficient of skewness, moments and Kurtosis • Data presentation models; covariance models, spatial statistical model, multivariate spatial model, Gaussian and non-gaussian random process models, etc.	**7**
III	**Hypothesis Testing (with biological examples)** • Principles of hypothesis testing, significance level, null hypothesis • Type I and Type II errors • Examples of hypothesis testing: comparison of means, t-test, Chi-square test	**5**

IV	**Design, correlation and regression analysis** • Statistical design of experiments, single and multifactorial designs, fractional factorial designs. • Principles of experimental designs; randomization, replication and local control; Complete, incomplete and randomized block designs; • Covariance and correlation, Pearson's, Kendal's and Spearman's correlations, use of correlation and regression in biological analyses • Univariate, Bivariate and Multivariate data; linear, multilinear, and non-linear regression, generalized linear model and other models of regression analysis (nonparametric regression, Bayesian linear regression, etc.)	**8**
V	**Statistical Methods:** • Analysis of variance table (ANOVA), • Post hoc Tests- • Tukey's test for pairwise comparison of treatments • Dunnet's test for comparison of treatment means with control • Duncan's multiple range test • Mann–Whitney U test	**6**

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   Proteins, Latest Edition. Publisher: New York, John Wiley & Sons, Inc.
3. Teresa Attwood, Parry-Smith David J. Introduction to Bioinformatics. Publisher: Pearson Education (Singapore) Pte.Ltd., Latest Edition
4. Gibas Cynthia, JambeckPer. Developing Bioinformatics Computer Skills. Publisher: Shroff Publishers and distributors O'Reilly Media, Inc., Latest Edition
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17. Daniel, W. W. (1987). Biostatistics, a Foundation for Analysis in the Health Sciences. New York: Wiley.
18. P.S.S. Sunderrao and J. Richards-An introduction to Biostatistics, Prentice Hall Pvt. Ltd. India
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Subject Code: 23 MBT- 304

Subject: Laboratory Course IV

(4 Credit course) (Laboratory course in Animal Biotechnology, Bioprocess Engineering, Bioinformatics and Statistics)

Sr. No.	Animal Biotechnology Practical	No. Of Practical
1.	Initiation of primary culture from chick embryo	1
2.	Subculture and establishment of cell line	2
3.	Growth curve analysis of cell line	1
4.	Demonstration of cryopreservation of cell	1
5.	Chromosome spread preparation from cell line	1
Sr No	**Bioprocess Engineering Practical**	

1.	Screening and identification (Genus Level) of a production strain (enzyme /antibiotic) from soil samples. Maintenance of the isolated production organism (Agar slants/ glycerol stocks /soil culture/ lyophilization) at least two methods.	2
2.	Medium optimization for laboratory scale production of enzyme/antibiotics.	1
3.	Study of Working of lab bench fermenter (with production of enzyme or antibiotic using screened organism)	1
4.	Recovery and Assay of product formed (Bioassay or Enzyme assay).	1
5.	Solid state fermentation : Lab scale production of a product.	1
6.	Visit to fermentation industry and Report writing	1
Sr. No.	**Bioinformatics and Biostatistics Practical**	
1.	Using online resources like NCBI, PubMed(GenBank, UniProtKB, PDB), Genome Browser	1
2.	Sequence alignment using BLAST/ Database Similarity searching using BLAST	1
3.	Phylogenetic analysis using Phylip or Mega	1
4.	Basic Structure visualization using DeepView (Performing basic tasks like Selecting and Displaying structures, Colouring, Measuring distances and labeling)	1
5.	Prediction of protein tertiary structure using any method (CPH, MODELLER, SWISS Model, EasyModeler)	1
6.	Molecular Docking using AutoDock and Molecular visualization of docked complexes (using Pymol or Chimera)	1
7.	**Biostatistics practical based on theory course :**	4
i.	Determination of Karl-Pearson's coefficient of correlation/ Spearman's rank correlation coefficient from the given grouped and ungrouped data.	
ii.	Examples based on t – test , Chi-square test for goodness of fit and independent attributes.	
iii.	Analysis of variance on the given data (ANOVA)	
iv.	Measures of skewness and measures of Kurtosis (grouped and ungrouped data).	

Subject code: 23MBT- 305

Subject – Quality Control, Biosafety & Bioethics

4 Credit Course (Total Lectures: 60)

Units	Topic	No. of Lectures 60
	Quality Control	
I	• Quality Standard & Quality assurances: Concept of quality Assurance & Quality control their function and adventage, Quality assurance and quality management in Biotech Industy • Critical quality point in different stages of production includingraw materials & processing material • Types of validation in pharma industry, Importance of validationElements of validation (Q,OQ, PQ,DQ) Toxicity, clinical trials, studies, clinical research & clinicaldata management, • Export, Import of product, Rules & Regulations for startup companies GMP , cGMP	10
II	**Essential Documents & Regulatory Submission, Compliance AndAudits** – • Preparation, production and quality control of regulatorydocuments, creating editorial timelines and work flow specifications, SOP • Scheduling and tracking documents, writing and proofreading. • Development and updates on specifications for the design, tracking of regulatory documents and artwork used in regulatorydocument • Regulatory requirements for Biotech/pharma productdevelopment	10
	Bioethics	
III	**Introduction** Introduction to Ethics and Bioethics, Framework for ethicalDecision Making National Ethical Guidelines for biomedical and health research. Bioethical issues related to Healthcare & medicine Food & agricultureGenetic engineering	10
IV	**Ethical Issues:** • Animal cloning & human cloning • Human genome project, biopiracy, biowarfare • Public education of producing transgenic organism • Legal & socioeconomic impacts of Biotechnology • Hazardous materials used in biotechnology: Handling & disposal • Experimenting on Animals: Animal right activities Bluecross in India- society for prevention of cruelty against animals.	10

	CPCSEA committee, Ethical limits of Animal use. • Publication ethics and regulations • Biodiversity	
	Biosafety	
V	**Biosafety** • Introduction, Biosafety in Laboratory & Institution, Laboratory associated infections & other hazards. • Introduction to Biological Safety Cabinets, Primary Containment for Biohazards • Biosafety Levels, Biosafety Levels of Specific Microorganisms, Recommended Biosafety Levels for Infectious Agents and Infected animals • Safety & hazards: Chemical & radiation hazards Control of exposure to radiation, Fire prevention methods • Industrial Hygiene & toxicology: Introduction , evaluation & control, Personal protective equipment • Risk Analysis, Risk Assessment, Risk management and communication	14
VI	**Biosafety guidelines** – • Guideline & regulations(National & International) • GMOs & LMOs Guidelines of India • Environmental release issues of GMOs, • Risk Analysis, assessment, risk management and communication • Roles of Institutional Biosafety Committee RCGM, GEAC etc	6

References:

1. Deepa Goel & Shomni Parashar IPR, Biosafety and Bioethics, , published by Pearson Education India
2. M K Sateesh Bioethics and Biosafety. Jeffrey M. Gimble, Academia to Biotechno logy, Elsevier Academic Press.
3. Rajmohan Joshi (Ed.). 2006. Biosafety and Bioethics. Isha Books, Delhi.
4. Sasson A, Biotechnologies and Development, UNESCO Publications.
5. Senthil Kumar Sadasivam and Mohammed Jaabir M. S. (2008). IPR, Biosafety and Biotechnology Management, Jasen Publications, Ind

Subject Code: 2 3 MBT- 306T

Subject : Agricultural Biotechnology

2 Credit Course (Total Lectures: 30)

Unit	Topics	No. of Lectures 30
I	• **Introduction to agricultural Biotechnology** • Importance of Agriculture at national economy • Advantages of biotechnological methods over conventional methods of cropimprovement. • *In-Vitro* Plant propagation- a) Virus indexing, virus free plants, b) fruit crop c) flower crops d) Cereals and e) oil seeds plants • Endosperm culture & production of triploids for production of seedless plantvarieties with examples • Use of bioreactors in plant production & Scale-up for Commercialization • Beneficial microorganisms in Agriculture: Biofertilizer (Bacterial Cyanobacterial and Fungal), microbial Bioinsecticides • Major pest and diseases of horticultural crops and their control byBiotechnological methods	**10**
II	**Crop improvement** – • Improvement of crop quality (FlavrSavr tomato, Golden rice) • Chloroplast manipulations for production of therapeutic proteins, vaccines,antibodies and increased production,	**3**
III	**Recent advances** – • Species Conservation: Seed Bank, Gene Bank. • Plant genotyping by different methods PCR, Plant fingerprinting,Microsatellite, Nanotechnology. • Homogenous assays – Qualitative Real Time PCR assays, applications • CRISPR based technology: Introduction, techniques, and its application inplants • Plant DNA Barcoding- Introduction, Barcoding Markers (matK, rbcl, ITS,tm HpsbA), Recent advances in plant bar coding Benefits, Limitations	**8**
IV	• **Development and formulation (with various carrier materials) ofbioinoculants, for better Agricultural productivity, using:** i. Growth promoting , ii. Nitrogen fixing, iii. Phosphate solubilizing, iv. Metal chelating, (siderophores) v. Growth hormone producing microorganisms • Agricultural biotechnology and agribusiness • Opportunities in the Agriculture Biotechnology	**8**

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15. Textbook of Agricultural Biotechnology Paperback – 2008 by Nag and Ahindra
16. Handbook on Agriculture, Biotechnology and Development(2014) : By Daved Castle
17. Biocatalysis and Agricultural Biotechnology: Fundamentals, Advances, and ...By Anjali Priyadarshini, Prerna Pandey (2017).
18. Agricultural Biotechnology (2006) By Varun Metha)Book by Varun Mehta
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Subject Code: 23 MBT- 306P

Subject : Agricultural Biotechnology

(2 Credit Practical Course)

Sr. No.	Laboratory Course - Agricultural Biotechnology	No. Of Practical
1.	Production of virus free plants Virus indexing- ELISA and PCR, (Demonstration)	2
2.	Suspension culture and study the parameters to scale-up the production of in-vitro plants Monitoring of growth and differentiation of cells,	2
3.	Endosperm culture for regeneration of seedless plants Hardening /Acclimatization of regenerated plants, Transfer to soil	2
4.	Non gel techniques for plant genotyping and CRISPR based technology (Demonstration using web resources)	1
5.	Preparation, formulation (using suitable carrier material) and application (pot trials) of bio inoculants (Nitrogen fixing and Phosphate solubilising Microorganisms)	1

Semester IV

Course code	Course Title	Credits
Core Compulsory Theory Papers (CCTP)		
23MBT- 401	Genomics and Proteomics	4 Credits
23MBT- 402	Advanced Bio analytical Techniques	4 Credits
Core Compulsory Practical Paper : CCPP-1		
23MBT- 403	Research Project	4 Credits
Choice Based Optional Papers: CBOP (any Two)		
23MBT - 404	Bio entrepreneurship & Start up Designing	4 Credits
23MBT - 405	Pharmaceutical Biotechnology& Drug Designing	4 Credits
23MBT - 406	Research Methodology & Scientific Communication	4 Credits (2T + 2P)
23MBT - 407	Clinical Research, Database Management and IPR	4 Credits
Total		20 Credits

Subject code: 23MBT-401

Subject - Genomics and Proteomics

4 Credit Course (Total Lectures: 60)

Units	Topic	No. of Lectures 60
	Genomics	
I	• Genomics and Proteomics overview, omes and omics, • Concepts and applications Genome overview with model organisms example • Whole Genome sequencing – Methods, Assembly and Analysis, NGS Platforms • Comparative genomics - Goals, bioinformatics of genome annotation, methods and limitations. • Structural genomics –Goals, methods, applications. • Functional genomics –Goals, methods, applications.	8
II	**Transcriptomics and Microarray** • Introduction to transcriptomics and expression profiling DNA and RNA Microarray –Preparation, working and analysis • Investigative techniques –EST, SAGE, SNP, MPRAs • DNA and RNA Microarray –Preparation, working and analysis. Microarray databases and bioinformatics tools.	10
III	**Applications of genomics** • Metagenomics • Toxicogenomics • Pharmacogenomics • Basic research • Medical Genetics	12
	Proteomics	
IV	Introduction & concept of proteomics, Protein structure-function relationship, **Types of Proteomics:** • Protein expression proteomics • Structural Proteomics, • Functional Proteomics	5 L
V	**Techniques in Proteomics**: • Protein Isolation and Separation techniques • Structural analysis of proteins- X-ray crystallography and NMR spectroscopy • 2 D electrophoresis • Peptide mapping & sequencing • Protein structure prediction- homology modelling	12

	• Mass Spectrometry: MALDI_TOF, ESI Tandem, Ion Trap, Peptide mass fingerprinting • LC-MS, (SILAC) - Chemical tagging, fluorescence, radio-labeling	
VI	**Applications of Proteomics** • Protein expression profiling • Protein-protein & Protein-DNA interaction (Chip Technique) • Methods for detection of protein-protein interactions - Yeast 1, 2 and 3 `hybrid systems – Phage display – • Proteomics and Protein microarrays, databases and allied bioinformatics tools.	8
VII	**Applications** • Health care**,** Biomarkers in disease diagnosis, -Biomarker, drug development and their target identification • Identification and characterization of novel proteins	5

References:

1. Daniel C. Liebler, Introduction to Proteomics. Humana Press.
2. Twyman RM, Principle of Proteomics. BIOS Scientific Publishers. (2004).
3. Kamp RM, Methods
4. in Functional Genomics: Protein Structure Analysis.
5. Birkhauser (2000).
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15. Bioinformatics-Sequence and Genome Analysis (2004) David W Mount Cold SpringHarbor Laboratory Press; 2nd edition
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16 Functional Genomics : Methods and Protocols (2003) M J Brownstein, A B KhodurskyHumana Press

17 Genome analysis and bioinformatics (2009) Sharma T R I.K. International PublishingHouse Pvt. Limited

Subject Code: 23MBT- 402

Subject: Advanced Bio-analytical Techniques

4 Credit Course (Total Lectures: 60)

Units	Topic	Lectures
I	**Microscopic Techniques:** • Staining and Visualization of cells and subcellular components. • Cryotomy, Scanning and Transmission microscopes, different fixation and staining techniques for EM • Freeze-etch and freeze- fracture methods for EM, Image processing methods in microscopy, confocal microscopy, single cell imaging.	13
I	**Histochemical and Immunotechniques** • Antibody generation, Detection of antigen using ELISA, RIA, Western blot • Immunoprecipitation, Flow cytometry and FACS • Detection of antigens in living cells (Stem Cell Markers) • *in situ* localization by techniques such as FISH and GISH.	12
II	**Advanced Application of Spectroscopy** • UV visible spectrophotometer, Fluorescence spectroscopy, Circular dichroism, NMR , IR and ESR spectroscopy , • Molecular structure determination using X-ray diffraction and X ray crystallography • Molecular analysis using light scattering, Mass spectrometry and LC-MS and surface plasma resonance methods.	15
IV	**Advanced Chromatography and Electrophoretic technique:** • Introduction, principle and applications of HPTLC, HPLC, GLC,GC • Affinity chromatography: Principle, types, Application, • IF and 2 D electrophoresis, Capillary Electrophoresis, DGGE (Denaturing gradient gel electrophoresis)	12
V	• **Advanced Bio-analytical Techniques and Automated Systems** • Advances in PCR technology & its applications (modifications), • Next Generations Sequencing (NGS): Principles and instrumentation, NGS data procession tools, • Automated microbial identification system, Automated DNA/ RNA Microarry systems.	08

References :

1. Principles and Techniques of Biochemistry and Molecular Biology,7th edition, (2010), Wilson K.M., Walker J.M., Cambridge University Press, UK
2. Biophysics. 1st edition (2002), Pattabhi V and Gautham N. Kluwer Academic

Publisher, USA.

3. Biochemical spectroscopy. Vol 46 of Methods in Enzymology. (1995) Kenneth Sauer. Academic Press, USA
4. Modern experimental biochemistry. 3rd edition. (2000) Rodney Boyer. Prentice Hall Publisher, USA.
5. Analytical Biochemistry, 3rd edition, (1998), David Holmes, H.Peck , Prentice Hall, UK.
6. Willard and Merrit, Instrumental Methods and Analysis
7. Ewing GW, Instrumental Methods of Chemical analysis.
8. Vogel's, Text Book of Quantitative Chemical Analysis, 6th Edition, 2004.
9. Raymond P. W. Scott, Techniques and Practice of Chromatography –Vol. 70.
10. Sethi P.D, DilipCharegaonkar, Chromatography –2nd Edition.
11. Hanes, Gel Electrophoresis of Proteins- A Practical Approach,
12. Biophysical chemistry by Upadhyay, Upadhyay and Nath, Himalaya publication house.
13. Next Generation Sequencing Methods and Protocols: Editors: Head, Steven R., Ordoukhanian, Phillip, Salomon, Daniel R. (Eds.) 2018.
14. Statistical Analysis of Next Generation Sequencing Data: Editors Somnath DattaDan Nettleton.
15. Next-Generation Sequencing Data Analysis 1st Edition by Xinkun Wang. CRC Press 2020.
16. Google search for Unit V contents

Subject Code: 23MBT- 403

Subject : Research Projects

(4 Credit Course)

Project work , Thesis Submission & presentation

- Project work / Thesis / Dissertation shall be carried out under the supervision of a qualified teacher in the concerned Department./Research Institute/Industry
- Project work / Thesis / Dissertation shall be pursued for a minimum of 12 weeks during the final semester, following the preliminary plan of work carried out in during the previous semester.
- The Project Report/Thesis / Dissertation report is to be prepared as per standard scientific research methodology and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.
- The assessment (Internal and external) of the project work will be as per SPPU guidelines.

Subject Code: 23 MBT - 404

Subject : Bio-entrepreneurship & Start up Designing

4 Credit Course (Total Lectures: 60)

Unit	Topic	No. of Lectures 60
I	**Introduction to Entrepreneurship**	
	• Meaning Knowledge and concept of entrepreneurship, • Need and Importance of entrepreneurship • The history of entrepreneurship development, • Skills and characteristic of successful entrepreneurs; • Entrepreneurship process; • Factors impacting emergence of entrepreneurship • Role of entrepreneurship in economic development, • Evolution and Growth of Entrepreneurship in India	10
II	**An Entrepreneur and an Entrepreneurship Journey**	
	• Types of Entrepreneurs • Ethical Entrepreneurship • Entrepreneurial Value: Values, Attitudes and Motivation. • The entrepreneurial decision process, and role models, • Self Assessment of Qualities, • Skills, Resources and Dreams. • Role of Society and Family in the growth of an entrepreneur.	11
	Activity : Motivational games to boost the decision power, accuracy and Attitude of the students	
III	**Starting the venture:**	11
	Generating business idea – • Sources of new ideas, • Methods of generating ideas, • Creative problem solving, • Opportunity recognition and assessment • Environmental scanning, • Competitor and industry analysis; • Feasibility study : - Market feasibility:-Marketing plan: marketing research for the new venture, Steps in preparing marketing plan, - Technical/operational feasibility, - Financial feasibility.	
	Activity : **1. Organization of 'Brain Storming' session for generating Creative Business idea** **2. Market survey/Marketing Strategy**	
IV	**Preparing a Business Plan:**	11
	• Introduction to Business and its Environment • Components of a business plan, • Meaning and significance of a business plan • Challenges of New Venture Strategies	

	• Start-up Policy Framework and Incentives • drawing business plan • Preparing project report; • Business Plan Preparation • Presenting business plan to investors • Execution of Business Plan • Business Incubation Centres	
	Activity : Presentation on Business plan /Start-up business plan	
V	**Entrepreneurship as Problem Solving**	**6**
	• Entrepreneurs- as problem solvers. • Risk taking-Concept; types of business risks. • Barriers to Entrepreneurship. • Support structure for promoting entrepreneurship (various government schemes).	
VI	**Dimensions of Entrepreneurship**	6
	• Entrepreneurial Culture • Entrepreneurial Society • Women Entrepreneurship • Rural Entrepreneurship	
VII	**Strategic Frameworks for Decision**	5
	• Vision, Mission, Objective and Goal • Porter's 5-Forces Model • SWOT Analysis • Competitive Strategies • Value Chain Analysis	

References:

1. Entrepreneurship, Hisrich, Robert D., Michael Peters and Dean Shepherded, , Tata McGraw Hill, ND
2. Entrepreneurship, , Brace R., and R., Duane Ireland, , Pearson Prentice Hall, New Jersy (USA).
3. Entrepreneurship, Lall, Madhurima, and ShikhaSahai, , Excel Book, New Delhi.
4. Entrepreneurship Development and Small Business Enterprises, Charantimath, Poornima, Pearson Education, New Delhi.
5. Entrepreneurship : New Venture Creation – David H. Holt
6. Entrepreneurship : Hisrich Peters
7. The Culture of Entrepreneurship- Brigitter Berger
8. Dynamics of Entrepreneurship development and Management: Entrepreneurship, Project Management, Finances, Programmes, and Problems – Vasant Desai (2009)
9. Entrepreneurship Development – Dr. P.C. Shejwalkar
10. Thought Leader : Shrinevas Pandit
11. Leadership and new Science : Margrat wheatly
12. Handbook of Entrepreneurship Research: An Interdisciplinary Survey and Introduction (International handbook series on Entrepreneurship) (2003) : Zolten J ACs, David B. Audretch

13. Knowledge-Driven Entrepreneurship (2009) : The Key to Social and EconomicTransformation By Martin Curley, Piero Formica and Thomas Anderson
14. Entrepreneurship (3rd ed) Steven Brandt
15. The Entrepreneurial Connection – Gurmit Narula
16. Business Guru Speak –S.N. Cnary
17. Dhirubhai Ambani: Against All Odds: A Story of Courage, Perseverance andHope Paperback – 1 July 2017 : by A G Krishnamurthy
18. Mythbreaker: Kiran Mazumdar-Shaw and the Story of Indian Biotech Hardcover – 29April 2016 by Seema Singh
19. The Entrepreneur's Guide to a Biotech Startup: Peter Kolchinsky
20. The Anotomy of your Creativity : Chris Grady

Subject Code: 23 MBT - 405

Subject : Pharmaceutical Biotechnology & Drug Designing

4 Credit Course (Total Lectures: 60)

Units	Topic	No. of Lectures 60
I	**Introduction :** • Introduction to Pharmaceutical Biotechnology and Drug discovery. • Drug targets: Structure and functions; Physiochemical properties of drugs; drugs from natural sources. • Pharmacodynamics, pharmacokinetics and drug metabolism, Drug tolerance & intolerance, drug allergy, drug induced side effects with examples. • Screening and isolation of bioactive compounds	8
II	**Drug action and Resistance** • Mechanism of action of anti-diabetic, anticancer, anti-inflammatory and antibiotics (any two drugs of each) • Mechanisms of drug resistance to antibiotics and anticancer drugs with examples • MDR, XDR or PDR • Assay of drug potency- bioassay and immunoassay	8
III	**Process of Drug Development** • Target identification and validation. • Pre-clinical studies- -Toxicity (Cytotoxicity, Genotoxicity, Reproductive toxicity, Carcinogenicity, Mutagenicity, and other tests) • Animal models for *in vivo* activity of drugs testing	7

IV	**Clinical Research in Drug Development:** **Protocol Designing:** • Definition of protocol, its importance and purpose • Protocol format: broad contents of protocol • Protocol writing team and role of each member • Clinical trial design: Types of study designs • Sampling, sample size, randomization, Inclusion & Exclusion criteria • Phases of clinical trial & Types of trials **Good Clinical Practice (GCP)-ICH :** • Ethics in clinical research: Principles and origin • ICH: Purpose, regulations & guidelines • Ethics committees: Roles & responsibility of IEC and IRB • Responsibilities of Sponsors, Investigators & Regulators • Clinical trial Monitoring and responsibilities of monitors • Informed consent and Informed consent form	18
	• Essential Documents **Clinical Safety & Pharmacovigilance:** • Definition, recording & reporting of AE, ADR, SAE • Pharmacovigilance: International procedures • Pharmacovigilance in India	
VI	**Computer aided drug design** (CADD) • Importance of CADD • Drug discovery- issues • Target and lead identification • Drug and databases • Drug- Properties / Simplified Molecular Input Line Entry System (SMILES) • Drug- ADMET • Molecular Modeling	10
VI	**Role of Regulatory Authorities in Drug Approvals:** • The Food and Drug Administration (FDA), Investigational new drug application, New drug application; • European regulations National regulatory, authorities, European medicines agency and the new EU drug approval system, Centralized procedure, Mutual • Regulatory Authority in India (DCGI & CDSCO) • Schedule Y of Drugs & Cosmetics Act • Pharmacopeia • Drug patenting and licensing in Pharma industry	10

References:

1. Olive Kaiser ,Rainer Muller, Pharmaceutical Biotechnology: Drug Discovery andClinical Application, Wiley VCH publisher, 2004
2. Vyas and Dixit Pharmaceutical Biotechnology, 1 st CBS Publisher New Delhi, 1991

3. P. K. Gupta, Elements Of Biotechnology, Rastogi Publication, 10 th edition, 2004
4. S.S. Purohit, Biotechnology Fundamentals and Applications Student edition AgrobiosPublisher;2002
5. K. Sambamurthy, Ashutosh Kar, Pharmaceutical Biotechnology, 2nd edition NewAGE International (LP) Limited, 2007
6. Hermann Dugas, Bioorganic Chemistry: A chemical Approach to Enzyme action bySpringer New York, 1999.
7. Kerns, E.H.; Di, L. Drug-Like Properties: Concepts, Structure Design and Methods:from ADME to Toxicity Optimization, Academic Press, Oxford, 2008
8. M. E. Wolff, John Wiley & Sons Burger's Medicinal Chemistry and Drug Discovery,7th Edition, Vol. 1-6. Principles and Practice, edited by: New York, 2010.
9. Foye's Principles of Medicinal Chemistry, 7th Edition, edited by T.L. Lemke, D. A.Williams, V. F. Roche, and S.W. Zito, Williams and Wilkins: Philadelphia, 2013.
10. Edward C. Olson, Christoffersen Editor, Ralph E. Computer-assisted drug design /2009, American Chemical Society.
11. Martin YC, Marcel Deckker Quantitative Drug Design - A Critical Introduction by Inc. New York.
12. Veerapandian, "Structure Based Drug Design". Taylor and Francis, 1997.
13. Drug Design, V.M. Kulkarni, K.G. Bothara, Nirali Prakashan
14. Graham L. Patrick An Introduction to Medicinal Chemistry, ,Oxford UniversityPress1995
15. Richard B. Silverman The Organic Chemistry of Drug Design & Drug Action, ,Elsevier Academic Press, 2014.
16. Natanya Civjan, Chemical Biology: Approaches to Drug Discovery and Developmentto Targeting Disease, Edited by Wiley (2012).
17. Biology For Engineers 2019 Edition by SINGAL R, CBS Publishers and Distributors

Subject Code: 23 MBT – 406T

Subject: Research Methodology & Scientific Communication

2 Credit Course (Total Lectures: 30)

Sr No	Topic	No. of Lectures 30
1.	**Introduction to Research Methods:** • Types of research philosophies (positivist, interpretivist, pragmatist and realistic), various steps in scientific research, Scientific temper andattitude, Experimental Design, Defining Controls, deductive and inductive reasoning; reductionist and holistic approaches of scientificresearch.	3
2	**Scientific Methodology:** • Problem identification, Critical thinking, hypothesis formulation and hypothesis testing (Power analysis) • Difference between hypothesis, reasoning, theory and scientific law	3

3	**Data Collection and analysis**: • Types of Data, Methods and Techniques of data collection • Methods of primary data collection (observation/ experimentation/ questionnaire/ interviewing/ case/ pilot study) Methods of secondary data collection (internal/ external), schedule method **Research data organization:** • Creating, Analyzing, Formatting Data & Content using Spreadsheets Insert, View, Edit etc. • Managing Lab Work books, Data tabulation, Calculations, Equations and analyzing biological Data using statistical tools. **Data Analysis:** • Data distributions, Statistical tests for comparison of sample means and sample variance-t-test, non-parametric tests, Correlation and Regression, F, t and Z distribution; goodness of fit, chi-square. • Introduction to multivariate analysis Mathematical models Simulation as a tool to test these models. • Software for data processing: Multidimensional Use of Excel; Sigmastat; GraphPad Prism; SPSS, SAS, R software.	10
4	**Research in Practice:** • Literature review, Journals, Conference Proceedings, Journal Impactfactor, Citation Index, h, g, h-g index	3
5	**Research Ethics:** • Social implications of research, bio-safety issues Animal experimentation ethics, wild-life ethics and human experimentation ethics • Data fudging and plagiarism: Use of URKUND, Turnitin and iThenticate software	3
6	**Scientific Communication:** • Importance of scientific communication, Types of scientific communications, Logical organization of scientific data and documentation.	8
	Different modes of scientific communication: • **Scientific Writing:** Characteristic of good scientific writing, Structure and content, Style, Literature references • **Report Writing**: Types of research reports, guidelines for writing a report, report format, Details of research Proposal writing, Research paper writing, Thesis writing(Introduction, Literature review, Materials and Methods, Results, Discussion, Conclusion and Implications, conflict of interest) • **Oral forms of scientific Communication**-Popular and Scientific talks, Poster presentations, Organizing Presentation Material, Use of audio visual aids in presentation elements of presentation preparation: objective, subject, audience, Length of talk Managing & Delivering Presentations • **Legal forms of communication in science**: Plagiarism and scientific misconduct, Ethics in scientific communication, patent submissions. • **Internal examination of scientific communication**	

References:

1. H. Hofmann, Scientific Writing and Communication Papers, Proposals, and Presentations. New York: Oxford UniversityPress, 2010, pp. xv–xvi.
2. T. L. J. Ferris, E. Sitnikova, and A. H. Duff, "Building graduate capabilities to communicate research and planssuccessfully," Int. J. Eng. Educ., vol. 26, no. 4, pp. 891–899, 2010
3. Michael Alley, The Craft of Scientific Writing, fourth edition, Springer,2018.
4. Stephen B. Heard, The Scientists Guide To Writing, Princeton University Press, 2018.
5. Anthony M. Graziano, Michael L. Raulin, Research Methods: A Process Of Inquiry(2012) 8th Edition, , Pearson Publication, Delhi2. Barass Robert, Scientists Must Write: A Guide to Better Writing for Scientists,Engineers and Students (2002), Routledge Publication, UK3.
6. David B. Resnik, The Ethics of Science: An Introduction (1998), Routledge Publication,UK5.
7. Fisher R A, TheDesign of Scientific Experiment (1971) 9th edition, Collier MacmillanPublishers, London
8. GanguliPrabuddh, Intellectual Property Rights (2001), Tata McGraw-Hill PublishingCompany Ltd., Delhi7.
9. John D'Angelo, Ethics in Science: Ethical Misconduct in Scientific Research (2012),CRC Press, USA
10. Kuhn Thomas, The Structure of Scientific Revolution (2012) 50th anniversaryedition,Chicago University Press, USA
11. Martha Davis, Scientific Papers And Presentations 2nd edition (2004), Academic Press
12. Medawar, P. B. And Medawar, J. S., The Life Science: Current Ideas of Biology(1977),Wildwood House, London
13. Peter Raven et al, Biology 9th edition (2010), McGraw-Hill Education, Singapore
14. Popper Karl, The Logic of Scientific Discovery (2004), Routledge Publication, UK
15. Richard P. Feynman, The Meaning Of It All: Thoughts Of A Citizen-Scientist (2005),Basic Books, New York
16. Richard P. Feynman, The Pleasure of Finding Things Out: The Best Short WorksOfRichard P. Feynman (1999), Edited By Jeffrey Robbins, Perseus Books, USA

Subject Code: 2 3 MBT – 406P

Subject: Research Methodology & Scientific Communication

(2 Credit Practical Course)

S. No.	Practical	No. of Practical
1	Using the tools for literature survey (PubMed/ INFLIBNET/ Delnet/ JGate/ Google Scholar)	1
2	Writing hypothesis and designing the research question	2
3	Designing the biological/biotechnological experiment	1
4	Handling/utilizing different types of statistical analysis software (GraphPad Prism/ Origin/ SigmaPlot) for given biological datasets (Chi-square/ t-test/ DMRT/ ANOVA)	2
5	Presenting scientific photographs/ diagrams/ tables and preparation of captions / legends thereof	1
6	Using a web-based reference manager tool like Mendeley, Zotero	1
7	Scientific presentation (writing or constructing abstract/ graphical abstract/ work-flow/ concept notes, etc.) from the provided experimental study	2

8	Study of data fudging and plagiarism using online tools (iThenticate/URKUND/Turnitin)	1
9	Submission of manuscript to a peer-reviewed indexed research journal – key pre-requisites and the process involved	1

Subject Code: 23 MBT - 407

Subject: Clinical Research, Data Management and IPR

4 Credit Course (Total Lectures: 60)

Unit	Topic	No. of Lectures 60
	CLINICAL RESEARCH AND DATA MANAGEMENT	
I	**Introduction to Clinical Research** **Drug Development Process** • Overview of Drug Development Process including clinical trials phases	1
II	**Protocol Designing:** • Definition of protocol, its importance and purpose • Protocol format: Chapters (Headings) and broad contents of protocol • Important scientific and administrative aspect included in protocol • Protocol writing team and role of each member • Clinical trial design: Types of study designs • Sampling, sample size, randomization, Inclusion &Exclusion criteria • Phases of clinical trial & Types of trials	5
III	**Good Clinical Practice (GCP)-ICH E6:** • Ethical Principles and their origin • Ethics in clinical research: As per ICMR & GCP • Ethics committees: Roles & responsibility of IEC and IRB • Ethics in relation to vulnerable groups & special situations • Responsibilities of Sponsors, Investigators & Regulators • ICH: Purpose, regulations & guidelines • Informed consent and Informed consent form • Essential Documents	5
IV	**Drug Regulatory Affairs (Clinical Trial)** • Regulatory Authority in India (DCGI & CDSCO) • Schedule Y of Drugs & Cosmetics Act • International Scenario of Regulatory Aspects: FDA, CFR,	4

V	**Clinical Safety &Pharmacovigilance:** • Definitions of AE, ADR, SAE, • Recording & reporting: Objectives & Importance • Pharmacovigilance: International procedures • Pharmacovigilance in India	3
VI	**Monitoring of Clinical Trials** • Monitoring and its role in clinical trials • CRF and other source documents relevant to monitoring	2
VII	**Concept of Database and Clinical Data Management** • Concept and designing of Database, • Data management & IT in clinical research • CRF designing • Query raising and query resolution • EDC System and 21 CFR Part 11 compliance • **Practical for Protocol Design, CRF Design and source documentation**	10
INTELLECTUAL PROPERTY RIGHTS		
VIII	• General Regime of Intellectual Property Rights: Overview and Historical Perspectives; • Intellectual Property as an Instrument of Development; • Need for Protecting Intellectual Property- PolicyConsideration-National Perspectives and Internationaldemands; • TRIPS (Trade Related Intellectual Property Rights) Agreement and International Treaties related to IPR	6
IX	• Patents: Criteria of Patentability; types of patent applications: provisional and complete specifications. • Procedure for Filing Patent Applications, Patent Granting Procedure; • Revocation, Patent Infringement and Remedies; • Relevant Provisions of the Biological Diversity Act, 2002; • Commercialization of patented innovations; licensing –outright sale, licensing, royalty;	8

X	• Copyright and Neighboring Rights - Conceptual Framework, Copyright works, Ownership, transfer and duration of Copyright, Renewal and Termination of Copyright, Neighbouring Rights, Infringement of copyrights and remedies; Examples and Casestudy; • Protection of Plant Varieties and Plant Breeders' Rights - Protection of Plant Varieties and Farmers' Rights, Authority and Registry, Registration of Plant Varieties and Essentially derived variety, Duration, Effect of Registration and Benefit Sharing; Examples and Case study;	12
XI	Patent Specification Drafting Exercise	4

Reference Books:

1. Katzung, B.G. Basic and Clinical Pharmacology, (2010) Prenticehall,International
2. National Ethical ***Guidelines*** for Biomedical and Health Research InvolvingHuman Participants (2017)
3. E6 ***Good Clinical Practice***. Code, Document Title, Previously coded. E6(R2) ***Good Clinical Practice***(***GCP***). Finalised Integrated Addendum:November2016.
4. New ***Drugs*** and Clinical Trials Rules ***2019***
5. Website: https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm
6. Karki, M S, Intellectual property rights: basic concepts (2009) M AtlanticPublishers & Distributors, New Delhi
7. Wadehra, B.L. Law Relating To Intellectual Property, (2011), Fifth Edition,Universal Law Publishing Co.Pvt. Ltd.
8. TIFAC 2002 Some questions and answers on Patents an d Copyrights
9. Das, H K ,Text book of Biotechnology,(2010), 4th edition, Wiley India Pvt. Ltd,New Delhi
10. Chawala, H .S., Introduction to Plant Biotechnology, 3rd edition, Science Publishers
11. Hirvani R, Patents in Plant Breeding: Guarding the Green Gold-,BiotechNews,
12. GanguliPrabuddh, Intellectual Property Rights , (2001), Tata McGraw-HillPublishing Company Ltd.
13. Narayanan,P, Law of copyright and Industrial Designs,(2010), Eastern LawHouse,Delhi
14. Office of the Controller General Of Patents, Designs & Trade,(CGPDTM):Manual of Patents/Manual of Industrial Design/DraftManual of Trademarks
15. Website: https://www.wipo.int / www.ipindia.nic.in

Progressive Education Society's

Modern College Of Arts, Science and Commerce, Ganeshkhind, Pune – 411 016

(Autonomous)

Syllabus for

M. Sc. II Computer Science

Introduction:

Computer Science Department came into existence in the year 1996. The department is sponsored by DBT, Govt. of India under STAR College Scheme. At present department offers following courses

1. B.Sc.(Computer Science) - 240 Seats
2. M.Sc.(Computer Science) - 60 Seats
3. M.Sc.(Computer Applications) - 60 Seats

Department provides following facilities:

- Experienced faculty members.
- Visiting faculty from reputed industrial unit.
- Well-furnished separate labs for B.Sc.(Computer Science), M.Sc.(Computer Science) and M.Sc.(Computer Applications).
- Internet access to students
- In addition, following activities are conducted - Intercollegiate computer competitions (Interaction), Quiz competition, Poster competition, Tech-Fest (Interclass competition)
- Various seminars, guest lectures by eminent personalities from industries/institutions
- A separate placement cell is formed M.Sc.(Computer Science) and MCA (under science faculty) course as well as for other Under Graduate and Post Graduate courses
- Remedial coaching for students

Programme Objectives:

Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

Programme Specific Outcomes (PSOs):

After completing M.Sc. Computer Science Programme, students will be able to:

Knowledge Outcomes:

Students will able to

PO1 Become technology-oriented with the knowledge and will get the ability to develop creative solutions, and will better understand the effects of future developments of computer systems and technology on people and society.

PO2 Identify, formulate, and develop solutions to computational challenges. Through project work.

PO3 Get ability to apply knowledge of computer science and skills to succeed in their career/ professional development and/or postgraduate education to pursue flexible career paths amidst future technological changes to real-world issues.

PO4 Understand and apply computer science principles to manage multi-disciplinary projects using knowledge of programming languages, cloud computing, web services, different database technologies, operating systems and different design patterns.

PO5 Apply domain knowledge, use creativity, critical thinking, analysis and will become expertise for enhancing research capability to transform innovative research ideas into reality.

Skill Outcomes:

Students will be able to

PO6 have a wide perspective on software development including web based applications as well as graphic applications by learning new technologies, grasping the concepts and issues behind its use and the use of computers.

PO7 Get prepared for soft skills and develop their personality together with their technical skills.

PO8 Create, select, and apply appropriate techniques, resources, and modern IT tools including prediction and modeling to complex activities with an understanding of the limitations.

PO9 Build up programming, analytical, logical thinking and software development abilities.

General Competence

The students will be able to

PO10 Use innovation-based knowledge and creative methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO11 Understand the recent developments in IT, future possibilities and limitations, and the value of lifelong learning.

PO12 Devise solutions for complex problems and plan system components or processes that meet the specified needs with appropriate consideration for the society, health, safety, cultural, societal, and environmental considerations.

Examination Pattern:

IA : 30M

CE : 70M

Suggested internal assessment tools for courses:

The concerned teacher shall announce the units for which internal assessment will take place. A teacher may choose one of the methods given below for the assessment.

1. Library notes
2. Students Seminar
3. Short Quizzes / MCQ Test
4. Home Assignments
5. Tutorials/ Practical
6. Oral test
7. Research Project
8. Group Discussion
9. Open Book Test
10. Study Tour
11. Written Test
12. PPT presentation
13. Field Visit
14. Industrial Visit
15. Viva
16. Research Paper writing

Teaching Methodology:

1. Classroom Teaching
2. Guest Lectures
3. Group Discussions
4. Power Point Presentations
5. Visit to Institutions / Industries
6. Research Papers & Projects
7. E-content
8. Mind map

Subject List

SEMESTER III

Sr. No.	Subject Type	Subject Code & Title	Credits			Total No. of Lectures
			Theory	Practical	Total	
1	Theory	23-CSUT231 Software Architecture and Design Pattern	4		20	60
2	Theory	23-CSUT232 Machine Learning	4			60
3	Theory	23-CSUT233 Web Frameworks	4			60
4	Theory Optional Paper	23-CSDT234A Big Data Analytics 23-CSDP234A Big Data Analytics Practical OR 23-CSDT234B Web Analytics 23-CSDP234B Web Analytics Practical OR 23-CSDT234C Project 23-CSDP234C Project related Assignments OR 23-CSDT234C Introduction to Data Science23-CSDT234C Practical on Data Science	4			60
5	Practical	23-CSUP235 Practical on CSUT231, CSUT232 and CSUT233		4		60

Extra Credit (Mandatory)			
Course Type	**Course Code**	**Course Name**	**Credit**
Extra Credit Theory Paper	23-392	Introduction to Cyber Security/ Information security-III	1

	23-394	Skill Development-I	2
	23-395	Introduction to Constitution	2

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year II Semester IV							
Year/ Sem	**Course Type**	**Course Code**	**Course Name**	**Credit**	**% of Assessment**		
					IA	**CE**	**Total**
II Year Sem-IV	Core	23-CSUIT241	Industrial Training /Institutional project	20	**150**	**350**	**500**

Extra Credit (Mandatory)			
Course Type	**Course Code**	**Course Name**	**Credit**
Extra Credit Theory Paper	23-492	Introduction to Cyber Security/ Information security-IV	1
	23-494	Skill Development-II	2

IA :- Internal Assessment, CE :- College Examination
Practical paper implementation strategy:

Subject	**Platform**
PPL	Linux
Database Technologies	Linux / Windows
AI	Linux
Web Services	Linux / Windows
Cloud Computing	Linux/ Windows/ AWS

Note : Any version of Linux (Fedora/ Redhat/ Ubuntu etc.) can be used as per your comfort

Syllabus

Semester-III

Subject Code: 23-CSUT231
Subject: Software Architecture and Design Patterns(4 Credit Course)
Total Lectures=60

Chapter	Course Contents	No. of Lectures
1	**Introduction** • UML The Notation • Process Unified Process / Rational Unified Process inception, elaboration, construction, transition • How various components fit in the life cycle The artifacts at end of each process / discipline	4
2	**Software Architecture** • What Software Architecture is and what it isn't. • Why is architecture important? • Architectural structures and views • Architectural styles	6
3	**Architectural Styles** • Pipes and Filters • Data Abstraction and Object – Oriented organization Event based-implicit invocation Layered Systems • Repositories • Interpreters	6
4	**Introduction to Patterns** • What is a Pattern & Design Pattern • What makes a Pattern (GOF) • Describing Design Patterns. • Pattern Categories & Relationships between Patterns. • Organizing the Catalogue. • Patterns and Software Architecture.	10
5	**Study of Design Patterns** • Creational Patterns-singleton, factory method, abstract factory • Structural Patterns-adapter, decorator, facade • Behavioural Patterns-iterator, observer, strategy, command and state (study of intent, applicability, participants, structure, collaboration , Java Example code , Implementation and consequences)	12
6	**GRASP**(General Responsibility Assignment Software Patterns) • Expert, Creator, High Cohesion, Low Coupling	8

	• Controller, Polymorphism, Pure Fabrication, Indirection • Don't Talk to Strangers	
7	**Study of Frameworks** • Frameworks as reusable chunks of architecture • The framework lifecycle, development using frameworks • Spring Core Framework • Spring Boot Framework • Microservices with Spring • Web Architectures: Google Web Tool Kit, Spring , Hibernate etc. • Selection of proper framework • Comparing Frameworks • Advantages of Spring	5
8	**Case Study** (any one of the web Architecture) Take a Framework and find Patterns in the Framework.	9

Reference Books:

1. Head First Design Publisher: Pattern Kathy Sierra, Bert Bates, Elisabeth Robson, Eric Freeman O'Reilly Media, Inc
2. Software Architecture- Perspectives on an emerging discipline Mary shaw and David Garlan Pearson
3. Design Patterns – Elements of Reusable Object-oriented Software E. Gamma, Richard Helm, Ralph Johnson , John Vlissides (GoF) Addison-Wesley Professional
4. Pattern – Oriented Software Architecture (POSA) Volume 1 Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal. Wiley
5. Software Architecture in Practice Len Bass, Paul Clements, Rick Kazman Pearson Addison-Wesley Professiona
6. Applying UML and Patterns Craig Larman. PHI

Subject Code: 23-CSUT232

Subject: Machine Learning (4 Credit Course)

Total Lectures=60

Chapter	Course Contents	No. of Lectures
1	**Introduction to Machine Learning** • Data Science, Artificial Intelligence and Machine Learning • Why Learn and What is Learning, What is Machine Learning Traditional Programming Vs. Machine Learning, Machine Learning Process, Types of Data, Key Elements of Machine Learning (Representation, Evaluation and Optimization), Dimensionality Reduction (Feature Reduction) • Descriptive and Inferential Statistics: Probability, Distribution, Distance Measures (Euclidean and Manhattan), Correlation and Regression, Hypothesis Testing. • Introduction to Numpy,Pandas and scikit library • Creating our own dataset, Importing the dataset, Handling Missing Data, Splitting the dataset into the Training set and Test set, Feature Scaling • Relations of ML with other fields (Data Mining, Data Warehousing, Artificial Intelligence, Statistics)	15
2	**Machine Learning Models** • Type of Learning- Supervised, Unsupervised and Semi- Supervised Learning • Components of Generalization Error (Bias, Variance, underfitting, overfitting) • A Learning System Cycle and Design Cycle • Metrics for evaluation viz. accuracy, scalability, squared error, precision and recall, likelihood, posterior probability • Classification Accuracy and Performance	9
3	**Regression Models** • Linear Regression - Simple , Multiple, Polynomial • Non-linear Regression – Decision Tree, Support Vector, Random Forest	10
4	**Classification Models** • K – Nearest Neighbors (KNN) • Logistic Regression • Naive Bayes Theorem • Support Vector Machine • Decision Forest Classification • Random Tree Classification	12
5	**Clustering Models** • K-means • Hierarchical Clustering (Agglomerative,Divisive),Dendrogram • Selecting optimal number of clusters: Within Clusters Sum of Squares (WCSS) by Elbow Method	8
6	**Association Rules**	5

	• Key Terms: Support, Confidence and Lift • Apriori Algorithm	

Reference Books:

1. Machine learning WCB Mitchell, Tom M McGraw Hill Education
2. A first course in machine learning Rogers, Simon, and Mark Girolami CRC Press, 2015
3. The elements of statistical learning. Vol 1 Friedman, Jerome, Trevor Hastie, and Robert Tibshirani Springer, Berlin: Springer series in statistics, 2001
4. Machine learning course material Andrew Ng Stanford university

Subject Code: 23-CSUT233

Subject: Web Frameworks (4 Credit Course)

Total Lectures=60

Chapter	Course Contents	No. of Lectures
1	**Java Script Basics** • Java Script data types • Variables, Functions, Events, Regular Expressions • Array and Objects in Java Script • Java Script HTML DOM • Promises and Callbacks	6
2	**Node Package Manager** • What is NPM? • Installing package locally • Adding dependencies in package.json • Installing packages globally • Updating packages • Managing Dependencies	6
3	**Web Server** • Creating Web Server • Handling HTTP requests • Sending Requests • HTTP Streaming	5
4	**File System** • FS Model	6

	• Files and Directories • Streams • Reading and Writing Files • Reading and Writing Directories • Other File Operations	
5	**Events** • Asynchronous JS • Asynchronous control flow with callbacks • Promises • EventEmitter Class • ASync/Await • Returning Event Emitter • Inheriting Events	8
6	**Working with Databases** • Connection String • Configuring • Working with Select command • Various database operations • MongoDB • Mongoose ODM • Mongoose Schema • Mongoose Model • Querying with Mongoose	8
7	**Express JS** • REST • Introduction to Express JS • Routing, Responding • Configuration • Views • Receiving Data • Error Handling	7

Reference Books

1. Node.js complete Reference guide , velentin Bojinov, David Herron, Dioge Resende PACKT Publishing Ltd
2. Mastering Nod.js Sandro Pasquali PACKT Publishing
3. Smashing Node.js, Java Script Everywhere Guillermo Rauch, John wiley & Sons Wiley publishing
4. Two Scoops of Django 1.11 : Best Practices for the Django web Framework Book Danial Roy Greenfeld and Audrey Roy Greenfeld Two Scoops Press
5. Django for Beginners : Build websites with Python and Django William S Vincent Kindle Edition
6. Web Development with Django CookBook, second edition Aidas Bendoraits Second Edition PACKT Publishing

Subject Code: 23- CSDT234A

Subject: Big Data Analytics (2 Credit Course)

Total Lectures=60

Chapter	Course Contents	No. of Lectures
1	**Introduction to Big data** • Big Data :Definition & taxonomy • Sources of Big Data • 3V's of Big Data (need for Hadoop) • Varying data structures • Characteristics of Big Data • Applications of Big Data • Challenges in Big Data • Big Data Implications for Industries • Big Data Analytics for Telecom/Banking/Retail/HealthCare/IT/Operations	5
2	**Emerging Database Landscape** • Scale-Out Architecture, RDBMS Vs Non-Relational Database • Database Workload & its Characteristics • Implication of Big Data Scale on Data Processing	3
3	**Application Architecture & Data Modeling For Big Data And Analytics** • Big Data Warehouse & Analytics • Big data Warehouse System requirements & Hybrid Architectures • Enterprise Data Platform Ecosystem • Big Data and Master Data Management • Understanding data integration Pattern • Big Data Workload Design Approaches • Map-Reduce patterns ,Algorithms and Use Cases	5
4	**The Hadoop Ecosystem** • Introduction to Hadoop • Hadoop Architecture • History of Hadoop-Facebook,Dynamo,Yahoo,Google • Hadoop Components :HDFS, Mapreduce • Introduction to Pig,Hive ,HBase ,Mahout • Installation of single node cluster-installation of java Hadoop configuration	8
5	**Extracting Value From Big Data** • Real Time Analytics • In-Memory Data Grid for real Time Analysis • Map reduce & Real Time Processing ,Use Cases	4

6	**Big Data Analytics Methodology** • Big Data Analytics Methodology-Analyze & evaluate business cases • Develop Business Hypothesis –Analyze outcomes, Build & Prepare Data Sets ,Select & Build Analytical Model ,Design for Big Data scale .Build production ready system ,setting up the Big Data Analytics system ,Gathering data ,measure & monitor	5

Reference Books:

1. "Big Data Imperatives: Enterprise Big Data Warehouse,BI Implementations and Analytics",1st Edition
   Madhu Jagdeesh,Soumendra Mohanty,Harsha Srivatsa Apress(2013)
2. "Big Data Analytics:Turning Big Data into Big Money" Frank J.Ohlhorst Wiley Publishers(2012)
3. DB2 11:The Database for Big Data & Analytics" Cristian Molaro,Surekha Parekh Terry Purcell MC Press,(2013)
4. "Hadoop-The Definitive Guide,Storage and analysis at internet scale" Tom White SPD, O'Really.
5. Big Data Case Study Bernard Marr Willey Publications

Subject Code: 23- CSDP234A

Subject: Big Data Analytics Practical (2 Credit Course)

Total Practicals=10 (30 hrs)

Assignment Number	Assignment Name	Number of Sessions
1	Case study on Facebook	2
2	Case Study on IoT Sensors	1
3	Case Study on Telecom Industry	1
4	Case Study on Banking	1
5	Case study on Amazon	1
6	Case Study on General Electric –By TCS	1
7	Case Study on Uber	1
8	Case Study on Netflix	1

9	CDC(Corona Virus and other Pandemics)	1

Practical's

Note: Slips should be designed on the basis of following topics at college level. The practical's should be taken on the basis of above case studies.

1. Navigating in Hadoop environment [Operational commands in Hadoop environment like moving, copying files. creating directories etc.
2. Understand HDFS
3. Using unix tools
4. Development in Hadoop environment , using various Hadoop tools/utilities
5. Develop mapReduce programs [Assignments] - Develop mapReduce functions either in Java or Python

Subject Code: 23-CSDT234B

Subject: Web Analytics (2 Credit Course)

Total Lectures=30 hrs

Chapter	Course Contents	No. of Lectures
1	**Introduction** • What is web Analytics • Importance of web Analytics • Web Analytics process • Types of web analytics • Web analytics technical requirements • Web analytics 2.0 framework	**2**

2	**Qualitative Analysis** • Heuristic evaluations: • Conducting a heuristic evaluation • Benefits of heuristic evaluations • Site Visits: • Conducting a site visit, • Benefits of site visits • Surveys: • Website surveys • Post-visit surveys • creating and running a survey • Benefits of surveys.	**4**
3	**Web Metrics** • Key metrics • Dashboard • Implementation • metrics • Types of metrics • Conversion • goals • funnels • Data sources • server log • visitors data • search engine statistics and conversion funnels • Data segmentation • Analysis • Emerging analytics • e commerce • mobile analytics • A/B testing • Social Media Analytics • Sentimental Analysis • Text Analysis • Annotation and Reporting • Automated • Actionable	**10**
4	**Web analytics** • Introduction to analytics • Competitive intelligence analysis • CI data sources • Toolbar data • Panel data • ISP data • Search engine data	**7**

	• Hybrid data	
5	**Website traffic analysis:** • Comparing long term traffic trends • Analyzing competitive site overlap and opportunities.	3
6	**Google Analytics:** • Audience analysis • Acquisition analysis • Behavior analysis • Conversion analysis • Google website optimizer • Implementation technology • Privacy issues	4

Reference Books:

1. Advanced Web Metrics with Google Analytics, , Inc.2nd ed. Clifton B Wiley Publishing
2. Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity, , Inc. 1st ed. Kaushik A Wiley Publishing
3. Web Analytics: An Hour a Day, 1st ed Kaushik A Wiley Publishing
4. Web Metrics: Proven methods for measuring web site success Sterne J John Wiley and Sons

Subject Code: 23-CSDP234B

Subject: Web Analytics Practical (2 Credit Course)

Total Practical's=10 Practical's(30 hours)

Assignment No.	Assignment Particulars
1	Mining Twitter: Exploring Trending Topics, Discovering What People Are Talking About, and More Why Is Twitter All the Rage?, Exploring Twitter's API, Fundamental Twitter Terminology, Creating a Twitter API Connection, Exploring Trending Topics, Searching for Tweets, Analysing the 140 Character, Extracting Tweet Entities, Analysing Tweets and Tweet Entities with Frequency Analysis, Computing the Lexical Diversity of Tweets, Examining Patterns in Retweets, Visualizing Frequency Data with Histograms
2	Mining Facebook: Analyzing Fan Pages, Examining Friendships, and More Overview, Exploring Facebook's Social Graph API, Understanding the Social Graph API, Understanding the Open Graph Protocol, Analysing Social Graph Connections, Analysing Facebook Pages, Examining Friendships

3	Mobile Analytic: Analyze the your site on mobile device In last 30 days, how many new users come from mobile, What was the bounce rate of visitors on mobile device, What was the average session duration?
4	Segment traffic: Which social channel is sending the most engaged new users, Which page of your Website have been shared most, Which URL has the best engagement matrix
5	Use Google Analytics to measure the various metrics for E-commerce site amazon. **On-site** − It measures the users' behaviour once it is on the website. For example, measurement of your website performance. **Off-site** − It is the measurement and analysis irrespective of whether you own or maintain a website. For example, measurement of visibility, comments, potential audience, etc
6	Use Google Analytics to measure the various metrics for E-commerce site flipkart Count It is most basic metric of measurement. It is represented as a whole number or a fraction. For example, Number of visitors = 12999, Number of likes = 3060, etc. Total sales of merchandise = $54,396.18. Ratio It is typically a count divided by some other count. For example, Page views per visit. Key Performance Indicator (KPI) It depends upon the business type and strategy. KPI varies from one business to another.
7	Visitors loyalty: Analyse the person who visit site again and again is loyal to company because they can become customer
8	Consider the any E-Commerce site and to measure the web analytics. Content It gives you insight about website's content section. You can see how each page is doing, website loading speed, etc. Page Load Time More is the load time, the more is bounce rate. Tracking page load time is equally important. Engagement Rate It shows how long a person stays on your web page. What all pages he surf. To make your web pages more engaging, include informative content, visuals, fonts and bullets.
9	**Text Analytics:** Interpreting Twitter Data From college students Tweets. Extracting Tweet Entities, Analysing Tweets and Tweet Entities with Frequency Analysis, Computing the Lexical Diversity of Tweets, Examining Patterns in Retweets, Visualizing Frequency Data with Histograms
10	Consider the any E-Commerce site and to measure the web analytics. Bounce Rate If a person leaves your website within a span of 30 sec, it is considered as a bounce. The rate at which users spin back is called the bounce rate. To minimize bounce rate include related posts, clear call-to-action and backlinks in your webpages. Behaviour Behaviour lets you know page views and time spent on website. You can find out how customer behaves once he is on your website

Subject Code: 23-CSDT234C

Subject: Project (2 Credit Course)

Total Practical's=10 Practical's(30 hours)

Teaching Scheme: Project: 2 hours/week Batch Size: 5 students	**No. of Credits: 2**

Workload :

- One project guide to be assigned to 5 students.
- 2 hours /week to be allotted for 5 students

Guidelines:

- Students should work in a team of minimum 2 and maximum 3 students.
- Students can choose a project topic without any restriction on technology or domain.
- The student group will work independently throughout the project work including: problem identification, information searching, literature study, design and analysis, implementation, testing, and the final reporting.
- Project guide must conduct project presentations (minimum 2) to monitor the progress of the project groups.
- At the end of the project, the group should prepare a report which should conform to international academic standards. The report should follow the style in academic journals and books, with clear elements such as: abstract, background, aim, design and implementation, testing, conclusion and full references, Tables and figures should be numbered and referenced to in the report.
- The final project presentation with demonstration (UE) will be evaluated by the project guide (appointed by the college) and one external examiner (appointed by the University).

Evaluation guidelines:

IA (15 marks)			**UE (35 marks)**		
First presentation	Second presentation	Documentation	Project Logic/Presentation	Documentation	Viva
5	5	5	20	5	10

Recommended Documentation contents: Abstract

Introduction

-motivation
-problem statement
-purpose/objective and goals
-literature survey

-project scope and limitations System analysis

-Existing systems

- scope and limitations of existing systems

-project perspective, features

- stakeholders

-Requirement analysis - Functional requirements, performance requirements, security requirements etc.

System Design

- Design constraints
- System Model: UML diagrams
- Data Model

-User interfaces

Implementation details

-Software/hardware specifications

Outputs and Reports Testing

Test Plan, Black Box Testing or Data Validation Test Cases, White Box Testing or Functional Validation Test cases and results

Conclusion and Recommendations Future Scope

Bibliography and References

Subject Code: 23-CSDP234C

Subject: Project Related Assignments (2 Credit Course)

Total Practical's=10 Practical's(30 hours)

Teaching Scheme:
2 lectures/week

Workload :

- 2 lectures/week

Guidelines:

The project assignments are a compulsory part of the project course and should be carried out by each project group.
Project assignments are to be given by the guide for continuous internal evaluation.
The project assignments are to be allotted to each group separately by the project guide on the basis of the implementation technology. A suggested list of assignments is given below.

2. Project Time management: plan (schedule table), Gantt chart, Roles and responsibilities, data collection, Implementation
3. Simple assignments to evaluate choice of technology
4. Assignments on UI elements in chosen technology
5. Assignments on User interfaces in the project
6. Assignments on event handling in chosen technology
7. Assignments on Data handling in chosen technology
8. Online and offline connectivity
9. Report generation
10. Deployment considerations
11. Test cases

Each student within the group must work actively and contribute to the assignments,
project work and report writing.

Evaluation guidelines:

IA (15 marks)		UE (35 marks)	
Attendance	Assignments	Assignments	Viva
5	10	25	10

Subject Code:23-CSDP234C

Subject: Introduction to Data Science (2 Credit Course)

Total Lectures= 30 hours

Chapter	Course Contents	No. of Lectures
1	**Introduction & What is Data Science?** • Historical Overview of data analysis • Data Scientist vs. Data Engineer vs. Business Analyst, • Career in Data Science • Why Data Science • Applications for data science, Data Scientists Roles and Responsibility	**5**
2	**Data** • Data Collection • Data Management • Big Data Management • Organization/sources of data • Importance of data quality • Dealing with missing or incomplete data	6
3	**Data Classification Data Science Project Life Cycle** • Business Requirement • Data Acquisition • Data Preparation • Hypothesis and Modeling • Evaluation and Interpretation, Deployment.	6
4	**Introduction to Data Mining** • The origins of Data Mining • Data Mining Tasks • OLAP and Multidimensional data analysis • Basic concept of Association Analysis and Cluster Analysis	6

5	**Application of Business Analysis** • Retail Analytics • Marketing Analytics • Financial Analytics • Healthcare Analytics • Supply Chain Analytics.	6
6	**Introduction to R** • R Programming Basics, • Programs using List & Vectors, • Matrix, String and Factors, • Program using data frame and visualization	6

Subject Code: 23-CSDP234C

Subject: Practical on Data Science (2 Credit Course)

Total Practicals= 10 (30 hours)

Note: Implementation of Subject using R Programming Language		
Assignment No	Assignment	No. of Sessions
1	R Assignment using data frames, vectors,strings and bar plot	1
2	Data Pre-processing Assignments	2
3	Data Classification Assignments	1
4	Regression Assignment	2
5	Association Rules Assignment	2
6	Clustering Assignment	2

Subject Code: 23-CSUP235

Subject: Practical on CSUT231, CSUT232 and CSUT233 (4 Credit Course)

Total Practicals= 30 (60 hours)

Software Architecture & Design Pattern List of Assignments		
Assignment Number	**Assignment Name**	**Number of Sessions**
1	Virtual Lab Assignment Software Engineering Virtual Lab List of experiment • Modeling UML USE case Diagrams and Capturing Use Case Scenarios http://vlabs.iitkgp.ernet.in/se/ • Identifying Domain Classes From the Problem Statements • Modeling UML class diagram and sequence diagram • State Chart and Activity Modelling • Identifying the requirements from problem statements • ER Modelling from problem statements	**1**
2	Write a JAVA Program to implement built-in support (java.util.Observable) Weather station with members temperature, humidity, pressure and methods mesurmentsChanged(), setMesurment(), getTemperature(), getHumidity(), getPressure() Book 6: (Page No.-67)	
	Write a Java Program to implement I/O Decorator for converting uppercase letters to lower case letters.	
3	Write a Java Program to implement Factory method for Pizza Store with createPizza(), orederPizza(), prepare(), Bake(), cut(), box(). Use this to create variety of pizza's like NyStyleCheesePizza, ChicagoStyleCheesePizza etc. Book 6:(Page No.-125-130)	
4	Write a Java Program to implement Singleton pattern for multithreading. Book 6(Page no 180)	**2**
5	Write a Java Program to implement command pattern to test Remote Control. Book Page no 210)	
6	Write a Java Program to implement undo command to test Ceiling fan. Book (Page no 222)	

7	Write a Java Program to implement Adapter pattern for Enumeration iterator.(Page no 250)	**3**
8	Write a Java Program to implement Iterator Pattern for Designing Menu like Breakfast, Lunch or Dinner Menu Book6(Page no 326)	
9	Write a Java Program to implement State Pattern for Gumball Machine. Create instance variable that holds current state from there, we just need to handle all actions, behaviors and state transition that can happen. For actions we need to implement methods to insert a quarter, remove a quarter, turning the crank and display gumball. Book 6(Page no 390/391)	
10	Write a java program to implement Adapter pattern to design Heart Model to Beat Model. Book 6(Page no 546/547) Design simple HR Application using Spring Framework Book 9	**4**
Machine Learning Practical's		
	Virtual Lab for Python Kindly use the below link for checking Python programming • Arithmetic Operations • Built-in Functions • Loops • Data Types • Strings • Classes and Objects • Built-in Modules • Constructors and Inheritance Link: Welcome to Virtual Labs - A MHRD Govt of india Initiative (vlabs.ac.in)	**5**
1	Write a python program to Prepare Scatter Plot (Use Forge Dataset / Iris Dataset)	
2	Write a python program to find all null values in a given dataset and remove them.	
3	Write a python program the Categorical values in numeric format for a given dataset.	
4	Write a python program to implement simple Linear Regression for predicting house price.	
5	Write a python program to implement multiple Linear Regression for a given dataset.	
6	Write a python program to implement Polynomial Regression for given dataset	**6**
7	Write a python program to Implement Naïve Bayes.	

8	Write a python program to Implement Decision Tree whether or not to play tennis.	
9	Write a python program to implement linear SVM.	**7**
10	Write a python program to find Decision boundary by using a neural network with 10 hidden units on two moons dataset	
11	Write a python program to transform data with Principal Component Analysis (PCA)	**8**
12	Write a python program to implement k-nearest Neighbors ML algorithm to build prediction model (Use Forge Dataset)	
13	Write a python program to implement k-means algorithm on a synthetic dataset.	**9**
14	Write a python program to implement *Agglomerative clustering* on a synthetic dataset. Data Sets for ML • **UCI Machine Learning Repository** • **www.kaggle.com**	
Web Frameworks Practical's **Note : Install node js and visual studio editor on your machine**		
	HTML Virtual Lab • Introduction to HTML • Applying Attributes in HTML Tags • Inserting images through img tags • Using Anchor Tags for Hyperlinks • How marquee Tags work in HTML • Creating Tables in HTML • Types of Lists in HTML • Working of div Tag in HTML • Embedding through iframe Tag • Creating Webpage Layout in HTML Link : Virtual Labs (vlabs.ac.in)	**10**
1	Create an HTML form that contain the Student Registration details and write a JavaScript to validate Student first and last name as it should not contain other than alphabets and age should be between 18 to 50.	
2	Create an HTML form that contain the Employee Registration details and write a JavaScript to validate DOB, Joining Date, and Salary	**11**
3	Create an HTML form for Login and write a JavaScript to validate email ID using Regular Expression.	**12**
4	Create a Node.js file that will convert the output "Hello World!" into upper-case letters:	**13**

5	Using nodejs create a web page to read two file names from user and append contents of first file into second file	**14**
6	Create a Node.js file that opens the requested file and returns the content to the client. If anything goes wrong, throw a 404 error	
7	Create a Node.js file that writes an HTML form, with an upload field	**15**
8	Create a Node.js file that demonstrate create database and table in MySQL	
9	Create a node.js file that Select all records from the "customers" table, and display the result object on console	**16**
10	Create a node.js file that Insert Multiple Records in "student" table, and display the result object on console	
11	Create a node.js file that Select all records from the "customers" table, and delete the specified record.	**17**
12	Create a Simple Web Server using node js	
13	Using node js create a User Login System	
14	Using node js create a eLearning System	
15	Using node js create a Recipe Book	**18**
16	write node js script to interact with the filesystem, and serve a web page from a file	
17	Write node js script to build Your Own Node.js Module. Use require ('http') module is a built-in Node module that invokes the functionality of the HTTP library to create a local server. Also use the export statement to make functions in your module available externally. Create a new text file to contain the functions in your module called, "modules.js" and add this function to return today's date and time.	
18	Create a js file named main.js for event-driven application. There should be a main loop that listens for events, and then triggers a callback function when one of those events is detected	**19**
19	Implement a simple Django application for portfolio management.	
20	Create your own blog using Django	
21	Build your own To-Do app in Django	**20**
22	Develop Online School System using Django	

23	Create a clone of the "Hacker News" website.	
24	Implement your E-commerce Website using Django Implement Login System using Django	

Subject Code: 23-395

Subject: Introduction to Constitution (2 Credit Course)

Total Lectures= 30

UNIT	Course Contents	No. of hours
I	**PHILOSOPHY OF THE INDIAN CONSTITUTION** a) Constitutional History of India b) Role of Dr. B.R. Ambedkar in Constituent Assembly c) Preamble – Source and Objects d) Sovereign and Republic e) Socialist and Secular f) Democratic – Social and Economic Democracy g) Justice – Social, Economic and Political h) Liberty – Thought, Expression, Belief, Faith and Worship i) Equality – Status and Opportunity j) Fraternity, Human Dignity, Unity and Integrity of the Nation	5
II	**FUNDAMENTAL RIGHTS** a) Right to equality b) Right to freedoms c) Right against exploitation d) Right to freedom of religion e) Cultural and educational rights f) Right to property g) Right to constitutional remedies	10
III	**DIRECTIVE PRINCIPLES OF STATE POLICY** a) Equal Justice and free legal aid b) Right to work and provisions for just and humane conditions of work c) Provision for early childhood, Right to education and SC,ST, weaker section d) Uniform Civil Code e) Standard of Living, nutrition and public health f) Protection and improvement of environment g) Separation of Judiciary from executive h) Promotion of International peace and security	10

IV	**FUNDAMENTAL DUTIES** a) Duty to abide by the Constitution b) Duty to cherish and follow the noble ideals c) Duty to defend the country and render national service d) Duty to value and preserve the rich heritage of our composite culture e) Duty to develop scientific temper, humanism ,the spirit of inquiry & reform f) Duty to safeguard public property and abjure violence g) Duty to strive towards excellence	5

References:

a) D. D. Basu, Introduction to the Constitution of India, LexisNexis
b) Granville Austin, The Constitution of India: Cornerstone of a Nation,
Oxford University Press
c) Subhash Kashyap, Our Constitution, National Book Trust
d) M.P. Jain, Indian Constitutional Law, LexisNexis V.N.Shukla, Constitution of India, Eastern Book Company
f) P.M. Bakshi, The Constitution of India, Universal Law Publishing
g) M.V.Pylee, Constitutional Government in India, S. Chand
h) V. S. Khare, Dr. B.R.Ambedkar and India's National Security
i) डॉ. सत्यरंजन साठे, भारताच्या राज्यघटनेची ५० वर्षे, कॉन्टिनेन्टल प्रकाशन
j) नरेन्द्र चपळगावकर, राज्यघटनेचे अर्धशतक, मौज प्रकाशन गृह
k) सुहास पळशीकर, राजकारणाचा ताळेबंद भारतीय लोकशाहीची वाटचाल, साधना प्रकाशन
l) जयदेव गायकवाड, संविधान सभेत डॉ. आंबेडकर, पद्मगंगा प्रकाशन
m) झिया मोदी, टेन जजमेंट्स दॅट चेंज्ड् इंडिया, सकाळ प्रकाशन
n) डॉ. रावसाहेब कसबे, डॉ. आंबेडकर आणि भारतीय राज्यघटना, सुगावा प्रकाशन

Subject Code: 23-392

Subject: Introduction to Cyber Security / Information Security- III (2 Credit Course)

Total Lectures= 30

Chapter	Course Contents	No. of Lectures
Module 3: Information and Network Security		
1	**Chapter 1: Access Control and Intrusion Detection** 1. Overview of Identification and Authorization 2. Overview of IDS 3. Intrusion Detection Systems and Intrusion Prevention Systems	4
2	**Chapter 2: Server Management and Firewalls** 1. User Management 2. Overview of Firewalls 3. Types of Firewalls 4. DMZ and firewall features	4
3	**Chapter 3: Security for VPN and Next Generation Technologies** 1. VPN Security 2. Security in Multimedia Networks 3. Various Computing Platforms: HPC, Cluster and Computing Grids 4. Virtualization and Cloud Technology and Security	6

SEMESTER IV

Subject Code: 23-CSUIT241

Subject: Industrial Training /Institutional project (20 Credit Course)

<table>
<tr><td>Teaching Scheme: 2 hrs/week</td><td>No. of Credits: 20</td></tr>
<tr><td>Course Prerequisites:</td><td>The Industrial Training /Institutional project is equivalent to 5 theory courses of 4 credits each. Marks per 4 credits = 100. The total weightage for Industrial/Institutional training is 500 marks.</td></tr>
<tr><td colspan="2">Workload :
1. One mentor to be assigned for 5 students.
2. 2 hours /week to be allotted for 5 students</td></tr>
<tr><td></td><td>Guidelines:
• Each student must individually complete minimum 5 months full time Industrial training / Institutional project in the 4th semester.
• College should assign a student mentor to every student. The mentor will monitor the progress of the student throughout the semester for continuous assessment.
• Student should submit a valid offer letter and synopsis within two weeks of starting the internship.
• There will be continuous assessment of the work done by the student during the internship period.
• Continuous assessment guidelines:
1. Student should submit a weekly report in the college to the mentor.
2. The report should contain the following details: Name of student, project title, company name, company mentor, daily activities and results/output, proposed work for next week.
3. The weekly report should be duly signed by the student and company mentor/ institute guide (CM).
4. Student Mentor should maintain weekly attendance record for every student.
5. Two presentations should be conducted for each student (first presentation after first month and second presentation after 3rd month)</td></tr>
</table>

	6. Student Mentor should take feedback from the Company mentor regarding overall performance of the student. • At the end of the internship period, each student should prepare a report which should conform to international academic standards. The report should follow the style in academic journals and books, with contents such as: abstract, background, aim, design and implementation, testing, conclusion and full references, Tables and figures should be numbered and referenced to in the report
	Examination and Evaluation guidelines • The project done during internship period will be evaluated in the following manner: IA - 150 marks + UE-350 marks. • The final presentation and documentation will be evaluated by three examiners: 1. Student mentor (appointed by respective college) 2. External examiner (appointed by the University) 3. IT expert (appointed by respective college)

IA (150 marks)				
Weekly Attendance	Weekly Reports	First Presentation	Second Presentation	Documentation
20	40	20	40	30

UE (350 marks)		
Mentor	IT Expert	External Examiner
100	125	125

Recommended Documentation contents:

Title page
Company / Institute certificate Internship completion certificate **Abstract**
Introduction
-motivation
-problem statement
-purpose/objective and goals
-literature survey
-project scope and limitations
System analysis

-Comparative study of Existing systems
- scope and limitations of existing systems

-project perspective, features
- stakeholders

-Requirement analysis - Functional requirements, performance requirements, security requirements etc.

System Design
- Design constraints
- System Model: UML diagrams
- Data Model

User interfaces

Implementation details

-Software/hardware specifications, etc.

Reports Testing

Test Plan, Black Box Testing or Data Validation Test Cases, White Box Testing or Functional Validation Test cases and results

Conclusion and Recommendations Future

Scope

Bibliography and References

Subject Code: 23-492

Subject: Introduction to Cyber Security / Information Security- IV (2 Credit Course)

Total Lectures= 30

Chapter	Course Contents	No. of Lectures
Module 4: System and Application Security		
1	**Chapter 1: Security Architectures and Models** 1. Designing Secure Operating Systems 2. Controls to enforce security services 3. Information Security Models	2
2	**Chapter 2: System Security** 1. Desktop Security 2. email security: PGP and SMIME 3. Web Security: web authentication, SSL and SET 4. Database Security	2

3	**Chapter 3: OS Security** 1. OS Security Vulnerabilities, updates and patches 2. OS integrity checks 3. Anti-virus software 4. Configuring the OS for security 5. OS Security Vulnerabilities, updates and patches	6
4	**Chapter 4: Wireless Networks and Security** 1.Components of wireless networks 2. Security issues in wireless	4

Subject Code: 23-494

Subject Skill Development II (2 Credit Course)

Total Lectures= 30

Teaching Scheme: **2 hrs/week**	**Examination Scheme:** **IA: 10 Marks** **CE: 15 Marks**	**No. of Credits: 2**
Student are informed to perform project based on any technology/language/platform		

Progressive Education Society's

Modern College Of Arts, Science and Commerce, Ganeshkhind, Pune – 411 016 (Autonomous)

Syllabus for

M. Sc. II Computer Applications

Introduction:

Computer Science Department came into existence in the year 1996. The department is sponsored by DBT, Govt. of India under STAR College Scheme. At present department offers following courses

1. B.Sc.(Computer Science) - 240 Seats
2. M.Sc.(Computer Science) - 60 Seats
3. M.Sc.(Computer Applications) - 60 Seats

Department provides following facilities:

- Experienced faculty members.
- Visiting faculty from reputed industrial unit.
- Well-furnished separate labs for B.Sc.(Computer Science), M.Sc.(Computer Science) and M.Sc.(Computer Applications).
- Internet access to students
- In addition, following activities are conducted - Intercollegiate computer competitions (Interaction), Quiz competition, Poster competition, Tech-Fest (Interclass competition)
- Various seminars, guest lectures by eminent personalities from industries/institutions
- A separate placement cell is formed M.Sc.(Computer Applications) and MCA (under science faculty) course as well as for other Under Graduate and Post Graduate courses
- Remedial coaching for students

Programme Objectives:

Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

Programme Specific Outcomes (PSOs):

After completing M.Sc. Computer Applications Programme, students will be able to:

Knowledge Outcomes:
Students will able to

PO1	Apply computing knowledge and domain specific knowledge.
PO2	Identify, produce, and develop solutions to computational challenges through.
PO3	Understand professional, ethical, legal, security, and social issues and responsibilities for the computing profession.
PO4	Understand and apply computing management principles to manage multi-disciplinary Projects.

PO5 Design and develop computer programs/computer-based systems in the areas related to algorithms, networking, web design, cloud computing, Artificial Intelligence, Mobile applications and Internet of Things.

Skill Outcomes:
Students will be able to

PO6 Use software development tools, software systems, and modern computing platforms

PO7 Integrate several scientific and technical disciplines in the area of information technology.

PO8 Communicate and engage effectively with diverse stakeholders.

General Competence
The students will be able to

PO9 Understand how technological advances impact society and the social, legal, ethical and cultural ramifications of computer technology and their usage.

PO10 Contribute to innovative thinking and innovation processes.

Examination

IA : 30M
CE : 70M

Suggested internal assessment tools for courses:

The concerned teacher shall announce the units for which internal assessment will take place. A teacher may choose one of the methods given below for the assessment.

1. Library notes
2. Students Seminar
3. Short Quizzes / MCQ Test
4. Home Assignments
5. Tutorials/ Practical
6. Oral test
7. Research Project
8. Group Discussion
9. Open Book Test
10. Study Tour
11. Written Test
12. PPT presentation

13. Field Visit
14. Industrial Visit
15. Viva
16. Research Paper writing

Teaching Methodology:

1. Classroom Teaching
2. Guest Lectures
3. Group Discussions
4. Power Point Presentations
5. Visit to Institutions / Industries
6. Research Papers & Projects
7. E-content
8. Mind map

Subject List

Semester-III

Sr. No.	Subject Type	Subject Code & Title	Credits			Total No.of Lectures
			Theory	Practical	Total	
1	Theory	23-CA- CCTP-7 Mobile Application Development Using	4		20	60
2	Theory	23-CA- CCTP-8 Internet of Things	4			60
3	Theory	23-CA- CCTP-9 Digital Marketing	4			60
4	Theory Optional Paper	23-CA-CBOTP- 3 A Python Programming 23-CA-CBOPP- 3A Python Programming Laboratory **OR** 23-CA-CBOTP- 3 B Big Data 23-CA-CBOPP- 3B Big Data Laboratory **OR** 23-CA-CBOTP- 3 C Django 23-CA- CBOPP-3C Django Laboratory	4			60
5	Practical	23-CA- CCPP-3 Practical on Android Programming Laboratory		4		60

Extra Credit (Mandatory)			
Course Type	**Course Code**	**Course Name**	**Credit**
Extra Credit Theory Paper	23-392	Introduction to Cyber Security/ Information security-III	1
	23-394	Skill Development-I	2
	23-395	Introduction to Constitution	2

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year II Semester IV							
Year/ Sem	**Course Type**	**Course Code**	**Course Name**	**Credit**	**% of Assessment**		
					IA	**CE**	**Total**
II Year Sem-IV	Core	23-CSUIT241	Industrial Training /Institutional project	20	**150**	**350**	**500**

Extra Credit (Mandatory)			
Course Type	**Course Code**	**Course Name**	**Credit**
Extra Credit Theory Paper	23-492	Introduction to Cyber Security/ Information security-IV	1
	23-494	Skill Development-II	2

IA :- Internal Assessment, CE :- College Examination
Practical paper implementation strategy:

Subject	Platform
PPL	Linux
Database Technologies	Linux / Windows
AI	Linux
Web Services	Linux / Windows
Cloud Computing	Linux/ Windows/ AWS

Note : Any version of Linux (Fedora/ Redhat/ Ubuntu etc.) can be used as per your comfort

Syllabus

Semester-III

Subject Code: 23-CA-CCTP-7
Subject: Mobile Application Development Using Android (4 Credit Course)
Total Lectures=60

Chapter	Course Contents	No. of Lectures
1	**Android Fundamentals** • Introduction to Android - Overview and evolution of Android, Features of Android, Android architecture • Components of an Android Application, Manifest file • Android Activity Service Lifecycle	12
2	**Android UI Design**: • Basic UI Designing (Form widgets, Text Fields, Layouts, [dip, dp, sip, sp, versus px) • Intent (in detail) • All components (e.g Button, Slider, Image view, Toast) Event Handling • Adapters and Widgets • Menu	12
3	**Android Thread and Notification:** • Threads running on UI thread (runOnUiThread) • Worker thread • Handlers & Runnable • Asyn Task (in detail) • Broadcast Receivers • Services and notifications • Toast • Alarms	12
4	**Advanced Android Programming:** • Content Providers – SQLite Programming • JSON Parsing • Accessing Phone Service (Call, SMS, MMS) • Location based services	12
5	**PhoneGap Programming**: • Why Use PhoneGap? • How PhoneGap Works • Designing for the Container • Writing PhoneGap Applications • Building PhoneGap Applications • PhoneGap Limitations • PhoneGap Plug-Ins • Hello, World! Program • PhoneGap APIs –1 • Accelerometer:	10

	• Querying Device Orientation • Watching a Device's Orientation • Creating a Contact, Searching for Contacts, Cloning Contacts, Removing Contacts	
6	**iOS Fundamentals** : • **Introduction** - What is IOS ,IOS Architecture, Frameworks, Application Life Cycle, Features • Swift - Introduction to Swift ,General Concepts of Swift • Xcode - Introduction to Xcode , Navigator, Editor Utility, Tools, Console, Document, Simulator, Instruments • **Startup** - Application Templates, Introduction to Storyboard , Hello World Application, How 'Hello World' Working, Debugging Database, Plist, • Preference, Sqlite Web Service, Restful Web Service (JSON & XML)	2

Reference Books:

1. IOS Apprentice by Matthijs Hollemans
2. PhoneGap: Beginner's Guide by Giorgio Natili, Purusothaman Ramanujam, PACKT Publication
3. Beginning Android Application Development

Subject Code: 23-CA-CCTP-8

Subject: Internet of Things (IoT) (4 Credit Course)

Total Lectures=60

Chapter	Course Contents	No. of Lectures
1	**Fundamentals of IoT** • Basic Concepts of IoT, Architecture, Interaction with the Internet, • Major components of IoT devices, • Control Units, Sensors, • Communication Modules, • Power Sources Communication Technologies Wireless Communication Bluetooth, • ZigBee, WiFi, RF Links, Mobile Internet, • Wired Communication, • Layered Protocol, Ethernet TCP/IP, • Overview of each Layer, HTTP, • IOT Protocol: MQTT, CoAP, XMPP, OSGi Architecture/Services	12
2	**Microcontroller Fundamental and Programming** • System on Chip, Microcontrollers, • Programming Microcontrollers, Arduino Platform, The Boards, The Anatomy of an Arduino Board, The Development Environment Arduino Software Setup the IDE, • Writing Arduino Software, The Arduino Sketch, Some Basic Examples, Trying the code on an Arduino Emulator - Extending Arduino, Arduino Libraries 25 • Programming & Interfacing. • Programming Arduino for the Internet of Things, Using Timers, Threads, • Adding Security to Sensor Readings, Authenticating and Encrypting Arduino	14

	Data Introduction to Raspberry PI, • Installation, GPIO, • Interfacing, Programming. Features of Python.	
3	**Introduction to Cloud Computing** • Introduction to Cloud Computing, • Cloud based Architecture, SaaS, PaaS and IaaS, • Benefits risk and challenges of cloud computing platforms and services, • Introduction to cloud based IoT Platforms like IBM, Bluemix, Carriots etc	9
4	**Sensor Fundamentals** • Sensor Fundamentals: How Sensors Work, Classification of Sensors, • Analog and Digital Sensors, Pull-Up/Down resistors and Examples of sensors and working principles, • Sensor Networks, • Actuators Types of Digital Sensors, Temperature, Humidity, • LUX, Gas sensor, Water Level Sensors.	9
5	**Arduino Interface** • **Arduino-Ethernet Interface** Connect Arduino using the Ethernet, Arduino Ethernet Library, Simple Ethernet Client Example, Simple Ethernet Server Example • **Arduino using the WiFi** Connect Arduino using the WiFi, WiShield Library, WiFly Shield Library, Using the Arduino Library for Processing, **IoT Privacy, Security and governance**, Security issues at different layers.	10
6	**IoT Application and Case study** • Application of IoT and Case studies: Home Automation, Smart Parking, Water Management, • Agriculture, Citizen Safety, Waste Management, Intelligent Transport System, Smart city.	6

Reference Books:

1. Waher, Peter. Learning internet of things. Packt Publishing Ltd, 2015
2. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"
3. The Internet of Things: From RFID to the Next-Generation Pervasive Networked Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning
4. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , Arshdeep Bahga
5. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally
6. "Mobile Computing," Tata McGraw Hill, Asoke K Talukder and Roopa R Yavagal, 2010
7. Computer Networks; By: Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi, 4th Edition
8. Data and Computer Communications; By: Stallings, William; Pearson Education Pte. Ltd., Delhi, 6th Edition
9. "Fundamentals of Mobile and Pervasive Computing," F. Adelstein and S.K.S. Gupta, McGraw Hill, 2009. 8. Cloud Computing Bible, Barrie Sosinsky, Wiley- India, 2010
10. Schwartz, M. (2016). Internet of Things with Arduino Cookbook. Packt Publishing Ltd

Subject Code: 23-CA-CCTP-9

Subject: Digital Marketing (4 Credit Course)
Total Lectures=60

Chapter	Course Contents	No. of Lectures
1	**Introduction to Digital Marketing** • E-Commerce • Understanding Internet Marketing • What is Digital Marketing • Digital Vs Real Marketing • Digital Marketing Channels • Types of Digital Marketing	8
2	**Creating Initial Digital Marketing Plan** • Content Management • SWOT analysis • Target Group Analysis Exercise: Define a target group	4
3	**Marketing Using Websites** • Web Design • Optimization of Websites • MS Expression Web Exercise: Creating Websites, MS Expression	8
4	**Search Engine Optimization** • SEO Optimization • Writing the SEO Content	4
5	**Customer Relationship Management** • Introduction to CRM • CRM Platform • CRM Models Exercise	6
6	**Social Media Marketing** • Understanding Social Media Marketing • Social Networking (Facebook, Linkedin, Twitter) • Social Media(Blogging, Video sharing, Youtube, Instagram, podcast) • Web Analytics- levels • Modes of Social Media Marketing • Email Marketing Plan- Email Marketing campaign analysis • Digital Marketing Tools- Google Ads, Facebook Ads, Google Analytic, Zapier, Google Keyword Planner	20
7	**Digital Marketing Budgeting** • Resource Planning • Cost Estimating • Cost Budgeting • Cost Control	5
8	**Case Study**	5

	• Tata Sky Transfer Digital Marketing Case Studies Amazon India Digital Marketing Case Studies	

Reference Books:

1. Digital Marketing for Dummies by Ryan Deiss & Russ Henneberry
2. Digital Marketing Strategy: An Integrated Approach to Online Marketing by Simon Kingsnorth
3. The Art of SEO: Mastering Search Engine Optimization by Eric Enge, Jessie Stricchiola, Stephan Spencer
4. New Rules of Marketing and PR by David Meerman Scott

Subject Code: 23-CA-CCPP-3

Subject: Android Laboratory (4 Credit Course)
Total Practicals=10(hours 30)

Chapter	Course Contents	No. of Practicals
1	Create an Application Which will Send ―Hello message from one activity to another with help of Button (Use Intent).	3
2	Create application with Login Screen. On successful login, gives message go to next Activity (Without Using Database).	3
3	Create First Activity to accept information like Student First Name, Middle Name, Last Name, Date of birth, Address, Email ID and display all information on Second Activity when user click on Submit button.	3
4	Create a "Contact" layout to hold multiple pieces of information, including: Photo, Name, Contact Number, E-mail id	4
5	Create registration form. Also perform appropriate validation	3
6	Construct an app to display the image.	3
7	Construct a bank app to display different menu like withdraw, deposit etc.	3
8	Construct a register app to display different menu like add, delete, edit etc.	3
9	Create sample application with login module (Check username and password). On successful login, pass username to next screen And on failing login, alert user using Toast (Hint :Use Login(username, password) Table.)	4
10	Create Table project (pno, p_name, ptype, duration) and employee (id, e_name, qulification, joindate) Project – employee have many to many relationship Using database perform following operation. 1) Add new record into table. 2) Accept a project name from user and display information of employees working on the project.	4
11	Create application to send and receive messages using SMS Manager	3
12	Create application to send email.	4
13	Create application to design login form, validate it. Write and send email with appropriate message.	4
14	Write a program to search a specific location on Google Map	4
15	Write a program to calculate distance between two locations on Google Map.	4
16	Create application using JSON which gives us list of contacts where each node contains contact information like name, email, address, gender and phone numbers.	4
17	Create application using JSON which gives the Employee information.	4

Subject Code: 23-CBOTP-3A

Subject: Python Programming (2 Credit Course)
Total Lectures =30 hrs

Chapter	Course Contents	No. of Lectures
1	**Introduction to python** • Why Scripting is Useful in Computational Science • Why Python? Script or Program? • Application of Python **Basics of python** • Python identifiers and reserved words • Lines and indentation, multi-line statements and Comments • Input/output with print and input functions, • Command line arguments and processing command linear augments Standard data types - basic, none, Boolean (true & False), numbers Data type conversion • Python basic operators (Arithmetic, comparison, assignment, bitwise logical) Python membership operators (in & not in) • Python identity operators (is & is not) • Operator precedence • Control Statements, Python loops, Iterating by subsequence index, loop control statements • Menu Driven Implementation (break, continue, pass)	6
2	**Python strings** • Concept, escape characters • String special operations String formatting operator • Single quotes, Double quotes, Triple quotes • Raw String, Unicode strings, • Built-in String methods • Python Lists - concept, creating and accessing elements, updating & deleting lists,basic list operations, reverse • Indexing, slicing and Matrices built-in List functions • Functional programming tools – filter (), map(), and reduce() • Using Lists as stacks and Queues, List comprehensions	4

3	**Python tuples, sets, Dictionary** • Creating & deleting tuples, Updating tuples Accessing values in a tuple, deleting tuple elements built- in tuple functions and operations • Indexing, slicing and Matrices Sets - Concept, operations. • **Dictionary** • Concept (mutable) • Creating and accessing values in a dictionary • Updating dictionary, delete dictionary elements • Properties of dictionary keys built-in dictionary functions and methods.	**5**
4	**Functions** • Defining a function (def) and calling a function • Function arguments - Pass by value, Keyword Arguments, default arguments Scope of variable - basic rules • Documentation Strings Variable Number of Arguments Call by Reference • Order of arguments (positional, extra & keyword) Anonymous functions • Recursion • Treatment of Input and Output Arguments Unpacking argument lists • Lambda forms Function Objects function ducktyping & polymorphism • Generators (functions and expressions) and iterators	**5**
5	**Files and Directories** • Creating files and Operations on files (open, close, read, write) File object attributes, file positions, Listing Files in a Directory Testing File Types • Removing Files and Directories • Copying and Renaming Files Splitting Pathnames • Creating and Moving to Directories Traversing Directory Trees • Illustrative programs: word count, copy file	**3**
6	**Python Classes and Objects** • Object oriented programming and classes in Python creating classes, instance objects, accessing members • Data hiding (the double underscore prefix) Built-in class attributes • Garbage collection: the constructor Overloading methods and operators • Inheritance - implementing a subclass, overriding methods Recursive calls to methods • Class variables, class methods, and static methods	**6**

7	**Python Exceptions** • Exception handling: assert statement • Except clause - with no exceptions and multiple exceptions • Try - finally, raising exceptions, user-defined exceptions	**1**

Reference Books:

1 Introducing Python- Modern Computing in Simple Packages – Bill Lubanovic, O„Reilly Publication
2 Beginning Python: From Novice to Professional, Magnus Lie Hetland, Apress
3 Practical Programming: An Introduction to Computer Science Using Python 3, Paul Gries, et al.,Pragmatic Bookshelf, 2/E 2014
4 Introduction to Computer Science Using Python- Charles Dierbach, Wiley Publication Learning with Python ", Green Tea Press, 2002
5 E-Books: python_tutorial. pdf, python_book_01.pdf
6 Beginning Programming with Python for Dummies Paperback – 2015 by John PaulMueller
7 A Beginner"s Python Tutorial: http://en.wikibooks.org/wiki/A

Subject Code: 23-CA-CBOPP-3A

Subject: Python programming Laboratory (2 Credit Course)
Total Practicals=10 (30 hrs)

Assignment No	Assignments Name	No. of Practicals 30
1	Create a program that asks the user to enter their name and their age. Print out a message addressed to them that tells them the year that they will turn 100 years old.	2
2	Write a program to check whether the number is even or odd, print out an appropriate message to the user.	1
3	Write a program which will find all such numbers which are divisible by 7.	1
4	Write a program which can compute the factorial of a given numbers.	1
5	Write a program that prints out all the elements of the list that are less than 10.	1
6	Write a program that returns a list that contains only the elements that are common between the lists (without duplicates). Make sure your program works on two lists of different sizes.	2
7	To determine whether the number is prime or not.	1
8	To check whether a number is palindrome or not. (using recursion and without recursion).	1

9	Write a program that asks the user how many Fibonnaci numbers to generate and then generates them.	1
10	Write a program (using functions!) that asks the user for a long string containing multiple words. Print back to the user the same string, except with the words in backwards order. E.g " I am Msc student" is :"student Msc am I"	2
11	Write a program to implement binary search to search the given element using function.	1
12	Given a .txt file that has a list of a bunch of names, count how many of each name there are in the file, and print out the results to the screen.	1
13	Write a program that takes a list of numbers (for example, a = [5, 10, 15, 20, 25])and makes a new list of only the first and last elements of the given list.	1
14	Write a program that accepts sequence of lines as input and prints the lines after making all characters in the sentence capitalized.	2
15	Write a program that accepts a sentence and calculate the number of letters and digits.	1
16	Write a program that accepts a sentence and calculate the number of upper case letters and lower case letters.	1
17	Write a Python function to calculate the factorial of a number (a non- negative integer). The function accepts the number as an argument.	2
18	Write a Python program of recursion list sum.	1
19	Write a Python program to solve the Fibonacci sequence using recursion.	1
20	Write a Python program to get the sum of a non-negative integer.	1
21	Write a Python program to find the greatest common divisor (gcd) of two integers	1
22	Write a Python function that takes a list and returns a new list with unique elements of the first list.	1
23	Write a Python function to check whether a number is perfect or not	1
24	Write a Python program to read a file line by line store it into an array.	1

Subject Code: 23-CBOTP-3B

Subject: Big Data (2 Credit Course)

Total Lectures= 30

Chapters	Topic	No. of Lectures 30
1	**Introduction to Big Data** • Big Data :Definition & taxonomy • Sources of Big Data • 3V's of Big Data (need for Hadoop) • Varying data structures • Characteristics of Big Data Applications of Big Data Challenges in Big Data • Introduction to Big Data Technology • Industry applications of BIG Data	3
2	**From SQL to NoSQL** • Evolution of Databases, Scale-Out Architecture, RDBMS Vs Non-Relational Database • NoSQL Data Store • NoSQL Data Architectural Patterns Managing BIG Data using NOSQL Database Workload & its Characteristics	4
3	**Big Data Warehouse and Analytics** • Big Data Warehouse & Analytics • Big data Warehouse System requirements & Hybrid Architectures • Enterprise Data Platform Ecosystem • Big Data and Master Data Management Understanding data integration Pattern • Big Data Workload Design Approaches • Map-Reduce patterns, Algorithms and Use Cases	5

4	**The Hadoop Ecosystem** • Introduction to Hadoop • Hadoop and its Ecosystems • Hadoop Components :HDFS, Mapreduce Frame work and Programming model • Hadoop Yarn • Introduction to HBase, Hive, Pig and Mahout	8
5	**Spark and Big Data Analytics** • Introduction • Data Analysis using Spark – Spark SQL, Using Python with Spark SQL, Operations • Introduction to programming with RDDs • Introduction to Machine learning with Mlib • Introduction to ETL using Spark • Introduction to Analytics, Reporting and Visualizing	5
6	**Case Studies of Big Data Analytics** Business Case Studies: Netflix, Facebook, LinkedIn and Google For each study – The problem to solve, how it was solved, results, what data was used, Technical details, challenges faced and learning lessons	5

Reference Books:

1. Raj Kamal, Preeti Sexena, "Big Data Analytics", McGraw Hill Education
2. Madhu Jagdeesh, Soumendra Mohanty, Harsha Srivatsa,"Big Data Imperatives: Enterprise Big Data Warehouse,BI Implementations and Analytics",1st Edition, Apress(2013)
3. Cristian Molaro,Surekha Parekh,Terry Purcell,"DB2 11:The Database for Big Data & Analytics",MC Press,(2013)
4. Tom White,"Hadoop-The Definitive Guide,Storage and analysis at internet scale",SPD, O'Really.
5. DT Editorial Services,"Big Data, Black Book-Covers Hadoop2, MapReduce, Hive, YARN, Pig, R and Data Visualization" Dreamtech Press (2015).
6. Big Data Case Study by Bernard Marr –Willey Publications.

Subject Code: 23-CA-CBOPP-3B
Subject: Big Data Laboratory (2 Credit Course)
Total Practical's=10 Practical's(30 hours)

Assignment No.	Big Data Assignments	No. of Practicals
1	Hadoop and its components	2
2	Case study on Sprint	3
3	Case Study on IBM Watson	5
4	Case Study on Terra Seismic	5

5	Case Study on Uber	5
6	Case study on Twitter	5
7	Case Study on Kaggle	5

Reference Books:

1. Big Data Case Study by Bernard Marr –Willey Publications

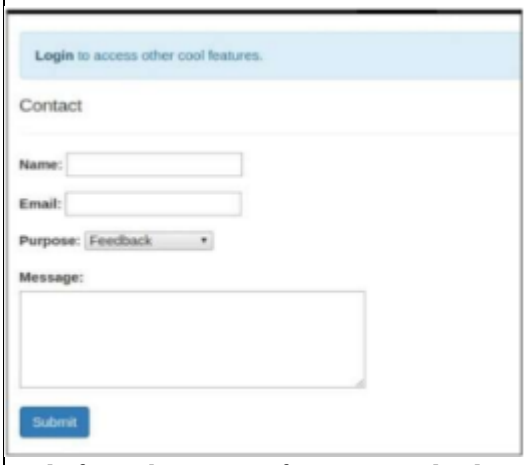
Subject Code: 23-CBOTP -3 C
Subject: Django (2 Credit Course)
Total Lectures=30 hours

Chapter	Topic	No. of Lectures30
1	**Introduction to Django** • What is Django? • Django and Python • Django' s take on MVT: Model, View and Template • DRY programming: Don't Repeat Yourself • How to get and install Django	7
2	**Getting started with Django** • About the 3 Core Files: models.py, urls.py, views.py • Setting up database connections with SQLite and MySQL • Managing Users & the Django admin tool • Installing and using 'out of the box' Django features	7
3	**Django URL Patterns, Views and Forms** • Designing a good URL scheme • Generic Views • Form classes • Validation • Authentication • Advanced Forms processing techniques	8
4	**REST APIs** • Django REST framework • Requests and Responses • Class Based Views • Authentication and Permissions	8

5	**References** 1. Django for Beginners: Build websites with Python and Django Kindle Edition by William S. Vincent 2. Two Scoops of Django 1.11: Best Practices for the Django Web Framework	

Subject Code: 23-CA-CBOPP-3 C
Subject: Django Laboratory (2 Credit Course)
Total Practicals =10(30 hours)

Assignment No	Django Assignments	No. of Lectures 30
1	Create a web page that outputs "Hello Django".	**1**
2	Create a Django built-in login form with password validation.	**1**
3	Design Django Admin App site in which, you can • Add new user. • Modify existing user. • Search and filter users. • Sort the user data by clicking on the column header • Delete user	**2**
4	Create Django login page	**1**
5	Create Django templates that represent the HTML GUI that the client can view	**1**
6	Build Django application that illustrate template inheritance	**1**
7	Build, handle, submit & validate HTML forms in the Django way.	**1**
8	Write a Python program to connect a database and create SQLite table within	**2**
9	Write a Python program to list the tables of given SQLite database file.	**2**
10	WriteaPythonprogramtocreateatableandinsertsomerecordsinthattable. Finally select all rows from the table and display the records.	**1**
11	Create Django app that will print records of employee having attributes first name, last name and Designation from Django admin.	**1**
12	Write Python Django program to insert, update and delete record in to database table using GUI	**1**
13	Build the Django form which will accept the name, email and address. Validate Name field. Name should start with 'A', else display error message.	**2**
14	Develop Django models and model relationships for customized application.	**2**
15	Query the created models & connect to MySQL database.	**1**
16	Using Object Relational Mapper(ORM), design Django app that can insert and access the data from the student's database	**2**

17	Create Django authentication (or auth) app that provides a wide array of tools for User management ranging from authenticating users to resetting passwords.	**2**
18	Design Django application that will create contact-us page as shown below  And after submitting information it displays Thank you message on the same page	**2**
19	Build REST web services and mapping web URLs with view functions & perform complex routing	**2**
20	Use the built-in HTTP session object parameters to control the session behaviours /patterns	**2**

Subject Code: 23-395

Subject: Introduction to Constitution (2 Credit Course)
Total Lectures= 30

UNIT	Course Contents	No. of hours
I	**PHILOSOPHY OF THE INDIAN CONSTITUTION** a) Constitutional History of India b) Role of Dr. B.R. Ambedkar in Constituent Assembly c) Preamble – Source and Objects d) Sovereign and Republic e) Socialist and Secular f) Democratic – Social and Economic Democracy g) Justice – Social, Economic and Political h) Liberty – Thought, Expression, Belief, Faith and Worship i) Equality – Status and Opportunity j) Fraternity, Human Dignity, Unity and Integrity of the Nation	5

II	**FUNDAMENTAL RIGHTS** a) Right to equality b) Right to freedoms c) Right against exploitation d) Right to freedom of religion e) Cultural and educational rights f) Right to property g) Right to constitutional remedies	10
III	**DIRECTIVE PRINCIPLES OF STATE POLICY** a) Equal Justice and free legal aid b) Right to work and provisions for just and humane conditions of work c) Provision for early childhood, Right to education and SC,ST, weaker section d) Uniform Civil Code e) Standard of Living, nutrition and public health f) Protection and improvement of environment g) Separation of Judiciary from executive h) Promotion of International peace and security	10
IV	**FUNDAMENTAL DUTIES** a) Duty to abide by the Constitution b) Duty to cherish and follow the noble ideals c) Duty to defend the country and render national service d) Duty to value and preserve the rich heritage of our composite culture e) Duty to develop scientific temper, humanism ,the spirit of inquiry & reform f) Duty to safeguard public property and abjure violence g) Duty to strive towards excellence	5

References:

a) D. D. Basu, Introduction to the Constitution of India, LexisNexis
b) Granville Austin, The Constitution of India: Cornerstone of a Nation,
Oxford University Press
c) Subhash Kashyap, Our Constitution, National Book Trust
d) M.P. Jain, Indian Constitutional Law, LexisNexis V.N.Shukla, Constitution of India, Eastern Book Company
f) P.M. Bakshi, The Constitution of India, Universal Law Publishing
g) M.V.Pylee, Constitutional Government in India, S. Chand
h) V. S. Khare, Dr. B.R.Ambedkar and India's National Security
i) डॉ. सत्यरंजन साठे, भारताच्या राज्यघटनेची ५० वर्षे, कॉन्टिनेन्टल प्रकाशन
j) नरेन्द्र चपळगावकर, राज्यघटनेचे अर्धशतक, मौज प्रकाशन गृह
k) सुहास पळशीकर, राजकारणाचा ताळेबंद भारतीय लोकशाहीची वाटचाल, साधना प्रकाशन
l) जयदेव गायकवाड, संविधान सभेत डॉ. आंबेडकर, पद्मगंगा प्रकाशन
m) झिया मोदी, टेन जजमेंट्स दॅट चेंज्ड् इंडिया, सकाळ प्रकाशन
n) डॉ. रावसाहेब कसबे, डॉ. आंबेडकर आणि भारतीय राज्यघटना, सुगावा प्रकाशन

Subject Code: 23-392

Subject: Introduction to Cyber Security / Information Security- III (2 Credit Course)

Total Lectures= 30

Chapter	Course Contents	No. of Lectures
Module 3: Information and Network Security		
1	**Chapter 1: Access Control and Intrusion Detection** 1. Overview of Identification and Authorization 2. Overview of IDS 3. Intrusion Detection Systems and Intrusion Prevention Systems	4
2	**Chapter 2: Server Management and Firewalls** 1. User Management 2. Overview of Firewalls 3. Types of Firewalls 4. DMZ and firewall features	4
3	**Chapter 3: Security for VPN and Next Generation Technologies** 1. VPN Security 2. Security in Multimedia Networks 3. Various Computing Platforms: HPC, Cluster and Computing Grids 4. Virtualization and Cloud Technology and Security	6

SEMESTER IV

Subject Code: 23-CA-CCUP
Subject: Industrial Training/On Campus Project (20 Credit Course)

Units	Topic
1	**Guidelines** • Each student will take up either training at an industry/research institute or will work on campus on a project idea. • The institute will appoint faculty members to work as coordinators/mentors to supervise this activity. However, One faculty member will be assigned maximum 05 students • Students will meet the coordinator/mentor at least once in a week and will also submit synopsis and 2 copies of reports during the period of Industrial training (ITP) to the faculty mentor • Continuous assessment will be carried out by the faculty mentor for 150 marks on the basis of weekly attendance, performance, progress, report, presentations given by the student. • After Completion of the ITP, a student will have to submit the project completion certificate from the respective industry/research institute. • A student will produce two hard copies (Hard Black Bound with Golden Embossing -one student copy and one Department copy) and a soft copy of the report in the format given below. • End semester examination will be of 350 marks and will be conducted by three examiners: faculty mentor, expert from industry (appointed by the college) and one external examiner from affiliated college appointed by the University. • Students are advised to take online foreign language courses during the period

Subject Code: 23-492

Subject: Introduction to Cyber Security / Information Security- IV (2 Credit Course)

Total Lectures= 30

Chapter	Course Contents	No. of Lectures
Module 4: System and Application Security		
1	**Chapter 1: Security Architectures and Models** 1. Designing Secure Operating Systems 2. Controls to enforce security services 3. Information Security Models	2
2	**Chapter 2: System Security** 1. Desktop Security 2. email security: PGP and SMIME 3. Web Security: web authentication, SSL and SET 4. Database Security	2
3	**Chapter 3: OS Security** 1. OS Security Vulnerabilities, updates and patches 2. OS integrity checks 3. Anti-virus software 4. Configuring the OS for security 5. OS Security Vulnerabilities, updates and patches	6
4	**Chapter 4: Wireless Networks and Security** 1.Components of wireless networks 2. Security issues in wireless	4

Subject Code: 23-494
Subject Skill Development II (2 Credit Course)
Total Lectures= 30

Teaching Scheme: 2 hrs/week	**Examination Scheme: IA: 10 Marks CE: 15 Marks**	**No. of Credits: 2**
Student are informed to perform project based on any technology/language/platform		

Progressive Education Society's

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www.moderncollegegk.org

Structure of the M. Sc. Degree course in Microbiology

Choice Based Credit System

Syllabus for M. Sc. Second Year

To be implemented from 2023

M. Sc. Microbiology

Semester III

Course Type	Course Code	Course Name	Credit
Core Compulsory Theory Paper	**23-MBCT-231**	Immunology	4
	23-MBCT-232	Molecular Biology	4
	23-MBCT-233	Clinical Microbiology	4
Core Compulsory Practical paper	**23-MBCP-234**	Practicals Based on Compulsory theory credits	4
Choice Based Optional Papers	**23-MBET-235**	Cell Culture techniques	2
	23-MBEP-235	Practicals Based on Cell Culture techniques	2
	OR		
	23-MBET-236	Experimental Design and Quantitative approach for Biologist	2
	23-MBEP-236	Practicals Based on Experimental Design and Quantitative approach for Biologist	2
	OR		
	23-MBET-237	Microbial Virus Technology	2
	23-MBEP-237	Practicals Based on Clinical Microbiology and Microbial Virus Technology	2

Semester IV

Course Type	Course Code	Course Name	Credit
Core Compulsory Theory Paper	**23-MBCT-241**	Pharmaceutical Microbiology	4
	23-MBCT-242	Microbial Technology	4
Core Compulsory Practical paper	**23-MBCT-243**	Dissertation	4

Any TWO Choice Based Optional Papers	**23-MBET-244**	Quality Assurance and Validation in Pharmaceutical Industry and Development of Anti-infectives	2
	23-MBEP-244	Practicals based on quality assurance and validation in pharmaceutical industry and development of anti-infectives	2
	OR		
	23-MBET-245	Advances in Microbial Technology	2
	23-MBEP-245	Practicals based on Advances in Microbial Technology	2
	OR		
	23-MBET-246	Industrial Waste Water Treatment and Industrial Production of vaccines	2
	23-MBEP-246	Practicals based on Industrial Waste Water Treatment and Industrial Production of vaccines	2
	OR		
	23-MBET-247	Bioethics, Biosafety, Quality control and Quality Assurance	2
	23-MBEP-247	Practical's based on Bioethics, Biosafety, Quality control and Quality Assurance	2

Extra credit Courses for M. Sc.

With Reference to circulars by Savitribai Phule Pune University (Ref: BCUD/76, Ref: BCUD/77, Ref: Circular No. 344/2020), extra credit courses viz. Cyber security courses of 4 credits, Human Rights Education programme of 2 credits, Introduction to constitution of 2 credits have been incorporated in the syllabi of Post Graduate courses.

Regular students can take extra credit courses from their own department or from other departments. The extra credit courses opted and specified by the students and grades obtained for these courses will be noted on their grade sheets.

Course Code	Course Name
22-192	Cyber security Module-I
22-292	Cyber security Module-II
22-191	Human Rights Module-I
22-291	Human Rights Module-II
23-392	Cyber security Module-III
23-492	Cyber security Module-IV
23-394	Skill Development Module-I
23-494	Skill Development Module-II
23-395	Introduction to Constitution

Semester III

23-MBCT-231: Immunology

Core Compulsory Theory Paper

[4 Credits; 60 Lectures]

[1 credit=15 hrs x 60 mins]

Course Outcomes:

Students will be able to:

CO1: Explain structure and function of cell receptors.

CO2: Explain the mechanism of self-tolerance and clonal deletion.

CO3: Describe the importance of use of experimental animals.

CO4: Describe the approaches in cancer immunotherapy.

Unit	Title and Contents	Lectures
I	**Cell surface molecules and receptors** i. Definition, general Structure and mechanism (dimerization and rotation), components of signal transduction (extracellular signaling molecule, receptor proteins, intracellular signaling proteins and target proteins) ii. Adhesion molecules in immune activation**,** structure and functionof B Cell Receptor, TCR-CD3 complex, Toll-like receptors, Cytokine receptors, G-protein coupled receptors iii. Signal transduction pathways: IL-2 pathway (JAK/STAT, Ras /MAP Kinase Pathways, TCR-CD3 activation pathway)	15
II	**Regulation of Immune response** i. Negative Regulation-Immunological tolerance, Mechanisms of tolerance induction (related experimentation using transgenic animals), T cell mediated suppression of immune response **i.** Regulation of immune responses by antigen, **ii.** Antigen-antibody complexes, Network theory and its experimental evidence iv. Cytokine mediated cross regulation of TH subsets (TH1-TH2) v. Regulation of complement system – Classical and alternative pathway vi. Biological Response Modifiers for cancer therapy and autoimmune disorders	15

III	**Experimental Immunology** i. *In vitro* systems –Quantification of cytokines (ELISPOT assay), functional assays for phagocytes and cytokines (cytotoxicity and growth assays) ii. *In vivo* systems – Experimental animals in immunology research (Inbred animal strains, Knockout mice, transgenic animals), Animal models for autoimmunity and AIDS	15
IV	**Tumor Immunology** i. Cellular transformations during neoplastic growth, Classification of tumors based on histological, Tumors of lymphoid system (lymphoma, myeloma, Hodgkin's disease) ii. Escape mechanisms of tumor from host defense, Host immune response to tumor – Effecter mechanisms, Immuno- surveillance theory iii. Diagnosis of tumors – biochemical and immunological tumor markers iv. Approaches in cancer immunotherapy: Immune adjuvant and tumor vaccine therapy	15

Suggested references 23-MBCT-231 Immunology Semester III	
Unit I	**Cell surface molecules and receptors** 1. Austyn J. M. and Wood K. J. (1993). Principles of Molecular and CellularImmunology. First edition Oxford University Press, New York. 2. Barret J. T. (1983). Text Book of Immunology. Fourth edition. Saint Louis,Mosby, London. 3. Boyd W. C. (1966). Fundamentals of Immunology, Interscience Publishers, NewYork. 4. Gangal S. and Sontakke S. (2013). Textbook of Basic and Clinical Immunology. University Press, India. 5. Garcia K. C. and Adams E. J. (2005). How the T Cell Receptor Sees Antigen-A Structural view of Cell 122(3): 333–336. 6. Hafler D. A. (2007). Cytokines and interventional immunology, NatureReviews, Immunology. 7(6): 423-423. 7. Kindt T. J., Osborne B. A. and Goldsby R. A. (2006). Kuby Immunology, Sixth edition, W. H. Freeman & Co. 8. Yoshimura A., Naka T. and Kubo M. (2007). SOCS proteins, cytokine signalingand immune regulation. Nature Reviews, Immunology, 7(6): 454-465

Unit II	**Regulation of Immune response** 1. Abbas A. K. and Lichtman A. H. (2004). Basic Immunology. Functions and Disorders of Immune System. Second edition. Elsevier Inc. 2. Carroll M. C. (2004). The complement system in regulation of adaptive immunity. Nature Immunology. 5(10): 981-986. 3. Kindt T. J., Osborne B. A. and Goldsby R. A. (2006). Kuby Immunology. Sixth edition. W. H. Freeman & Co 4. Patwardhan B., Gautam M. and Diwanay S. (2006). Botanical immunomodulators and chemoprotectants in cancer therapy. In Drug Discovery and Development Volume I: Drug Discovery. Ed. Chorghade Mukund S. Wiley- Interscience, John Wiley and SonsInc. USA. 405-424. 5. Roitt I. M. (1984) Essentials of Immunology. P. G. Publishers Pvt. Ltd., New Delhi. 6. Roitt I. M. 1988. Essentials of Immunology. ELBS, London. 7. Yoshimura A., Naka T. and Kubo M. (2007). SOCS proteins, cytokine signaling and immune regulation. Nature Reviews. Immunology. 7(6): 454- 465
Unit III	**Experimental Immunology** 1. Gangal S. and Sontakke S. (2013). Textbook of Basic and Clinical Immunology. University Press, India. 2. House R. V. (1998). Therapeutic Manipulation of Cytokines, Biotechnology andSafety Assessment. Second edition. Taylor & Francis. 81-105. 3. Kindt T. J., Osborne B. A. and Goldsby R. A. (2006). Kuby Immunology. Sixth edition. H. Freeman and Co. 4. Mather J. P. and Roberts P. E. (1998). Introduction to Cell and Tissue Culture Theoryand Technique. Plenum Publishing Corporation, New York. 5. Roitt I., Brostoff J. and Male D. (1993). Immunology. Sixth edition. Mosby & Co.London. 6. Talwar G. P. (1983). Handbook of Immunology. Vikas Publishing Pvt. Ltd.New Delhi. 7. Paul W. E. (2003). Fundamental Immunology. 5th Ed. Lippincott. Williams and Wilkins Publishers.
Unit IV	**Tumor Immunology** 1. Bendelac A., Savage P. B. and Teyton L. (2007). The Biology of NKT Cells.Annu. Rev. Immunol. 25: 297–336. 2. Chatterjee C. C. (1992). Human Physiology Tenth Edition Vol. 1 and 2.Medical AlliedAgency, Calcutta. 3. Diwanay S., Gautam M. and Patwardhan B. (2004). Cytoprotection and Immunomodulation in Cancer Therapy. Current Medicinal Chemistry - Anti- Cancer Agents. 4(6): 479-490. 4. Guyton A. C. and Hall J. E. (1996). Text Book of Medical Physiology. Goel Book Agency, Bangalore. 5. Leen A. M., Rooney C. M. and Foster A. E. (2007). Improving T cell therapy for cancer. Annu Rev. Immunol. 25 (1): 243–265. 6. Malati T. (2007). Tumor Markers: An Overview, Indian Journal of Clinical Biochemistry 22(2): 17-31. 7. Patwardhan B. Gautam M. and Diwanay S. (2006). Botanical Immunomodulators and

	Chemoprotectants in Cancer Therapy. In Drug discovery and development Volume I: Drug Discovery. Ed. Chorghade Mukund S. Wiley- Interscience, John Wiley and SonsInc. USA. 405-424. Stuhler G. and Walden P. 2002. Cancer Immune Therapy - Current and Future Strategies. Wiley-VCH.

Semester III

23-MBCT-232: Molecular Biology

Core Compulsory Theory Paper

[4 Credits; 60 Lectures]

[1 credit=15 hrs x 60 mins]

Course Outcomes:
Students will be able to:

CO1: Describe the concept of gene variation, role of Prokaryotic and eukaryotic SNPs and explain methods/tools for detection of SNPs.

CO2: Explain approaches to produce GMOs and their applications in different fields

CO3: Explain families of transposable elements, their origins, significance and the process of transposition

CO4: Describe various steps involved in Proteomic studies and applications of proteomics

Unit	Title and Contents	Lectures
I	**1. Genomics** a) Gene sequencing, conserved genes, finding base sequences which form genes b) Many proteins from one gene, alternative gene expression: DNA imprinting and Epigenetics. c) Genomic variation -SNPs, SNPS and diseases, SNPS detection and medical therapies. Eukaryotic and prokaryotic SNPs d) Role of genomic variation in aging, Recognition of trades offs associated with genomic variation.	15
II	**2. Genetically modified plants and animals** a) Genetically modified organisms-social and ethical issues b) Gene augmentation and gene therapy c) Applications in medicine – prevention, early detection and cure of diseases d) Applications of transgenic plants and animals - advantages and disadvantages	15
III	**3. Mobile DNA elements** a) Transposable elements in bacteria, IS elements, composite transposons, Integrons. b) Replicative, non-replicative transposons, and Mu transposition c) Controlling elements in Tn A, Tn 5and Tn 10 transposition d) Transposons in maize and Drosophila e) Retroviruses and retrotransposon, Ty elements in yeasts SINES, LINES and Alu elements	15

IV	**4. Proteomics** a) Basic concept of proteomics Expression, analysis and characterization of Protein. b) Analysis of protein structure c) Protein interaction. d) Basic concept of Metabolomics with examples and global biochemical networks	15

Suggested References MBCT 232 Molecular Biology : Semester III	
Unit I	**Genomics** 1. Alwi Z. B. (2005). The Use of SNPs in Pharmacogenomics Studies. *Malays J Med Sci.* 12(2):4-12. 2. Brown TA. (2002). Genomes. 2nd edition. Oxford: Wiley-Liss; Chapter 7, Understanding a Genome Sequence. Available from: https://www.ncbi.nlm.nih.gov/books/NBK21136/ 3. Butler J. M. (2012). Single Nucleotide Polymorphisms and Applications In: Advanced Topics in Forensic DNA Typing: Methodology. Academic Press: United States.347-369 4. Isenbarger T.A., Carr C.E., Johnson S.S., et al. (2008). The most conserved genome segments for life detection on Earth and other planets. Orig Life Evol Biosph. 38(6): 517-533. 5. Kaeberlein M. (2013). Longevity and aging. F1000Prime Rep. 5: 5. 6. Lemaître J. F., Berger V., Bonenfant C., Douhard M., Gamelon M., Plard F. and Gaillard J.M. (2015). Early-late life trade-offs and the evolution of ageing in the wild. *Proc Biol Sci.* 7; 282(1806): 20150209. 7. Morris B. J., Willcox B. J and Donlon T.A. (2019). Genetic and epigenetic regulation of human aging and longevity. Biochim Biophys Acta Mol Basis Dis. 1; 1865(7): 1718-1744. 8. Primrose S. B. and Twyman R. M. (2006). Principles of Gene Manipulation and Genomics, 7th Edition. S. B. Primrose & R. M. Twyman. Blackwell Publishing: U.S. 626 pp. 9. Ramírez-Bello J. and Jiménez-Morales M. (2017). Functional implications of single nucleotide polymorphisms (SNPs) in protein-coding and non- coding RNA genes in multifactorial diseases. Gac Med Mex. 153(2): 238- 250. 10. Shaw V., Bullock K. And Greenhalf W. (2016). Single-Nucleotide Polymorphism to Associate Cancer Risk. Methods Mol Biol. 1381: 93-110. 11. Stojanovic N., Florea L., Riemer C., Gumucio D., Slightom J., Goodman M., Miller W., and Hardison R. (1999). Comparison of five methods for finding conserved sequences in multiple alignments of gene regulatory regions, Nucleic Acids Research, 27 (19)1: 3899–3910. 12. Watson J. D., Baker T. A., Gann A., Bell S. P., Levine M. and Losick R. (2014). Molecular Biology of the Gene. 7th Edition. Pearson-USA 13. Yashin A. I., Ukraintseva S. V., Akushevich I. V., Arbeev K. G., Kulminski A. and Akushevich L. (2009). Trade-off between cancer and aging: what role do other diseases play? Evidence from experimental and human population studies. Mech Ageing Dev. 130(1-2): 98-104

Unit II	**Genetically modified plants andanimals** 1. Agnès E. Ricroch, Michèle Guillaume-Hofnung and Marcel Kuntz (2018). The ethical concerns about transgenic crops. *Biochem J* 475 (4): 803–811. 2. Cotrim A.P. and Baum B. J. (2008). Gene therapy: some history, applications, problems, and prospects. Toxicol Pathol. 36(1): 97-103. 3. Gene Therapy Tools and Potential Applications- Francisco Martin Molina (2013). Janeza Trdine 9, 51000 Rijeka, Croatia (online book) 4. Glick B. R. and Pasternak J. J. (1998). Molecular Biotechnology: Principles and Applications of Recombinant DNA. Washington D C, ASM Press. http://library.um.edu.mo/ebooks/b28045804.pdf 5. Maghari B. M. and Ardekani A.M. (2011). Genetically modified foods and social concerns. Avicenna J Med Biotechnol. 3(3): 109-17. 6. Ormandy E.H., Dale J. and Griffin G. (2011). Genetic engineering of animals: ethical issues, including welfare concerns. Can Vet J. 52(5): 544- 550. 7. Weaver R. (2007). Molecular Biology. 4th Edition. Mc-Grew Hill Publication 8. Worgall S. and R. G. (2014). Gene Therapy In: Principles of Tissue Engineering (Fourth Edition). Academic Press: United States. Chapter 34. 657-686.
Unit III	**Mobile DNA elements** 1. Carnell A. M. and Goodman J.I. (2003). The Long (LINEs) and the Short (SINEs)of It: Altered Methylation as a Precursor to Toxicity. Toxicological Sciences. 75(2): 229–235 2. Griffiths A. J. F., Gelbart W. M., Miller J. H., et al. (1999). Modern Genetic Analysis. New York: W. H. Freeman; Ty Elements in Yeast. Available from:https://www.ncbi.nlm.nih.gov/books/NBK21285/ 3. Kaminker J.S., Bergman C.M., Kronmiller B. *et al.* (2002). The transposable elements of the *Drosophila melanogaster* euchromatin: a genomics perspective. *Genome Biol* **3,** research0084.1 (2002). 4. Konkel M. K., Walker J. A. and Batzer M. A. (2010). LINEs and SINEs of primate evolution.Evol Anthropol. 1; 19(6): 236-249. 5. Kramerov D. A. and Vassetzky N. S. (2011). Origin and evolution of SINEs in eukaryoticgenomes. Heredity (Edinb). 107(6): 487-95. 6. Krastanova O, Hadzhitodorov M. and Pesheva M. (2005). Ty Elements of theYeast *Saccharomyces cerevisiae*, Biotechnology & Biotechnological Equipment, 19(2): 19-26 7. Lewin B. (2011). Genes X. Jones and Bartlett Publication. 8. Lodish H. F. (2003). Molecular Cell Biology 5th Edition. New York: W Hand Freeman Company. 9. Reddy, A.R., Peterson, P.A. Transposable elements of maize. *Molec Gen Genet* 192: 21–31 10. Watson J. D., Baker T. A., Gann A., Bell S. P., Levine M. and Losick R. (2014). Molecular Biology of the Gene. 7th Edition. Pearson-USA 11. Weiner A. M. (2002). SINEs and LINEs: The art of biting the hand thatfeeds you. Current Opinion in Cell Biology. 14(3): 343-350

Unit IV	**Proteomics** 1. Baidoo E. E. K. (2019). Microbial Metabolomics: A General Overview.Methods Mol Biol.1859: 1-8. 2. Banaei-Esfahani A, Nicod C, Aebersold R, Collins BC. (2017). Systems proteomics approaches to study bacterial pathogens: application to Mycobacterium tuberculosis. Curr Opin Microbiol. 39:64-72. 3. Chen B, Zhang D, Wang X, Ma W, Deng S, Zhang P, Zhu H, Xu N, Liang S. (2017). Proteomics progresses in microbial physiology and clinical antimicrobial therapy. Eur J Clin Microbiol Infect Dis. 36(3): 403- 4. Chen F, Ma R, Chen XL. (2019). Advances of Metabolomics in Fungal Pathogen-Plant Interactions. Metabolites. 15; 9(8): 169. 5. Ekman R., Silberring J., Brinkmalm A. W. and Kraj A. (2009). Mass Spectrometry: Instrumentation, interpretation and applications, John Wiley and Sons. Inc., Canada. 6. Graves P.R. and Haystead T. A. (2002). Molecular biologist's guide to proteomics. Microbiol Mol Biol Rev. 66(1):3 9-63. 7. Kellner R. (2000). Proteomics: Concepts and perspectives. Fresenius J Anal Chem. 366(6-7): 517-524. 8. Figeys D. (Editor). (2005). Industrial Proteomics: Applications for Biotechnologyand Pharmaceuticals. Preface. Methods Biochem Anal. 45: vii-viii. PMID: 19235289. https://analyticalscience.wiley.com/do/10.1002/sepspec.10201education/full/ 9. Luger K. and Phillips S.E. (2010). Protein-Nucleic acid interactions. Curr Opin Struct Biol. 20(1): 70-72. 10. Nölting B. (2006). Methods in Modern Biophysics. Second Edition, Springer: Germany. 11. Patwaradhan B. and Chaguture R. (2005). An overview of the basics of proteomics.In: Innovative approaches in drug discovery, Academic Press: United States. 12. Ramanathan M., Porter D.F. and Khavari P.A. (2019). Methods to study RNA-protein interactions. Nat Methods. 16(3): 225-234. 13. Tang J. (2011). Microbial metabolomics. Curr Genomics. 12(6): 391-403. 14. Villas-Bôas S. (2012). Katya Ruggiero Microbial Metabolomics CABI. 15. Webster D. (2000). Protein Structure, Prediction methods and Protocols. Methods in Molecular Biology Vol 143 Humana Press. 16. Wilson K. And Walker J. (2005). Principles and Techniques of Biochemistry and Molecular Biology, 6th Edn., Cambridge University Press, New York. 17. Zhao J., Wang G., Chu J. and Zhuang Y. (2019). Harnessing microbial metabolomics for industrial applications. World J Microbiol Biotechnol. 36(1): 1-8.

Semester III

23-MBCT-233: Clinical Microbiology

Core Compulsory Theory Paper

[4 Credits; 60 Lectures]

[1 credit=15 hrs x 60 mins]

Course Outcomes:

Students will be able to:

CO1: Describe determinants of pathogenicity, modes of action of different bacterial toxins

CO2: Explain significance of epidemiological modelling, use of mathematical models, modified epidemiological model for COVID 19 pandemic

CO3: Describe different bacterial, fungal and parasitic infections and their respective epidemiology, pathogenicity, diagnosis, prevention

CO4: Explain different viral diseases, significance of their study in current situation, epidemiology, pathogenicity mechanism, their laboratory diagnosis, therapeutic agents, prevention

Unit	Title and Content	Lectures
I	**A. Determinants of Microbial Pathogenicity** i. Adhesion ii. Invasion iii. Evasion iv. Toxigenesis (mode of action –In vivo and In vitro assay systems for diphtheria, cholera, tetanus toxoid and endotoxins of Gram negative bacteria) v. Bacterial resistance to host defenses- Phagocytosis, specific and nonspecific humoral factors) vi. Molecular basis of bacterial pathogenicity – Cytoskeletal modulation of host cell. Virulence genes and pathogenicity islands.	**15**
	B. Disease Prediction Epidemiological Models: i. Introduction to epidemiological modeling for infectious diseasedynamics ii. Types of Models: a. Susceptible infectious recovered (SIR) b. Susceptible exposed infectious recovered(SEIR) iii A case study: Disease Prediction Epidemiological ModelsCOVID 19	

II	Bacterial diseases with respect to causative agents, general characters, detection methods, therapeutic agents and prophylaxis. Handling and disposing of infectious material i. *Helicobacter pylori* ii. *Campylobacter jejuni* iii. *Mycobactertium tuberculosis* iv. *Acinetobacter boumanii* v. *Actinomycetes bovis/israelli*	**15**
III	Viral diseases with respect to causative agents, general characters, detection method, therapeutic agents and prophylaxis. Handling and disposing of infectious material. i. Hepatitis B ii. H1N1 iii. HIV iv. Oncoviruses v. Ebola Virus	**15**
IV	Fungal & protozoal diseases with respect to causative agents, generalcharacters, detection methods, therapeutic agents and prophylaxis. Handling and disposing of infectious material i. *Candida albicans* ii. *Trichophyton metagrophytes* iii. *Aspergillus flavus* iv. *Entamoeba histolytica* v. *Ascaris lumbricoides* vi. *Giardia lamblia*	**15**

Suggested References 23-MBCT-233Clinical Microbiology Semester III	
Unit	**References**
I	**A. Determinants of Microbial Pathogenicity** 1. Gal-Mor B. and Finlay B. B. (2006). Pathogenicity islands: a molecular toolbox for bacterial virulence. Cellular Microbiology. 8 (11): 1707-1719. 2. Iglewski B. H. (1990). Molecular Basis of Bacterial Pathogenesis, first edition, Academic Press: United States. 3. Kudva I. T., Cornick N. A., Plummer P. J., Zhang Q., T. L., Bannantine J.P. and Bellaire B. H. (2016). Virulence Mechanisms of Bacterial Pathogens. Fifth Edition, ASM: Washington. 4. Peterson J. W. (1996). Bacterial Pathogenesis In: Medical Microbiology. 4th Edition. Editor by Samuel Baron, Galveston, Texas, Link to the book: https://www.ncbi.nlm.nih.gov/books/NBK8526/ 5. Rosenberg E. (2005). The diversity of bacterial pathogenicity mechanisms. GenomeBiol. doi: 10.1186/gb-2005-6-5-320 6. Schmidt H. and Hensel M. (2004) Pathogenicity islands in bacterial pathogenesis. ClinMicrobiol Rev. 17(1): 14-56. **B. Disease Prediction Epidemiological Models:** 1. Hethcote H. W. (1989). The basic epidemiology models: models, expressions for r0, parameter estimation, and applications mathematical understanding of infectious disease dynamics. © World Scientific Publishing Co. Pte. Ltd. 1-61 2. Li L., Yang Z., Dang Z., Meng C., Huang J., Meng H., Wang D., Chen G., Zhang J., Peng H. and Shao Y. (2020). Propagation analysis and prediction of the COVID-19. Infect Dis Model, 5: 282-292 3. Siettos C.I. and Russo L. (2013). Mathematical modeling of infectious disease dynamics. Virulence. 4(4): 295-306. 4. Wearing H. J., Rohani P. and Keeling M. J. (2005). Appropriate models for the management of infectious diseases. PLoS Med 2(7): e174 5. Yang Z., Zeng Z., Wang K., Wong S., *et al*., (2020). Modified SEIR and AI prediction of the epidemics trend of COVID-19 in China under public health interventions. Journal of Thoracic Disease. 12(3): 165-174

II	1. Asif M., Alvi I.A. and Rehman S.U. (2018). Insight into Acinetobacter *baumannii*: pathogenesis, global resistance, mechanisms of resistance, treatment options, and alternative modalities. Infect Drug Resist. 11:.1249- 1260. https://www.intechopen.com/books/mycobacterium-research-and-development/virulence-factors-and-pathogenicity-of-mycobacterium. 2. Delogu G., Sali M. and Fadda G. (2013). The biology of *Mycobacterium tuberculosis* infection. Mediterr J Hematol Infect Dis. 16; 5(1): e2013070. 3. Echeverria-Valencia G., Flores-Villalva S.and Espitia C.I. (2017). Virulence Factors and Pathogenicity of *Mycobacterium*. Chapter 12. Mycobacterium - Research and Development. Editor-Wellman Ribón, IntechOpen. 4. Idowu A., Mzukwa, A., Harrison, U., Palamides P., Haas R., Mbao M., Mamdoo R., Bolon J., Jolaiya T., Smith S., Ally R., Clarke A. and Njom H. (2019). Detection of *Helicobacter pylori* and its virulence genes (*cag*A, *dup*A and *vac*A) among patients with gastroduodenal diseases in Chris Hani Baragwanath Academic Hospital, South Africa. *BMC Gastroenterol*.19:.73. 5. Jianjun S., Champion P. A. and Bigi F. (2019). Cellular and Molecular Mechanisms of *Mycobacterium tuberculosis* Virulence. Frontiers in Cellular and Infection Microbiology.9:.331. 6. Joly-Guillou ML. (2005). Clinical impact and pathogenicity of Acinetobacter. Clin Microbiol Infect. 11(11):.868-873. 7. Kao C. Y., Sheu B. S. and Wu J. J. (2006). *Helicobacter pylori* infection: An overview ofbacterial virulence factors and pathogenesis. Biomedical Journal. 39(1): 14-23 8. Kusters J. G., van Vliet A. H. and Kuipers E. J. (2006). Pathogenesis of *Helicobacter pylori* infection. Clin Microbiol Rev. 19(3):.449-490. 9. Lee C. R., Lee J. H, Park M., Park K. S., Bae I. K., Kim Y. B., Cha C. J., Jeong B. C.and Lee S. H. (2017). Biology of *Acinetobacter baumannii*: Pathogenesis, Antibiotic Resistance Mechanisms, and Prospective Treatment Options. Front Cell Infect Microbiol. 13: 7:55. 10. Levin R. E. (2007). *Campylobacter jejuni*: A review of its characteristics, pathogenicity, ecology, distribution, subspecies characterization and molecular methods of detection. Food biotechnology. 21(4): .271-347. 11. Misawa N. and Blaser M. J. (2000) Detection and characterization of autoagglutination activity by *Campylobacter jejuni*. Infection and Immunity. 68(11): 6168-6175. 12. Morris F. C., Dexter C., Kostoulias X., Uddin M. I. and Peleg A. Y. (2019). The mechanisms of disease caused by *Acinetobacter baumannii*. Front. Microbiol. 10: 1601. 13. Nyati K. K. (2013). Role of *Campylobacter jejuni* Infection in the Pathogenesis of Guillain-Barré Syndrome: An Update. Biomedical Research Journal. 1-13. 14. Pine L., Howell A. Jr and Watson S. J. (1960. Studies of the morphological, physiological, and biochemical characters of *Actinomyces bovis*. J Gen Microbiol. 23: 403-424. 15. Ricke S. C., Feye K. M., Chaney W. E., Shi Z., Pavlidis H. and Yang Y. (2019). Developments in rapid detection methods for the detection of foodborne *Campylobacter* in the United States. Front Microbiol. 9: 3280. 16. Sharma S., Hashmi M. F. and Valentino III D. J. (2020). Actinomycosis. In:

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III	1. Chauhan N., Narang J., Pundir S., Singh S. and Pundir C. S. (2012). Laboratory diagnosis of swine flu: A review. Artificial cells, blood substitutes and immobilization biotechnology. 41(3): 189-195 2. Chisari F.V., Isogawa M. and Wieland S.F. (2010). Pathogenesis of Hepatitis B virus infection. Pathol Biol (Paris). 58(4): 258-66. 3. Falasca L., Agrati C., Petrosillo N., Di Caro A., Capobianchi M. R., Ippolito G. and Piacentini M. (2015). Molecular mechanisms of Ebola virus pathogenesis: focus on celldeath. Cell Death Differ. 22(8): 1250-1259. 4. Jilani T. N., Jamil R. T. and Siddiqui A. H. (2020). H1N1 Influenza (Swine Flu) In: StatPearls [Internet]. Treasure Island (FL): StatPearls. Available from: https://www.ncbi.nlm.nih.gov/books/NBK513241/ 5. Kawai Y., Kimura Y., Lezhava A, *et al*. (2012). One-step detection of the 2009 pandemic influenza A (H1N1) virus by the RT-Smart Amp assay and its clinical validation. *PLoS One*. 7(1): e30236. 6. Khalafallah M. T., Aboshady O. A., Moawed S. A. and Ramadan M. S. (2017). Ebola virus disease: Essential clinical knowledge. Avicenna J Med. 7(3): 96-102. 7. Krajden M., McNabb G. and Petric M. (2005). The laboratory diagnosis of Hepatitis B virus. Can J Infect Dis Med Microbiol.16 (2): 65-72 8. Ravina R., Dalal A, Mohan H., Prasad M. and Pundir C.S. (2020). Detection methods for influenza A H1N1 virus with special reference to biosensors: a review. Biosci Rep. 40(2): BSR20193852 9. Rewar S., Mirdha D. and Rewar P. (2015). Treatment and prevention of pandemic H1N1 influenza. *Ann Glob Health*. 81(5): 645-653. doi: 10.1016/j.aogh.2015.08.014. 10. Simon V., Ho D.D. and Abdool Karim Q. (2006). HIV/AIDS epidemiology, pathogenesis, prevention, and treatment. Lancet. 5; 368(9534):.489-504. 11. Sullivan N., Yang Z.Y. and Nabel G. J. (2003). Ebola virus pathogenesis: implications for vaccines and therapies. J Virol. 77(18): 9733-9737. 12. Wilkins T., Sams R. and Carpenter M. (2019). Hepatitis B: Screening, prevention, diagnosis, and treatment. Am Fam Physician. 99(5): 314-323. 13. Wu C.C., Chen Y.S., Cao L., Chen X.W. and Lu M.J. (2018). Hepatitis B virus infection: Defective surface antigen expression and pathogenesis. World J Gastroenterol. 21; 24(31): 3488-3499.

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Semester III

23-MBCP-234: Practical based on Compulsory theory credits
Total Workload: - 4 credits = 120 hrs in semester

Course Outcomes:

Students will be able to:

CO1: Apply various immunological techniques such as immuno-electrophoresis, SRID, agglutination for detection of virus.

CO2: Carry out Plasmid Isolation, Separation using electrophoretic method and design an experiment to study bacterial transformation & conjugation.

CO3: Identify fungal and bacterial pathogens by cultural and biochemical characteristics

Units	Title and Contents	Lectures
I	**Practicals based on MBCT 231: Immunology** 1. Viral titre determination by haemagglutination 2. Rocket Immuno – electrophoresis 3. Preparation of serum from the blood sample and analysis of its proteins by electrophoresis a. Preparation of serum from whole blood sample. b. Separation of serum proteins by agarose gel electrophoresis. c. Analysis of separated protein fractions by densitometry(by Image J software). 4. Demonstration of PCR 5. Visit to Institute/ Industry for demonstration of ELISPOT/ CFT/FACS/animal inoculation	40
II	**Practicals based on MBCT 232 Molecular Biology** 1. Isolation of Plasmid from Bacteria by Alkaline lysis method 2. Preparation of competent cells by $CaCl_2$ method 3. To Perform Transformation by using suitable Plasmid 4. To check the efficiency of transformation using Blue white screening method 5. Demonstration of gene transfer by bacterial conjugation	40

III	**Practicals based on MBCT 233: Clinical Microbiology** **A.** Isolation, identification and antibiotic sensitivity testing of (any three) *1. Actinomycetes* *2. Acinetobacter* *3. Clostridium* *4. Corynebacterium* *5. Vibrio*	21
	B. Isolation, identification and antibiotic sensitivity testing of (any two) *1. Candida albicans* *2. Trichophyton mentagrophytes* *3.Aspergillus flavus*	14
	C. Demonstration of cultivation of viruses by egg inoculation technique with pock and plaque detection	05

Suggested References 23-MBCP-234: Immunology, Molecular Biology and Clinical microbiology

Unit	References
I	1. Axelsen N. H., Kroll J. and Weeke B. (1973). A manual of quantitative immunoelectrophoresis: methods and applications. Scand. J. Immunol. 2(Suppl. 1): 37- 46 2. Galvão de França N.D., Cristovão Poli M.C., Almeida Ramos P.G., Rocha Borsoi C.S. and Colella R. (2011). Titers of ABO antibodies in group O blood donors.Rev Bras Hematol Hemoter. 33: 259–262 3. Laurell C. B. (1966). Quantitative estimation of proteins by electrophoresis in agarose gel containing antibodies. Anal. Biochem. 15: 45–52 4. Alexander D.J. and Chettle N.J. (1977) Procedures for the haemagglutination and the haemagglutination inhibition tests for avian infectious bronchitis virus. Avian Pathology. 6(1):9-17 2. 5. Costabile M. (2010) Determining the Reactivity and Titre of Serum using a haemagglutination Assay J Vis Exp. 2010; (35): 1752. Published online 6. Noah D.L., Hill H., Hines D., White E.L.and Wolff M.C. 2009 Qualification of the hemagglutination inhibition assay in support of pandemic influenza vaccine licensure. Clinical and Vaccine Immunology: CVI. 16(4):558-566. 7. World Health Organization. WHO Collaborating Center for Reference and Research on Influenza Chinese National Influenza Center National Institute for Viral Disease Control and Prevention, China CDC (2013) Laboratory Procedures. (20 December 2013) Serological detection of avian influenza A(H7N9) virus infections by modified horse red blood cells haemagglutination-inhibition assay 8. Garibyan, L., & Avashia, N. (2013). Polymerase chain reaction. *The Journal of investigative dermatology*, *133*(3), 1–4. https://doi.org/10.1038/jid.2013.1 9. Coleman, W.B., Tsongalis, G.J. (2006). The olymerase Chain Reaction. In: Coleman, W.B., Tsongalis, G.J. (eds) Molecular Diagnostics. Humana Press. https://doi.org/10.1385/1-59259-928-1:047

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<tr><td>II</td><td>
1. Green M. R. and Sambrook J. (2018). The Hanahan Method for Preparation and Transformation of Competent Escherichia coli: High-Efficiency Transformation. ColdSpring Harb Protoc. (3): 10.
2. Griffiths A. J. F., Miller J. H., Suzuki D. T., et al. (2000). An Introduction to Genetic Analysis. 7th edition. New York: W. H. Freeman; Bacterial conjugation. https://www.ncbi.nlm.nih.gov/books/NBK21942/
3. Phornphisutthimas S., Thamchaipenet A. and Panijpan B. (2007). Conjugation in Escherichia coli: A laboratory exercise. Biochem Mol Biol Educ. 35(6): 440-445.
4. Sambrook J. and Russell D. (2001). Molecular Cloning: A Laboratory Manual, 3rd edition. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
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<tr><td rowspan="2">III</td><td>
A. Isolation and identification of
1. Meera Kumari, Bat-Erdene Myagmarjav, Birendra Prasad and Madhusudan Choudhary (2013). Identification and characterization of antibiotic-producing actinomycetes isolates. American Journal of Microbiology 4 (1): 24-31, 2013 ISSN: 1948-982x © 2013 Science Publications doi:10.3844/ajmsp.2013.24.31
2. Anupama Sapkota,Aishwarya Thapa, Anupa Budhathoki, Muskan Sainju,Prativa Shrestha and Sagar Aryal (March 2020). Isolation, Characterization, and Screening of Antimicrobial-Producing Actinomycetes from Soil Samples. International Journal of Microbiology Volume 2020 |Article ID 2716584 | https://doi.org/10.1155/2020/2716584.
3. Neetu Gupta, Nageswari Gandham, Savita Jadhav and Ravindra Nath Mishra (2015). Isolation and identification of Acinetobacter species with special reference to antibiotic resistance. J Nat Sci Biol Med. 2015 Jan-Jun; 6(1): 159–162. doi: 10.4103/0976-9668.149116
4. Shojadoost, B.; Peighambari, S.M. and Nikpiran, H. (2010). Isolation, identification and antimicrobial susceptibility of Clostridium perfringens isolates from acute necrotic enteritis of broiler chickens. Int.J.Vet.Res. (2010), 4; 3: 147-151
5. BS Reddy, A Chaudhury, U Kalawat, R Jayaprada, GSK Reddy, BV Ramana (2012). Isolation, speciation and antibiogram of clinically relevant non-diphtherial
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B. Isolation and identification of (any two fungal pathogens)
1. Baxter M. (1966) Isolation of Trichophyton mentagrophytes from British soil. Sabouraudia. 4: 207–209.
2. Joshi K. R. and Gavin J. B. (1974). A simple laboratory method for the rapid identification of Candida albicans. Pathology. 6(3): 231-233.
3. Meinhof W., Laschka P. and Scherwitz C. (1975). A synthetic medium for rapid chlamydospore formation in Candida albicans. Mykosen. 18(7): 291-298.
4. Gunasekaran M. and Hughes W. F. (1977). A simple medium for isolation and identification of Candida albicans directly from clinical specimens. Mycopathologia.61(3): 151-157.
5. Baxter M. (1966). Isolation of Trichophyton mentagrophytes from British soil, Sabouraudia, 4: 207–209.
6. Sinski J. T., Kelley L. M., Flynt P. M. and Miegel J. (1977). Dermatophyte isolation media: quantitative appraisal using skin scales infected with Trichophyton mentagrophytes and Trichophyton rubrum. J Clin Microbiol. 5(1): 34-38.
Taber R. A. and Schroeder H. W. (1967). Aflatoxin-producing potential of isolates of the Aspergillus flavus- oryzae group from peanuts (Arachis hypogaea). Appl Microbiol. 15(1):140-144.
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Semester III

23-MBET-235: Cell Culture techniques

Choice based Optional Theory Paper (Elective)

[2 Credits; 30 Lectures]

[1 credit=15 hrs x 60 mins]

Course outcomes:

CO1: Students will be able to describe various methods of Cell Culture Techniques

CO2: Student will gain knowledge of Immuno-modulation caused by agents activating or suppressing immune system function.

Unit	Title and Contents	Lectures
I	**Animal Cell Culture Techniques:** A. Definition of terms: Primary cell cultures and cell lines, establishedcell lines, suspension and anchorage dependent cell cultures. B. Transformation of cells in culture, culture media, factors affectingcells in culture.	15
II	**Commonly used cell culture systems and cell lines in immunologicalstudies:** A. Cell culture systems and their applications: primary lymphoid cellculture cloned lymphoid cell lines, hybrid lymphoid cell lines. B. Immuno-modulation	15

Suggested References 23-MBET: 235 Cell Culture Techniques	
Unit	**References**
I	**Animal Cell Culture Techniques:** 1. Freshney R. I. (2005). Culture of Animal Cells: A Manual of Basic Technique.5th Ed. John Wiley and Sons, Inc. 2. Masters J. R. W. (2000). Animal Cell Culture – A Practical Approach. 3rdEd. Oxford University Press. 3. Mather J. P. and Penelope E. R. (1998). Introduction to Cell and TissueCulture Theory and Technique. Plenum Press, New York
II	**Commonly used cell culture systems and cell lines in immunological studies:** 1. Kindt T. J., Goldsby R. A., Osborne B. A. and Kuby J. (2007). Kuby Immunology. 6th Ed. W. H. Freeman and Co. 2. Patwardhan B., Diwanay S.and Gautam M. (2006). Botanical immunomodulators and chemoprotectants in cancer therapy. In Drug Discovery and Development Volume I: Drug Discovery. Ed. Chorghade Mukund S. Wiley Interscience, John Wiley and Sons Inc. USA. 405-424.

Semester III

23-MBEP-235: Practicals Based on Cell Culture techniques

Choice based Optional Practical Paper (Elective)
(Total Workload): - 2 credits x 30 hrs = 60 hrs in semester

Course Outcomes:

Students will be able to

CO1: Culture lymphocytes and Study effect of immunomodulators

CO2: Culture chick embryo fibroblast cells.

Unit	Title and Contents	Lectures
I	**Practicals based on Animal Cell Culture Techniques:** A. Density gradient based separation of peripheral lymphocytes B. Preparation of Lymphocyte culture C. Effect of immunomodulators on lymphocyte proliferation (Stimulatory and inhibitory effect)	30
II	**Practicals based on Commonly used cell culture systems and celllines in immunological studies:** A. Chick embryo fibroblast cell culture	30

Suggested References 23-MBEP: 235 Practicals based on Cell Culture Techniques:Semester III Choice based Optional Practical Paper (Elective)	
Unit	**References**
I	**Practicals based on Animal Cell Culture Techniques:** 1. Freshney R. I. (2005). Culture of Animal Cells: A Manual of Basic Technique, 5th Ed., John Wiley and Sons, Inc 2. Masters J. R. W. (2000). Animal Cell Culture – A Practical Approach. 3rdEd. Oxford University Press.
II	**Practicals based on Commonly used cell culture systems and cell lines inimmunological studies:** 1. Mather J. P. and Penelope E. R. (1998). Introduction to Cell and TissueCulture Theory and Technique. Plenum Press, New York 2. Hernandez R. and Brown D.T. (2010). Growth and maintenance of chickembryo fibroblasts (CEF). Curr Protoc Microbiol.17: A.4I.1–A.4I.8

Semester III

23-MBEP-236: Experimental Design and Quantitative approach for Biologist

Choice based Optional Theory Paper (Elective)

[2 Credits; 30 Lectures]

[1 credit=15 hrs x 60 mins]

Course Outcomes:

The students will be able to

CO1: Understand design of experiments and survey design

CO2: Explain methodology of clinical trials and epidemiological studies

CO3: Present experimental data in various forms of data representation.

CO4: Explain various mathematical models

Unit	Title and Contents	Lectures
I	**Designing of Experiments** 1. Research Methodology 2. Sampling methods, sampling errors 3. Survey design, Design of Experiments in Agriculture (randomization, replication and local control), Experimental designs-CRD, RCBD and LSD 4. Factorial design (Full, Fractional and Plackett Burman) 5. Epidemiological Study designs: Case control, cohort, concurrent, cross-sectional, retrospective/prospective 6. Clinical/field trials-Randomization, Bias removal (Blinding – single &double), controlled and uncontrolled trials	(15)
II	**Mathematical approach for Biologists** *(Basic rules and application of limits, derivative and integration need to be discussed)* 1. Presentation of experimental data (Tables, graphs and equations) 2. Data Analysis (Trends, Testing mathematical models, Goodness of fit:Least Square Analysis, Linear and Non-linear models) 3. Concept of mathematical model, need, modelling the system of interest, modelling the data Deterministic Vs Stochastic model, Cyclic processes ofmodel construction, verification and applications	(15)

Semester III

23-MBEP-236: Practicals based on Experimental Design and Quantitative approach for Biologist

Choice based Optional Practical Paper (Elective)

(Total Workload): - 60 hrs in semester

Course outcomes

CO1: Students will be capable of writing a research proposal
CO2: Students will be able to carry epidemiological and statistical surveys
CO3: Students will be able to perform numerical calculations in microbiology related topics, to use software relevant to data analysis and data representation using several mathematical models.

Unit	Title and Contents	Lectures
I	1. Designing of Mock Research Proposal which includes: a) Title b) Hypothesis c) Review of Literature d) Methodology (Specify Statistical Methods) e) Possible outcomes (Statistical Interpretations) f) References Scientific writing should be followed for Research proposal	**20**
II	Epidemiological/statistical survey (Mini Project) a) Identification of Problem and Establishing Hypothesis b) Selection of Design c) Data Collection d) Data Analysis e) Data Presentation f) Conclusion (Data can be collected from Research papers/ Dissertations/ Journals)	**20**
III	Factorial Study Design (Plackett- Burmen, Fractional Factorial and full factorial) for Optimization of Media conditions (Data collection from Research Papers/ Dissertations /Journals)	**10**
IV	Numerical Microbiology Problem solving: Unit conversion, Numerical Problems on size, volume, number (CFU and PFU), dilutions, Neubauer chamber, direct microscopic count, Numerical Problems on Bacterial Growth. Numerical problems on diversity indices	**10**

Suggested References 23-MBEP-236: Practicals based on Experimental Design and Quantitative approach for Biologist: Semester III	
Unit	**References**
I	**1. Designing of Mock Research Proposal which includes:** a. Gastel B. and Day R. A. (2016). How to Write and Publish a Scientific Paper. United States: ABC-CLIO, LLC. Kothari C. R. (2004). Research methodology methods and techniques. 2 nd revised edition. New age international publisher. 2. Epidemiological study Proposal (Mini Project) b. Brown D. and Rothery P. (1993). Models in biology: mathematics, statistics, and computing. United Kingdom: Wiley. ISBN: 9780471933229. Digitized 20th June 2009 Newman S. C. (2003). Biostatistical Methods in Epidemiology. Germany: Wiley ISBN: 9780471461609 3. Statistical Survey c. Acharya R. and Roy T. K. (2016). Statistical Survey Design and Evaluating Impact.India: Cambridge University Press. d. Nardi P. M. (2018). Doing Survey Research: A Guide to Quantitative Methods. United Kingdom: Taylor & Francis. e. Singh Y. K. (2006). Fundamental of Research Methodology and Statistics. India: New Age International (P) Limited. 4. Factorial Study Design (Placket barmen, Fractional Factorial and full factorial) for Optimization of Media conditions f. Harvey L. and McNeil B. (2008). Practical Fermentation Technology. Germany: Wiley. g. Montgomery D. C. (2013). Design and Analysis of Experiments. Italy: Wiley.
II	**Credit II: Practicals based on Theory Mathematical approach for Biologists** 1. **Numerical Microbiology Problem solving: Unit conversion, Numerical Problems on size, volume, number (CFU and PFU), dilutions, Neubauer chamber, direct microscopic count, Numerical Problems on Bacterial Growth. Numerical problems on diversity indices** a. Aneja K. R. (2007). Experiments in Microbiology, Plant Pathology and Biotechnology. India: New Age International. b. Cappuccino J. G. and Welsh C. T. (2017). Microbiology: A Laboratory Manual. eBook, Global Edition. United Kingdom: Pearson Education. c. Green L. H. and Goldman E. (2008). Practical Handbook of Microbiology. United States: CRC Press. d. Pommerville J. C. (2010). Alcamo's Laboratory Fundamentals of Microbiology. United States: Jones & Bartlett Learning, LLC. e. Tate R. L. (1986). Microbial Autecology: A Method for Environmental Studies. Digitized 2009. United Kingdom: Wiley. 2. Computer applications: Using data sheets, and sorting data with different parameters, plotting graphs – bar charts, line graphs, pie charts, adding error bars. (Using Statistical Packages other than Microsoft Excel) f. Boslaugh S. (2012). Statistics in a Nutshell. Germany: O'Reilly Media Incorporated. g. Conner N. and MacDonald M. (2013). Office 2013: The Missing Manual. United States: O'ReillyMedia. h. McFedries P. (2019). Microsoft Excel 2019 Formulas and Functions. Pearson Education. i. Khan I. A. and Khanum A. (2016). Fundamentals of Biostatistics. 5th Edition. Ukaaz, Publications, Hyderabad. ISBN-13: 9788190044103 j. McFedries P. (2019). Microsoft Excel 2019 Formulas and Functions. Pearson Education k. Salkind N. J. (2016). Statistics for People Who (Think They) Hate Statistics: Using Microsoft Excel2016. United States: SAGE Publications

Semester III

23-MBET-237: Microbial Virus Technology

Choice based Optional Theory Paper (Elective)

[2 Credits; 30 Lectures]

[1 credit=15 hrs x 60 mins]

Course outcomes:
CO1: Students will understand the basics of isolation and characterization of bacteriophages.
CO2: They will be able to know various concepts of bacteriophage growth kinetics
CO3: Pupil shall also learn about Phage typing.

Unit	Title and Contents	Lectures
I	**A. Isolation and characterization of bacteriophages** i. Abundance of bacteriophages in the environment ii. Bacteriophage Lifecycle-Lytic, Lysogeny and chroniccycle. Genetic basis of lytic and lysogeny cycles	05
	B. Isolation of bacteriophages from various environmental samples- (Different methods) i River, Intestine, Lakes, Tooth plaque, Ponds, High temperature environment Cockroaches, Raw vegetables, Activated sludge, Fecal matter, Sewage , Soil, Flies, Sewage Treatment plant	03
	C. Bacteriophage growth kinetics i. Concept and calculations of EoP, MOI ii. Adsorption rate constant iii. One step growth curve-(Latent period, Eclipsed period, Rise period, Plateau, burst size	05
	D. Phage based bacterial detection: Phage typing	02
II	**A. Bacteriophage as biocontrol agent** i. Phage based technology for decontamination of water (drinkingwater, recreational water, medical waste water) ii. Phage based technology for pathogen control in aqua systems iii. Bacteriophages for the biocontrol of biofilms on medical devices iv. Bacteriophage based technology for pathogen control in Poultry	05
	B. Bacteriophage Therapy i. Use of bacteriophages as therapeutic agent **ii.** Phage lysine therapy and prophylaxis	04

	C. Mycoviruses: A new dimension in Microbiology i. Occurrence ii. Taxonomy of Mycoviruses iii. Mycovirus-host interaction mechanisms iv. Characterization Techniques v. Mycoviruses as biocontrol agents against fungal plant pathogens	05
	D. Introduction of algal viruses	01

Suggested References 23-MBET-237: Microbial Virus Technology : Semester III

Unit	References
I	**A** 1. Ahiwale S. (2013). Bacteriophages against enteric bacterial pathogens and their potential for bioremediation of pathogen infested water bodies. PhD thesis, University of Pune, Pune, Maharashtra 2. Rohwer F., Youle M., Maughan H. and Hisakawa N. (2014). Life in Our Phage World. A centennial field guide to the Earth's most diverse inhabitants. Illustrations by Leah L Pantéa and Benjamin Darby (Book) 3. Hobbs Z. and Abedon S. T. (2016). Virology Diversity of phage infection types and associated terminology: the problem with Lytic or lysogenic. Mini review. FEMS Microbiology Letters, 363, , fnw047 doi: 10.1093/femsle/fnw047, 2016
	B 1. Ahiwale S. (2013). Bacteriophages against enteric bacterial pathogens and their potential for bioremediation of pathogen infested water bodies. PhD thesis, University of Pune, Pune, Maharashtra 2. Azeredo J. and Sillankorva S. Editors. (2018) Bacteriophage Therapy from Lab to Clinical Practice. In Methods in Molecular Biology. Walker J. M. Series Editor. Humana Press Book. Springer. 3. Clokie M. R. J. and Kropinski A. M. Editors (2009). Bacteriophages: Methods and Protocols. Volume1: Isolation, Characterization and Interactions. Springer Book
	C 1. Clokie M. R. J. and Kropinski A. M. Editors (2009). Bacteriophages: Methods and Protocols. Volume1: Isolation, Characterization and Interactions. Springer Book Effect of bacterial growth rate on bacteriophage population growth rate, Dominik Nabergoj, Petra Modic, Ales Podgornik,Wiley Microbiology open, 2017
	D 1. Schofield D.A., Sharp N.J. and Waste Water C. (2012). Phage-based platforms for the clinical detection of human bacterial pathogens. Bacteriophage. 2(2): 105-283

II	**A. i.** 1. Ahiwale S. (2013) Bacteriophages against enteric bacterial pathogens and their potential for bioremediation of pathogen infested water bodies. PhD thesis, University of Pune, Pune, Maharashtra 2. McLaughlin M. R. and Brooks J. P. (2008) EPA worst case water microcosms for testing phage biocontrol of *Salmonella*. J Environ Qual. 37: 266-271 3. Sharma S., Soumya Chatterjee S., Datta S., Rishika Prasad R., Dubey D., Prasad R. K. and Vairale M.G. (2017). Bacteriophages and its applications: an overview. Folia Microbiol. 62(1):17-55 4. Singh M.K., Maurya A. and Kumar S. (2020). Bio augmentation for the treatment of waterborne pathogen contamination water. Waterborne Pathogens. 189-203 **A. ii.** 1. Culot A., Grosset N. and Gautier M. (2019). Overcoming the challenges of phage therapy for industrial aquaculture: A review. Aquaculture. Elsevier. 513:734423. 2. Kutter E. and Sulakvelidze A. Editors. (2004). Bacteriophages: Biology and Applications. Edition-illustrated. Publisher-CRC Press. 3. Nakai T. and Park S. C. (2002). Bacteriophage therapy of infectious diseases in aquaculture. Mini-review. Research in Microbiology. 153: 13–18 4. Vinod M. G., Shiva M.M., Umesha K.R., Rajaveera B.C., Krohne G. and Karunasagar J. (2006). Isolation of *Vibrio harveyi* bacteriophage with potential for biocontrol of luminous vibriosis in hatchery environments. Aquaculture. 55: 117-124 **A. iii.** 1. Ahiwale S. S. (2011). *In vitro* management of hospital *Pseudomonas aeruginosa* biofilm using indigenous T7-like lytic phage. Curr. Microbiology. 62: 335-340 2. Haradaa L. K., Silvaa E.C., Camposa W. F., Del Fiola F. S., Vilaa M., Dąbrowskab K., Krylovc V. N. and Balcão V. M. (2018). Applications of bacteriophages: State of the art, Review article. Microbiol Res. 212- 213: 38-58 3. Lu T. K. and Collins J. J. (2007). Dispersing biofilms with engineered enzymatic bacteriophage. Proceedings of National Academy of Science. 104: 11197-11202 **A. iv.** 1. Gorski A., Miedzybrodzki R. and Borysowski J. (Editors). (2019). Phage Therapy: A Practical Approach.Springer International Publishing 2. Żbikowska K, Michalczuk M. and Dolka B. (2020). The Use of Bacteriophages in the Poultry Industry.Review. Animals (Basel).10(5): 872

	B. Bacteriophage Therapy 1. Eric E. C. and Adhya S. L. (2015). Phage Therapy: Current Research and Applications. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America. 61(1): 141–142 2. Gorski A., Miedzybrodzki R. and Borysowski J. (Editors). (2019). Phage Therapy: A Practical Approach. Springer International Publishing 3. Hyman P. and Abedon S. T. Editors. (2012). Bacteriophages in Health and Disease. Volume 24 of Advances in molecular and cellular microbiology. Contributor C.A.B. International. Edition- illustrated. Publisher CABI. 4. Kutter E. and Sulakvelidze A. Editors. (2005). Bacteriophage Therapy in Humans. Chapter 14. Bacteriophages, biology and applications. CRC Press. 5. Principi N., Silvestri E. and Esposito S. (2019). Advantages and Limitations of Bacteriophages for the Treatment of Bacterial Infections. Front. Pharmacol. 10: 513 6. Vázquez R., García E. and García P. (2018). Phage lysins for fighting bacterial respiratory infections: a new generation of antimicrobials. Minireview article. Front. Immunol. 9: 2252
	C. Mycoviruses: A new dimension in Microbiology 1. Abbas J. (2016) A review Paper Mycoviruses Journal of Plant Pathology and Microbiology 2. Abid M., Khan M. Mushtaq. S., Afzaal S., and Haider M. (2018). A comprehensive review on mycoviruses as biological control agent. World 3. Journal of Biology and Biotechnology, 3(2): 187-192. 4. Kondo H., Chiba S., Toyoda K. and Suzuki N. (2013). Evidence fornegative-strand RNA virus infection in fungi. Virology, 435: 201–209 5. Niu Y., Yongze Yuan Y., Mao J., Yang Z., Cao Q., Zhang T., Wang S. and Liu D. (2018) Characterization of two novel mycoviruses from *Penicillium digitatum* and the related fungicide resistance analysis. Scientific Reports. 8: 5513 6. Zoll J., Verweij P. E. and Melchers W. J. G. (2018): Discovery and characterization of novel *Aspergillus fumigatus* mycoviruses. PLoS ONE 13(7): e0200511.
	D. Introduction of algal viruses 1. Coy S. R., Gann E. R., Pound H. L., Short S. M. and Wilhelm S. W. (2018). Viruses of eukaryotic algae: Diversity, Methods for detection and future directions. Viruses. 10 (9): 487

Semester III

23-MBEP-237: Clinical Microbiology & Virus Technology

Choice based Optional Practical Paper (Elective)
(Total Workload): - 2 credits x 30 hrs = 60 hrs in semester

Course outcomes:

Students will be able to

CO1: Perform isolation, purification and preservation of bacteriophages
CO2: Test various concepts of bacteriophage growth kinetics
CO3: Demonstrate applications of bacteriophages

Unit	Title and Contents	Lectures
I	A. Isolation and purification of lytic bacteriophages from various environmental samples (Phages specific for E. coli /Salmonella SPP./Klebsiella Spp.). B. Isolation and enumeration of actinophages from soil sample C. Isolation of phyco viruses from various sources in nature D. Determination of Adsorption Rate Constant for phage and One step growth Curve Experiment	30
II	A. Negative staining (Sample preparation) for electron microscopicstudies (Demonstration) B. Biocontrol of any plant pathogen using plant Bioassay technique C. In-vitro use of lytic bacteriophages specific against *Klebsiella* spp.biofilm (Micro- titre plate experiment) D. In-vitro use of lytic bacteriophages for decontamination of watersample (Microcosm Studies). E. Bacteriophage Formulation technique-Carrier based phage formulation and their shelf-life study(3 months)	30

Suggested References 23-MBEP: 237 Practicals based on Clinical Microbiology & Microbial Virus Technology Semester III	
Unit	**References**
I	1. Ackerman H. W. (2009). Phage classification and characterization. In: Clokie MRJ, Kropinski AM (Eds) Bacteriophages: methods and protocols, Volume: Isolation, characterization and interactions, Vol. 501. Humana Press, New York. 2. Ahiwale S. (2013). Bacteriophages against enteric bacterial pathogens and their potential for bioremediation of pathogen infested water bodies PhD thesis, University of Pune,Pune, Maharashtra. 3. Marei E.M. and Elbaz R. M. (2013) Isolation and molecular characterization of three virulent actinophages specific for S*treptomyces flavovirens*. Journal of Virology Research. 2(1): 12-17 4. Coy S. R., Gann E. R., Pound H. L., Short S. M. and Wilhelm S. W. (2018). Viruses of eukaryotic algae: Diversity, Methods for detection and future directions. Viruses.10: 487. 5. Lanning S. and Williams S.T. (1982). Methods for the direct isolation and enumeration of Actinophages in soil. Journal of General Microbiology, 128: 2063-2071 6. Nabergoj D., Modic P. and Podgornik A. (2018). Effect of bacterial growth rate on bacteriophage population growth rate. Microbiology Open, 7, e00558.
II	1. AhiwaleS.S. (2011). *InVitro* management of hospital Pseudomonas *aeruginosa* biofilm using indigenous T7-like lytic phage. Curr. Microbiology.62: 335-340 2. Balan A. and Padilla G. (1997). New thermal inducible phages isolated from tropical soils. Brazilian Journal of Genetics. 20: 4 3. Ahiwale S. (2013) Bacteriophages against enteric bacterial pathogens and their potential for bioremediation of pathogen infested water bodies PhD thesis, University of Pune, Pune, Maharashtra. 4. McLaughlin M.R. and Brooks J.P. (2008). EPA worst case water microcosms for testing phage biocontrol of *Salmonella*. J Environ Qual. 37: 266-271 5. Umrao P. D., Kumar V. and Kaistha S. D. (2021). Biocontrol potential of bacteriophage -sp1 against bacterial wilt-causing Ralstonia solanacearum in Solanaceae crops Egyptian Journal of Biological Pest Control 31:61 https://doi.org/10.1186/s41938-021-00408-3 6. Vinod M. G., Shiva M. M., Umesha K. R., Rajaveera B. C., Krohne G. and Karunasagar J. (2006). Isolation of *Vibrio harveyi* bacteriophage withpotential for biocontrol of luminous vibriosis in hatchery environments. Aquaculture. 55: 117-124

Semester IV

23- MBCT-241: Pharmaceutical Microbiology

Core Compulsory Theory Paper

[4 Credits; 60 Lectures]

[1 credit=15 hrs x 60 mins]

Corse outcomes:

Students will be able to:

CO1: Explain the concept of Medicinal Chemistry, historical perspectives of drug discovery as well as the modern rational approach along with classification of drugs.

CO2: Give account of the various stages of drug development process and the tools/techniques used at every stage.

CO3: Describe the regulatory authorities functional in the drug development process and explain roles of each of them and importance of pharmacopeia with various example of drug formulations.

CO4: Describe the Pharmacokinetics and the mechanism of ADME

Unit	Title and Contents	Lectures
I	**General introduction to medicinal chemistry** A. Definition and explanation of terms used in medicinal chemistry (HITS, Lead compound, Toxicity studies, HTS, ADME). Nomenclature of drugs B. Historical perspectives, significance of medicinal chemistry C. Introduction to modern drug discovery, rational drug design, molecular modeling, gene and DNA technology in chemotherapy D. Classification of drugs based on therapeutic classes, target, mechanism of action, chemistry, etc.	15
II	**Drug development** A. Lead optimization: lead likeness, drug likeness, determination of biological, biochemical properties of drug, pharmacovigilance. B. Drug designing: Ligand based receptor based drug design. (Protein Crystallography, molecular docking) C. Drug development: Preclinical development. Toxicity testing – acute,sub-acute, chronic. D. Clinical development: Clinical trials (aims, objectives and conduct). Clinical trials I, II, III and IV.	15

III	**Biopharmaceuticals: Regulations and sources** A. Regulatory authorities and its role: FDA, WHO and CLSI B. Introduction to pharmacopeia: IP, USP, and BP C. Formulation of following pharmaceutical preparation as per IP: i. Antibiotics (with any one example) ii. Antipyretics (with any one example) iii. Steroids (with any one example) iv. Injectables (Distilled water, Saline) v. Vitamins (with any one example	15
IV	**Physicochemical properties of drug and drug metabolism** A. Passage of molecules through biological barriers. Membrane transport (paracellular, transcellular). B. Drug absorption: Drug dosages, from gastric emptying to gastric permeability to drug, first pass effect, Bioavailability. C. Drug distribution: Drug-plasma/ serum binding, blood brain barrier, accumulations in tissues. D. Drug elimination: Drug excretion, Drug biotransformation Biotransformation reactions, Functionalization, Conjugation reaction, Reactions leading to toxic metabolites	15

Suggested References 23-MBCT-241: Pharmaceutical Microbiology-Semester IV Core Compulsory Theory Paper	
Unit	**References**
I	**General introduction to medicinal chemistry** 1. Agarwal S. S. and Paridhavi M. (2007). Herbal drug technology. Universities Press(India) Pvt. Ltd 2. Altreuter D. and Clark D. S. (1999) Combinatorial Biocatalysis: Taking the lead from nature. Curr. Opin. Biotechnol. 10: 130-136 3. Burn J. H. (1957) Principles of Therapeutics. Blackwell Scientific Pub. O. Ltd.Oxford. 4. Chatwal G. P. (2003) Bio-pharmaceutics and Pharmacokinetics. Himalaya Publishing House, Mumbai. 5. Committee for the Purpose of Control and Supervision on Experiments on Animals (CPCSEA). www.cpcsea.com 6. Dewick P. M. (2002). Medicinal natural products: A biosynthetic approach, 2nd Ed., John Wiley and Sons 7. Erhardt P. W. (2006). Medicinal Chemistry in the New Millennium: A Glance into the Future, Ed. Chorghade M. S. in Drug discovery and Development Volume I: Drug Discovery. Wiley-Interscience, John Wiley and Sons Inc. USA. 17-102. 8. Graly J. O. and Joubert P.H. (1997). Handbook of Phase I /II clinical drug trials, CRC Press 9. Iyengar M. A. (1993). Pharmacology of Powdered Crude Drugs. Iyengar series. Manipal, India 10. Micheles P. S., Khmelnitsley Y. L., Dordick J. S. and Clark D. S. (1998). Combinatorial biocatalysis, a natural approach to drug discovery. Trends in Biotechnol. 16(5): 210-215 11. Rawlins E. A., (Ed). (2002). Bentley's Textbook of Pharmaceutics. 8th Ed. Bailliere Tindall, London 12. Satoskar R. S. and Bhandarkar S. D. (1991). Pharmacology and Pharmacotherapeutics. 12th Ed., Vol. 1 and 2. Popular Prakashan, Mumbai. 13. Vyas S. P and Dixit V. R. (2002). Pharmaceutical Biotechnology, CBS Publishers and Distributors, New Delhi
II	**Drug development** 1. Franklin T. J. and Snow G. A. (1975). Biochemistry of Antimicrobial Action. Chapman and Hall, London. 1-22 and 160-174 2. Gale E. F., Cundliffe E., Reynolds P. E., Richmond M. H. and Waring M. J. (1972). The molecular basis of antibiotic action. John Wiley and Sons. 3. Goldstein A., Aronow L., and Kalman S. M. (1969). Principles of Drug Action. The Basis of Pharmacology. Harper international edition New York. 4. Lorian V. (1986). Antibiotics in laboratory medicine. 2nd Ed. Williams & Wilkins Publication 5. National Committee for Clinical Laboratory Standards (now Clinical and Laboratory Standards Institute, CLSI). NCCLS: 1997. Methods for dilution

	antimicrobial susceptibility testing for bacteria that grows aerobically. Approved Standards M7-A4. Villanova, PA: 6. National Committee for Clinical Laboratory Standards (now Clinical and Laboratory Standards Institute, CLSI). NCCLS: 2002.Performance standards for antimicrobial susceptibility testing; 12th information supplement (M100- S1). Villanova, PA
III	**Biopharmaceuticals: Regulations and sources** 1. Blondelle S. E., Perez Paya E. and Houghten R. A. (1996). Synthetic Combinatorial Libraries: Novel Discovery Strategy for Identification of Antimicrobial Agents. Antimicrobial Agents and Chemotherapy. 1067–1071 2. Holliger M. A. (2008). Introduction to Pharmacology. 3rd Ed. CRC Press. Taylor and Francis. 3. Indian Pharmacopoeia (IP 2018). 8th Edition. Four Volumes with addendum 2019. Published by the Indian Pharmacopoeia Commission (IPC) on behalf of the Government of India, Ministry of Health and Family Welfare. 4. Kokate C. K., Purohit A. P., Gokhale A. B. (2000). Pharmacology. 4th Ed., Nirali Prakashan. 5. Micheles P. S., Khmelnitsley Y. L., Dordick J. S. and Clark D. S. (1998). Combinatorial biocatalysis, a natural approach to drug discovery. Trends in Biotechnol. 16(5): 210-215 6. Osol A. (1980). Remington's Pharmaceutical Sciences, 16th Ed., Easton, Pennsylvania: Mack Publishing Company. 7. Satoskar R. S. and S. D. Bhandarkar (1991). Pharmacology and Pharmacotherapeutics. 12th Edition. Vol. 1 and 2. Popular Prakashan, Mumbai. 8. Vyas S. P. and Dixit V. R. (2002). Pharmaceutical Biotechnology. CBS Publishers and Distributors, New Delhi 9. Walsh G. (2006). Biopharmaceuticals: Biochemistry and Biotechnology. 2nd edition. Wiley (E-Book, 2013).
IV	**Physicochemical properties of drug and drugmetabolism** 1. Holliger M. A. (2008). Introduction to Pharmacology. 3rd Ed. CRC Press. Taylor and Francis. 2. Kokate C. K., Purohit A. P., Gokhale A. B. (2000). Pharmacology. 4th Ed. Nirali Prakashan. 3. Micheles P. S., Khmelnitsley Y. L., Dordick J. S. and Clark D. S. (1998). Combinatorial biocatalysis. A natural approach to drug discovery. Trends in biotechnol. 16(5): 210-215

Semester IV

23-MBCT-242: Microbial Technology

Core Compulsory Theory Paper

[4 Credits; 60 Lectures]

[1 credit=15 hrs x 60 mins]

Course Outcomes:

Students will be able to:

CO1: Describe basic operational parameters of different fermenters and reactors design

CO2: Explain about governing and influencing factors for any fermentation process

CO3: Explain about significance and features of batch, continuous and fed-batch operation mechanisms

CO4: Apply knowledge regarding designing part of aeration, agitation assembly as well as designs of fermenter reactors

CO5: Describe the significance of Intellectual property rights (IPR), different types and categorization of IP's as well as pros and cons of legal aspects of IPR

Unit	Title and Contents	Lectures
I	**Bioreactor design and operation** A. Designing of bioreactors Design aspects CSTRs: The dimensional ratios of the outer shell, and the operational aspects such as working volume, baffles and impellers. B. The configuration (placement) of impellers in a vessel and the different types of impellers (types of turbines and propellers, and their combinations) C. Immobilized cell reactors and air-lift reactors–Design and operation. D. Batch, Fed-batch and Continuous operation: Applications,advantages and limitations of each type	15
II	**Process Variables and Monitoring** **A. Process Variables**: i. Aeration Theory of oxygen transfer in bubble aeration, Oxygen transfer kinetics (Oxygen Uptake Rate –OUR; Oxygen Transfer Rate OTR;Ccrit), determination of KLa. ii. Agitation Functions of agitation. Flow patterns with different types of impellers. a) Fermentation broth rheology and power requirements for agitation – Concept of Newtonian and non-Newtonian fluids, b) Effect of broth rheology on heat, nutrient and oxygen transfer, Reynold's number, Power number, Aeration number: working out examples using different software c) Reynolds number ,Power number ,Aeration number: working out examples using different software	15

	B. Monitoring of process variables: i. Use of various types of sensors and biosensors for monitoring environmental parameters (pressure, pH, temperature, DO and DCO2) ii. Basic principles of operation, types of biosensors	15
III	**Microbial Fermentation Processes:** Upstream, Fermentation and Downstream Processing for the following: i. Antibiotics (Rifamycin) ii. Microbial enzymes (Chitinase) iii. Exopolysaccharides (Pullulan) iv. Use of immobilized cells / enzymes for bioconversion v. Use of fungi in agriculture and environmental applications	15
IV	**Principle Concepts of IPR, ISO & Validation Process:** A. Intellectual Property Rights (IPR): i. Basic concepts of IPR ii. Introduction to forms of IPR – Patents and Designs B. The concept of ISO Certification. C. Preparation of SOPs D. Validation protocols for methods in: i. Quality Control ii. Process validation The above should be discussed within WHO Norms. Exercises on preparation of SOPs, operation and validation for analytical methods	15

Suggested References 23-MBCT 242: Microbial Technology Semester IVCore Compulsory Theory Paper

Unit	References
I	**Bioreactor design and operation** 1. BIOTOL series. (1992). Bioreactor Design and Product Yield. Butterworth Heinemann. 2. Doran P. M. (1995). Bioprocess Engineering Principles. Imprint-AcademicPress. Copyright-Elsevier. 3. Lydersen B. K., D'Elia N. A. and Nelson K. M. (Eds.) (1993). Bioprocess Engineering: Systems, Equipment and Facilities. John Wiley and Sons Inc. 4. Maiti B. R. (2018). Principles of Bioreactor Design. Publisher: Viva books 5. McDuffie N. G. (1991). Bioreactor Design Fundamentals 1st Edition, Elsevier: eBook ISBN: 9781483221083 6. Ratledge C. and Kristiansen B. eds. (2001). Basic Biotechnology. 2nd Ed. Cambridge Univ. Press. Cambridge 7. Singh L., Mahapatra D. and Yousuf A. (2019). Bioreactors: Sustainable Design and Industrial Applications in mitigation of GHG emissions. Elsevier. ISBN-0128212640, 9780128212646

II	**Process Variables and Monitoring** 1. Aiba S., Humphrey A. E. and Millis N. F. (1982). Biochemical Engineering. Second Edition. Academic Press. 2. Chand S. (1998). Fermentation Biotechnology: Industrial Perspectives. Industrial Perspectives: Proceedings of the Symposium on Biotech Industry - a Challenge for 2005 A.D. -with Special Reference to Fermentations. November4-6, 1998. Publisher: All India Biotech Association 3. Jozala A. F. (2017). Fermentation Processes. Publisher-BoD. Books on Demand. ISBN-9535129279, E-Book 9789535129271 4. Mandenius C-F. (2016). Bioreactors: Design, Operation and Novel Applications. Reprint. Publisher-John Wiley & Sons. ISBN 3527683372 E- Book- 9783527683376 5. Larroche C., Sanroman M., Du G. and Pandey A. (Editors). (2016). Current Developments in Biotechnology and Bioengineering: Bioprocesses, Bioreactors and Controls. Publisher-Elsevier, ISBN 0444636749,E–Book 9780444636744 6. Lydersen B. K., D' Elia N. A. and Nelson K. M. (Eds.) (1993) Bioprocess Engineering: Systems, Equipment and Facilities. John Wiley and Sons Inc. 7. BIOTOL series. (1992). Operational Modes of Bioreactors Butterworths – Heinemann. 8. Stanbury P., Whitaker A. and Hall S. (2016). Principles of Fermentation Technology. 3rd Edition Imprint: Butterworth-Heinemann
III	**Microbial Fermentation Processes:** 1. Arora D. K. (2005). Fungal Biotechnology in Agricultural, Food and Environmental Applications (Mycology), Marcel Dekker, Inc. New York. Basel 2. Belter P. A., Cussler E. L. and Hu W. S. (1994). Bioseparations Downstream processing for Biotechnology. John Wiley and Sons. N.Y. ISBN: 978-0- 471-12113-8 3. Crueger W. and Crueger A (1990). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Sinauer associates, Inc 4. Klegerman M. E. and Groves M. J. (1992). Pharmaceutical Biotechnology: Fundamentals and Essentials. Interpharm Press Ltd. Buffalo Grove, Illinois 5. Meshram S. U. and Shinde G. B. (2009). Applied Biotechnology. I.K. International Pvt. Ltd. 6. Mishra C. S. K. (Editor) and Pascale Champagne (Associate editor). (2009). Biotechnology applications. I. K. International Pvt. Ltd. 7. Peppler H. J. and Perlman D. (1970). Microbial Technology. Volume 1and 2. Academic Press, New York. 8. Ponkhshe S. (1988). Management of Intellectual Property, Bhate and Ponkhshe Prakasham, Pune 9. Reed G. (Editor). Prescott and Dunn's Industrial Microbiology. 4th Ed., CBSPub. New Delhi. 10. Van Damme E. J. (1984.) Biotechnology of Industrial Antibiotics. Marcel Dekker Inc., New York.

	11. Wiseman A. (1985). Topics in Enzyme and Fermentation Biotechnology.Vol. 1and 2. John Wiley and Sons, New York
IV	**Principle concepts of IPR, ISO and Validation Process:** 1. Calnan N., Redmond A. and O'Neill S. (2009). The FDA's draft process validation Guidance A perspective from industry. Process Validation Guidance. Pharmaceutical Engineering. GMP Publishing. 7(4): 1-17 2. Supplementary Training Modules on Good Manufacturing Practice. Validation WHO Technical Report Series, No.937, 2006, Annex 4.

Semester IV

23- MBCT- 243: Dissertation

Course outcomes:

CO1: Identify the problem area to carry out research and state the hypothesis through survey of scientific literatureobtained from authentic sources/ means.
CO2: Decide the line of action, describe methodology and accordingly design experimental set up
CO3: Record observations, statistically analyze the obtained data, effectively represent and interpret the data and finally drawing conclusions.
CO4: Write an extensive and comprehensive report of research work so as to convey dissertation in the mostproficient and effective way

Guidelines for 23-MBCT- 243
Semester IV: Dissertation

1. A dissertation can be carried out by a single student or by group of students where the group should not contain more than four students.
2. The dissertation report will be prepared as per the thesis format.
3. Submission of the dissertation report will be at least ten days before the date of examination.
4. One copy of the report will be preserved in the department, in college.
5. If there are more than one student carrying out a single dissertation, a single report can be submitted to the department and these students will be assessed based on single oral presentation.
6. In such case, presentation should be carried out by all the students carrying out the same work; dividing the presentation equally among them.
7. At the time of presentation, the external and internal examiners appointed by the university will be present; the dissertation guide may or may not be present.
8. Presentation should be carried out to in the presence an audience comprising of examiners appointed by the university, departmental teaching staff and the postgraduate students of the department (M.Sc. I and II).
9. Oral presentation can be carried out using posters, blackboard, transparencies, model or LCD projector.
10. The allotted time for each oral presentation (one project) should be 10 to 12 minutes, followed by question and answer session of 5 to 8 minutes. The audience can participate in this session.
11. **The assessment of the dissertation is for total of 100 marks (IA-30 and UA-70).**
12. The assessment of first 30 marks (in semester) will be carried out by the guide(s) who has supervised the work of the candidate(s) throughout the semester. The assessment will be carried out on the basis of the points, as per the accompanied format of the mark sheet. Head of the department should communicate this point wise assessment system to the dissertation supervisor, well in advance. Guide(s) will give appropriate marks, point-wise and submit it in a sealed envelope(s) to the Head of the respective department, three days prior to examination and project presentation. On the day of examination, Head of the department will hand over these unopened envelopes to the examiners.

13. Assessment of remaining 70 marks (end semester examination for both courses) will becarried out for individual student at the time of examination jointly by Internal and External examiners by the means of oral presentation. The assessment will be carried out on the basis of the points as per the accompanied format of the mark sheet.
14. Students should be made aware of the assessment parameters, on which they will be assessed throughout the semester and at the end of the fourth semester.

Note: The external and internal examiners by mutual agreement will appropriately settle the marks given by the guide (reconsider, if necessary) and marks of oral presentation, and submit the mark list to the Coordinator of the M. Sc. Examination Panel for that examination.

Semester IV

23-MBET-244: Quality Assurance and Validation in Pharmaceutical Industry and Development of Anti-Infectives

Choice based Optional Theory Paper (Elective)

[2 Credits; 30 Lectures]

[1 credit=15 hrs x 60 mins]

Course Outcomes:

Students will be able to –

CO1: Explain GMP, GLP and safety measures.CO2: Explain the principles of Bioethics.

CO3: Describe the importance, role and functions of various regulatorycommittees on biosafety.

CO4: Describe the importance, role and functions of various regulatorycommittees on quality control and quality assurance.

Unit	Title and Contents	Lectures
I	**Quality Assurance and Validation in Pharmaceutical Industry** A. Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry. Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification. Safety in microbiology laboratory. B. Safety profile of drugs: i. Sterility Testing ii. Pyrogenicity testing iii. Mutagenicity and Carcinogenicity testing iv. Teratogenicity testing	**15**
II	**Development of Anti infectives:** Therapeutic ratio, MIC and MBCSusceptibility Testing: A. Use of liquid and solid media B. Factors affecting susceptibility testing, CLSI guidelines C. Diffusion methods – agar dilution technique, gradient plate techniques-test, Kirby Bauer, Stokes method D. Susceptibility testing for: i. Anti-mycobacterial agents ii. Anti-fungal agents iii. Anti-protozoan agents iv. Anti-viral agents	**15**

Suggested References 23-MBET-244: Semester IV
Quality Assurance and Validation in Pharmaceutical Industry and Development of Anti-Infectives
Choice based Optional Theory Paper (Elective)

Unit	References
I	1. Blondelle S. E., Pérez-Payá E. and Houghten R. A. (1996). Synthetic combinatorial libraries: novel discovery strategy for identification of antimicrobial agents. Antimicrobial Agents and Chemotherapy. 1067–1071 2. Holliger M. A. (2008). Introduction to Pharmacology. Third Ed., CRC Press. ISBN9781420047417 3. Kokate C. K., Purohit A. P. and Gokhale A. B. (2000). Pharmacology, 4th Edition. Nirali Prakashan. 4. Maron D. M. and Bruce N. A. (1983). Revised methods for the Salmonella mutagenicity test. Mutation Research. 113: 173-215 5. Osol A. and Hoover J. E. (1975). Remington's Pharmaceutical Sciences, 15th Ed., MackPub. Co., Pennsylvania. 6. Vyas S. P and Dixit V. R. (2002). Pharmaceutical Biotechnology, CBS Publishers and Distributors, New Delhi
II	1. Franklin T. J. and Snow G. A. (1975). Biochemistry of Antimicrobial Action. Chapman and Hall, London. 1-22 and 161-200. 2. Gale E. F., Cundliffe E., Reynolds P. E., Richmond M. H. and Waring M. J. (1972). The molecular basis of antibiotic action, John Wiley and Sons, London 3. Goldstein A., Aronow L., and Kalman S. M. (1969) Principles of Drug Action, The Basis of Pharmacology, Harper international edition New York. 4. Lorian V. (1986). Antibiotics in laboratory medicine. 2nd Ed, Williams & Wilkins Publication 5. National Committee for Clinical Laboratory Standards (now Clinical and Laboratory Standards Institute, CLSI). NCCLS: 1997. Methods for dilution antimicrobial susceptibility testing for bacteria that grows aerobically. Approved Standards M7-A4. Villanova, PA. 6. National Committee for Clinical Laboratory Standards (now Clinical and Laboratory Standards Institute, CLSI). NCCLS: 2002. Performance standards for antimicrobial susceptibility testing; 12th information Supplement (M100-S1). Villanova, PA

Semester IV

23-MBEP-244: Practicals based on Quality Assurance and Validation in Pharmaceutical Industry and Development of Anti Infectives

Choice based Optional Practical Paper (Elective)
(Total Workload): - 2 credits x 30 hrs = 60 hrs in semester

Course Outcomes:

Students will be able to –

CO1: Describe the NABL norms for calibration of Autoclave and Laminar Air Flow.

CO2: Refer to FSSAI manuals to demonstrate its application in water and food testing, tests prescribed for different samples for detection of different contaminating pathogens

CO3: Carry out quality assessment of packed foods with respect to pathogens like L monocytogenes.

Unit	Title and Contents	Lectures
I	**Sterility testing of following pharmaceutical preparations as per IP:** i. Oral preparation: Antipyretic or antibiotic tablets ii. Liquid preparation: water soluble vitamin or cough syrup orophthalmic drops iii. Bulk preparation: (any two) Surgical Cotton rolls/ gauze/ surgicalsutures/ disposable syringes.	30
II	**Detection and isolation of anti-infectives from plant** i. Extraction of bioactive principles from plant and activityfractionation ii. Estimation of its antimicrobial activity using standard guidelines(CLSI)	30

Suggested References 23- MBEP-244: Semester IV

Practicals based on Quality Assurance and Validation in Pharmaceutical Industryand Development of Anti Infectives from plants

Choice based Optional Practical Paper(Elective)

Unit	References
I	**Sterility testing of following pharmaceutical preparations as per IP** 1. Holliger M. A. (2008). Introduction to pharmacology. 3rd Edition. CRCPress 38 2. Indian Pharmacopoeia. (2007). Government of India, Ministry of Health and Family Welfare. The Indian Pharmacopoeia commission. Ghaziabad.1:53 3. Knudsen L. F. (1949). Sample size of parenteral solutions for sterilitytesting. JAmer Pharm Assoc. 38: 332–337. 4. McGuire J. and Kupiec T.C. (2007). Quality-control analytical methods: thequality of sterility testing. Intl J Pharm Compounding. 11(1): 52–55. 5. Madsen R. E. (1994). US vs. Barr Laboratories: a technical perspective.PDA JPharm Sci Tech. 48(4): 176–179. 6. Moldenhauer J. and Sutton S.V.W. (2004). Towards an improved sterilitytest.PDA J Pharm Sci Tech. 58 (6): 284–286. 7. Moldenhauer J. (2006). Viability-based rapid microbiological methods forsterility testing and the need for identification of contamination. PDA J PharmsciTech. 60(2):81-88 8. Schroeder H. G. (2005). Sterility failure analysis. PDA J Pharm Sci Tech.59(2):89–95. 9. Sykes G. (1956). The technique of sterility testing. J Pharm Pharmacol. 8:573
II	**Detection and isolation of anti infectives from plant** 1. Lorian V. (1986). Antibiotics in laboratory medicine. 2nd Ed. Williams and Wilkins Publication 2. National Committee for Clinical Laboratory Standards (now Clinical and Laboratory Standards Institute, CLSI). NCCLS: 1997. Methods for dilution antimicrobial susceptibility testing for bacteria that grows aerobically. Approved Standards M7-A4.Villanova, PA. 3. National Committee for Clinical Laboratory Standards (now Clinical and Laboratory Standards Institute, CLSI). NCCLS: 2002. Performance standards for antimicrobial susceptibility testing; 12th information supplement (M100-S1). Villanova, PA.

Semester IV

23- MBET-245: Advances in Microbial Technology

Choice based Optional Theory Paper (Elective)

[2Credits; 30 Lectures]

[1 credit=15 hrs x 60 mins]

Course outcomes

Students will be able to

CO1: Describe advances in Microbial Technology,
CO2: Explain applications of animal cell culture technology.

Unit	Title and Contents	Lectures
I	Microbial Growth characteristics and product formation i. Concept of primary (growth associated) and secondary (growth on associated) metabolites and their control, ii. Kinetics of growth and product formation (growth rate, yield coefficient, efficiency etc.) iii. Effect of type of growth on fermentation: The type of growth (mycelia pellet form, mycelia filamentous form, free cell, cells producing exopolysaccharides) affects mass transfer of nutrients, oxygen and heat; as also cell proliferation can be affected by shearing of cells. At least one example of each type may be explained to show these effects in any suitable fermentation.	15
II	i. Animal cell culture technology to produce: ii. Recombinant forms of natural proteins (insulin, erythropoietin), iii. Recombinant vaccines (protein: HIV, hepatitis B and DNA: HIV, malaria), Recombinant enzymes (lipase, restriction endonuclease), iv. Monoclonal antibodies v. Nucleic acid based products (introduction to gene therapy	15

Suggested References23- MBET -245: Advances in Microbial Technology Semester IV Choice based Optional Theory Paper (Elective)	
Unit	**References**
I	1. Gupta V. K., Schmoll M., Maki M., Tuohy M. and Mazutt M. A (Editors).(2013) Applications of Microbial Engineering. CRC Press 2. Rao D. G., (2010) Introduction to Biochemical Engineering. Tata McgrawHill Education 3. Stanbury P. F. (2009) Principles of Fermentation Technology. 2 Edition.Elsevier (A Division of Reed Elsevier India Pvt. Limited).
II	1. Moo Young M. ed. (1985). Comprehensive Biotechnology Vol: III and IV,Pergamon Press. N. Y 2. Ratledge C. and Kristiansen B. (editors). (2001) Basic Biotechnology. 2nd Ed.Cambridge Univ. Press. Cambridge 3. Satyanarayana U. (2005). Biotechnology. Books and Allied (p) limited.

23-MBEP-245 Practicals based on Advances in Microbial Technology Semester IV
Choice based Optional Practical Paper (Elective)
(Total Workload): - 2 credits x 30 hrs = 60 hrs in semester

Course outcomes:

Students will be able to

CO1: Describe Advances in Microbial Technology.
CO2: Explain applications of animal cell culture technology.
CO3: Explain latest techniques and their applications.

Unit	Title and Contents	Lectures
I	**A Bioconversion** Bioconversions using immobilized systems (cells / enzyme)Parameter testing: i. Effect of gel concentration **ii.** Effect of cell / enzyme concentration **B. Laboratory scale production** Laboratory scale production and media optimization for:exopolysaccharide / bioemulsifier production	30
II	**Animal Cell Culture Technology** A. Preparation of Hybridoma from tumour cell lines. B. Production of monoclonal antibodies from hybridoma of tumourcell lines	30

Suggested References 23- MBEP- 245: Semester IV Practicals based on Advances in Microbial TechnologyChoice based Optional Practical Paper(Elective)	
Unit	**References**
I	**A. Bioconversion:** 1. Arana-Peña S., Rios N. S., Carballares D., Mendez-Sanchez C., Lokha Y., Gonçalves L. and Fernandez-Lafuente R. (2020). Effects of enzyme loading and immobilization conditions on the catalytic features of lipase from *Pseudomonas fluorescens* immobilized on octyl-agarose beads. Frontiers in bioengineering and biotechnology. 8: 36. 2. Brena B, González-Pombo P and Batista-Viera F. (2013). Immobilization of enzymes: a literature survey. Methods Mol Biol. 1051: 15-31. 3. Gedam P. S., Raut A. N. and Dhamole P. B. (2019). Effect of operating conditions and immobilization on butanol enhancement in an extractive fermentation using non-ionic surfactant. Appl Biochem Biotechnol. 187: 1424–1436 4. Mahajan R., Gupta V. K. and Sharma J. (2010). Comparison and suitability of gel matrix for entrapping higher content of enzymes for commercial applications. Indian J Pharm Sci. 72(2): 223-228.

	B. **Laboratory scale production** 1. Biswas J. and PaulA. K. (2017). Optimization of factors influencing exopolysaccharide production by *Halomonas xianhensis* SUR308 under batch culture. AIMS Microbiology, 3(3): 564–579. 2. Hereher F., El-fallal A. and Abou-Dobara M. (2018). Cultural optimization of a new exopolysaccharide producer. "*Micrococcus roseus*". Beni-Suef University Journal of Basic and Applied Sciences. 7(4): 632-639

Semester IV

23-MBET-246: Industrial waste water treatment and Industrial production of vaccines

Choice based Optional Theory Paper (Elective)

[2 Credits; 30 Lectures]

[1 credit=15 hrs x 60 mins]

Course Outcomes:

Students will be able to

CO1: Know the concepts of Industrial Waste Water Treatment and sludge treatment

CO2: Explain Industrial Production of Vaccines

Unit	Title and Contents	Lectures
I	A. **Concept and Introduction** to Primary, Secondary and Tertiary treatment of Wastewater. B. **Biological Treatment**- Aerobic and Anaerobic, Suspended and Attached growth processes. C. Activated Sludge treatment and analysis (reactions and Kinetics, mass balance analysis, Hydraulic characters) Critical Operating parameters like DO, Hydraulic retention time, Mean cell retention time, F/M ratio. D. **Current industrial wastewater treatment processes:** Composition, physico-chemical properties and various effluents treatment methods with reference to: i. Dairies ii. Food processing iii. Dyeing industry / Dye-house effluents iv. Paper and pulp industry: Effluent Disposal and Reuse	15

II	**Industrial production of vaccines** **A. Introduction to vaccines** **B. Types**: Inactivated, Attenuated, Toxoid, Subunit, Conjugate, Experimental,Valence, Heterotypic **C. Production** i. Pilot and Industrial scale production ii. Excipients iii. Role of Adjuvants and preservatives **D. Production of viral, bacterial and protozoal vaccines** – Generations of vaccines: i. First generation vaccines– Live attenuated (BCG, MMR) and Inactivated (Pertussis, Tetanus toxoids) ii. Second generation vaccines(synthetic) protein/ peptide/ polysaccharide) a. Subunit vaccines (Hep B) b. Recombinant (Rotavirus), Hapten-Conjugate vaccines (diphtheria) iii. Third generation vaccines – DNA/RNA and Idiotype vaccines(Malaria) iv. Next generation vaccines using OMICs approach: SARS.	15

23-MBET 246: Semester IV

Industrial waste water treatment and Industrial production of vaccinesChoice based Optional Theory Paper (Elective)

Unit	References
I	1. Abdallh M. N., Abdelhalim W. S. and Abdelhalim H. S. (2016). Industrial wastewater treatment of food industry using best techniques. International Journal of Engineering Science Invention, 5(8): 15-28. 2. Ali Z. and Rahman M. (2008) Physico-chemical characteristics of pulp and paper mill effluent. Research in Environment and Life Sciences.1 (2): 59-60. 3. Ashtekar S., Bhandari V. M., Shirsath S. R., Sai Chandra P. L. V. N. and Jolhe P. D. (2013). Dye wastewater treatment: removal of reactive dyes using inorganic and organic coagulants. Journal of Industrial Pollution Control, 30(1): 33-42 4. Bajpai P. and Bajpai P. K. (1994). Mini review: Biological color removal of pulp and paper mill wastewaters. Journal of Biotechnology. 33: 211-220. 5. Bajpai P. (2001). Microbial degradation of pollutants in pulp mill effluents. Advances in Applied Microbiology.48: 79-134. 6. Catalkaya E.C. and Kargi F. (2006). Color, TOC and AOX removals from pulp mill effluent by advanced oxidation processes: A Comparative Study. Journal of Hazardous Materials. 139 (2): 244-253 7. Metcalf and Eddy (Eds.). (1991). 3rd Edition, Tata Mac Graw Hill Publishing Co. Ltd. New Delhi. 8. Patwardhan A. D. (2008). Industrial wastewater treatment. © Prentice – Hall ofIndia

	Pvt. Ltd., New Delhi. ISBN 978-81-203-335 9. Tchobanoglous G. and Burton F. L. (1991) Wastewater engineering, treatment,disposal and reuse. 3rd Edition, Metcalf and Eddy (Eds.), Tata Mac Graw Hill Publishing Co. Ltd. New Delhi.
II	1. Casida L. E. (1984). Industrial Microbiology.Wiley Easterbs, New Delhi 2. Patel A. H. (1985). Industrial Microbiology, Macmillan India Ltd. 3. Soma Marla S., Bonthala V. S., München H. Z., Suresh., Gaur V. S. and Gohar Taj G. (2012). Biotechnology in Medicine and Agriculture Principles and Practices. Publisher: I.K International Publishing House pvt.ltd, Editors: Anil Kumar, Ashwani Pareek, and Sanjay Mohan Gupta. 739-759 4. Stanbury P. F. and Whittaker A. (1984). Principles of Fermentation Technology. Pergamon press. 5. https://www.slideshare.net/adammbbs/pathogenesis-3-rd-internal-updated-43458567 6. https://www.bio.fiocruz.br/en/images/stories/pdfs/mpti/2013/selecao/vaccine-process-technology.pdf 7. https://www.dcvmn.org/IMG/pdf/ge_healthcare_dcvmn_introduction_to_pd_for _vaccine_ production_29256323aa_10mar2017.pdf 8. https://www.sciencedirect.com/science/article/pii/B9780128021743000059 https://www.researchgate.net/publication/313470959_Vaccine_Scale- up and Manufacturing

Semester IV

23-MBEP 246: Practicals based on Industrial Waste Water Treatment and Industrial Production of Vaccines

Choice based Optional Practical Paper (Elective)

(Total Workload): - 2 credits x 30 hrs = 60 hrs in semester

Course Outcomes:

The students will be able to –

CO1: Perform wastewater analysis by estimating parameters such as COD, BOD, TS, TSS, etc. with additional knowledge about setting up of laboratory scale bioreactors for wastewater treatment.

CO2: Define Potency of the vaccine and Assess quality of toxoid type of vaccine using immunological techniques

CO3: Perform the steps for isolation of Salmonella H and O antigen.

Unit	Unit Title and Contents	Lectures
I	**Practicals based on industrial waste water treatment:** i. Estimation of pollution load of a natural sample (e.g. river water / industrial waste water) ii. Setting up a laboratory experiment to assess degradability of synthetic wastewater	30
II	**Practicals based on industrial production of vaccines** i. Checking the potency of a toxoid based vaccine by immune diffusion assay ii. Preparation of *Salmonella* O and H antigen and estimation withknown antibodies	30

Suggested References 23-MBEP 246: Semester IV

Practicals based on Industrial Waste Water Treatment and Industrial Productionof Vaccines

Choice based Optional Practical Paper (Elective)

Unit	References
I	1. Barthwal R. R. (2002). Environmental Impact Assessment, New Delhi (India). New Age International (P) Limited Publishers. 2. Eaton A. D. (2005). Standard methods for the examination of water and wastewater. American Public Health Association. American Water Works Association. Water Environment Federation. Publisher: Washington, D.C.: APHA-AWWA-WEF. National government publication: English: 21st edition 3. Glasson J., Therivel R. and Chadwick A. (2012). Rutledge-Taylor and Francis Introduction to Environmental Impact Assessment. 4th Edition. 416 pages 4. Srivastava A. K. (2003). Environment Impact Assessment, (A.P.H. Publishing. Corporation, Delhi,ISBN-817648-4423

II	1. Cruickshank R. (1982). Medical Microbiology, 12th Edition, P.403.2. FelixA. (1942) Brit. Med. J. 11: 597. 2. Roitt L. (1994). Essential Immunology. 8th edition. Blackwell Scientific.Oxford, UK.114- 115. 3. Vaerman J. P. (1981). Single radial immune diffusion, in methods in enzymology. 73 (Langone, J. J.And Van Vunakis, H, Eds.) New York. 291- 305.

Semester IV

23-MBET 247: Bioethics, Biosafety, Quality Control and Quality Assurance

Choice based Optional Theory Paper (Elective)

[2 Credits; 30 Lectures]

[1 credit=15 hrs x 60 mins]

Course outcomes:

The students will be able to

CO1: Describe Quality Assurance reviewing and approval of procedures, reviewing records and performing audits.

CO2: Explain Ethical conflicts in microbiological and biotechnological research

CO3: Describe Biosafety Regulatory bodies (Role and functions)

Unit	Unit Title and Contents	Lectures
I	**Bioethics and Biosafety** **A. Bioethics** i. Concept of ethics and bioethics with respect to microbiologicalresearch ii. Principles of bioethics. iii. Ethical conflicts in microbiological and biotechnological research iv. Biological Diversity Act: conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of utilization of genetic resources **B. Biosafety** Regulatory bodies (Role and functions) i. Advisory Committee: Recombinant DNA Advisory Committee (RDAC) **ii**. Regulatory / Approval Committees: a. Genetic Engineering Appraisal Committee (GEAC) b. Review Committee on Genetic Manipulation (RCGM) c. SIRO (DSIR) d. Institutional Biosafety Committee (IBSC): Importance of Biosafety Institutional Biosafety Committees (IBSCs) Laboratory associated infections and hazards Bio safetyregulation: handling of recombinant DNA products and process in industry and in institutions iii. Monitoring Committees: a. State Biotechnology Coordination Committee (SBCC) b. District Level Committee (DLC)	15

II	**Quality Control and Quality Assurance Quality Control:** Assessment of suitability of components and products Evaluation of the performance of the manufacturing process A. Quality Assurance reviewing and approval of procedures, reviewingrecords and performing audits B. Good Manufacturing Practices (GMP) and Good Laboratory Practices(GLP) C. Regulatory bodies (Role and functions): **i.** The Central Drugs Standard Control Organization (CDSCO) **ii.** National Accreditation Board for Testing and Calibration Laboratories (NABL) **iii.** Food Safety and Standards Authority of India (FSSAI): Food and water Laboratories **iv.** International Standard ISO/IEC 17025:2017(E). **v.** Bureau of Indian Standards -IS 14648 (2011): Methods of Testfor Microbiological Examination of Industrial Product **vi.** (examples Cosmetics and Cosmetic Raw Materials) **vii.** The Central Pollution Control Board (CPCB)- Prevention and control of water and air pollution and improvement of the quality of air.	15

Suggested References 23-MBET 247: Semester VI Bioethics, Biosafety, Quality Control and Quality Assurance
Choice based Optional Theory Paper (Elective)

Unit	References
I	1. Biotechnology: A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH. (2nded) ISBN- 10 3527304320. 2. Encyclopedia of Bioethics 5 vol set, (2003) ISBN-10: 0028657748. 2. Thomas J.A. and Fuch R. L. (2002). Biotechnology and safety Assessment (3rd Ed) Academic press. 3. Notification from Department of Biotechnology, Ministry of Science and Technology, India. (2020) Revised simplified procedures/guidelines on Import, Export and Exchange of GE organisms and product thereof for R& D purpose. File no. BT/BS/17/635/2015-PID. dated-17/01/2020 4. https://ibkp.dbtindia.gov.in/ 5. Ministry of Law And Justice (Legislative Department) New Delhi, the 5th February, 2003/Magha 16, 1924 (Saka) published for general information: The Biological Diversity Act, 2002 No. 18 of2003 [5th February, 2003]

II	1. Draft Manual on method of microbiological testing (2016) microbiology of foods. Food safety and Food Standards. https://old.fssai.gov.in/Portals/0/Pdf/Microbiological_Testing_Foods_Draft_Manual_06_09_2016.pdf 2. Eleftheriadou M. and Tsimillis K. C. (Eds), Eurachem guide: Accreditation for Microbiological Laboratories, Second edition (2013), ISBN: 978-91- 87017-92-6. Available from www.eurachem.org. 3. https://archive.fssai.gov.in/home/food-testing/food-testing- manual.html. 4. https://cdsco.gov.in/opencms/opencms/en/About-us/Functions/ 5. https://cdsco.gov.in/opencms/opencms/en/Home/ 6. https://cpcb.nic.in/functions/ 7. https://www.iso.org/obp 8. International Standard ISO/IEC 17025:2017(E). General requirements for the competence of testing and calibration Laboratories. Third edition. 2017-11 9. IS 14648 (2011): Methods of Test for Microbiological Examination of Cosmetics and Cosmetic Raw Materials. https://law.resource.org/pub/in/bis/S11/is.14648.2011.pdf 10. Manual for Good Food Laboratory Practices (GFLPs). 2018. Food Safety and standards Authority of India (FSSAI) Ministry of Health and Family Welfare Government of India, New Delhi 04. Issue Date -11-Feb-2019 11. Manual of Methods for Analysis of Water 2016. Food Safety and Standards Authority of India (FSSAI), Ministry of Health and Family Welfare Government of India, New Delhi 12. National Accreditation Board for Testing and Calibration Laboratories(NABL). (2019) Specific Criteria for Accreditation. NABL 112. IssueNo:04. Issue date- 11-Feb-2019

23-MBEP 247: Semester IV

Practicals based on Bioethics, Biosafety, Quality Control and Quality Assurance Choice based Optional Practical Paper (Elective)

(Total Workload): - 2 credits x 30 hrs = 60 hrs in semester

Course outcomes:

The students will be able to

CO1: Apply NABL norms for Calibration of instruments

CO2: Perform tests for drinking water as per Food Safety and Standards Authority of India (FSSAI) regulations.

CO3: Analyze Water/butter/cheese/milk products and report if they satisfy FSSAI guidelines.

Unit	Description	Lectures
I	**A. NABL norms for Calibration of:** i. Autoclave- Calibration of pressure gauge and temperature by thermal mapping, sterility testing, SOP preparation. ii. Laminar Air Flow- checking the functioning of UV light by colony count method and sterility checking by blood agar media plate method, SOP preparation.	15
	B. Food Safety and Standards Authority of India (FSSAI) Regulations Test Methods for Drinking Water i. Detection of sulphite-reducing anaerobes (Clostridia) ii. Detection of bacteriophage and titre determination.	15
II	**A. Food Safety and Standards Authority of India (FSSAI) Regulations Test Methods for Water/butter/cheese/milk product for Processed Food Industry:** (perform any two) i. Proteolytic Plate Count ii. Lipolytic Plate Count iii. Thermophillic Bacterial Count (for Dairy Industry-Processing) iv. Slime Forming Bacteria (for Dairy industry-Hot water	15
	B. Food Safety and Standards Authority of India (FSSAI)Regulations for Microbiological Testing of food: i. Fermentation Test (Incubation test for Cans, Tetrapacks, Standypouches). ii. To study food (FSSAI) Regulations for Microbiological Testing of food through industrial visit and writing of report on it.	15

Suggested References 23-MBEP-247: Semester IV Practical based on bioethics, biosafety quality control and quality assurance Choice based Optional Practical Paper (Elective)	
Unit	**References**
I	**A. NABL norms for Calibration of** National Accreditation Board for Testing and Calibration Laboratories (NABL). (2019) Specific Criteria for Accreditation. NABL 112. Issue No: 04 Issue Date:11-Feb-2019
	B. Food Safety and Standards Authority of India (FSSAI) Regulations Test Methods for Drinking Water Manual of Methods for Analysis of Water 2016. Food Safety and Standards Authority of India (FSSAI), Ministry Of Health and Family Welfare Government of India, New Delhi
II	**A. Food Safety and Standards Authority of India (FSSAI) Regulations Test Methods for Water/butter/cheese/milk product for Processed Food Industry:** Manual of Methods for Analysis of Water 2016. Food Safety and Standards Authority of India (FSSAI), Ministry Of Health and Family Welfare Government of India, New Delhi
	B. Food Safety and Standards Authority of India (FSSAI)Regulations for Microbiological Testing of food: 1. Draft manual on method of microbiological testing (2016) microbiology offoods. Food safety and Food Standards. Available at:https://old.fssai.gov.in/Portals/0/Pdf/Microbiological_Testing_Foods_Draft_Manual_06_09_2016.pdf 2. https://archive.fssai.gov.in/home/food-testing/food-testing-manual.html. 3. Manual for Good Food Laboratory Practices (GFLPs). 2018. Food Safety and Standards Authority of India (FSSAI), Ministry Of Health and Family Welfare Government of India, New Delhi

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Progressive Education Society's

Modern College of Arts, Science andCommerce Ganeshkhind, Pune 16

(An Autonomous College Affiliated to Savitribai Phule Pune University)

Two Year Degree Program in Statistics

(Faculty of Science & Technology)

M.Sc. (Statistics) Part-II

Choice Based Credit System Syllabus

To be implemented from Academic Year 2023-24

Structure and code of papers

T: Theory P: Practical O: Open C: Compulsory E: Elective

Semester III						
Course Code	T/P	O/C /E	Title	Credits	ESE Duration	Marks Assigned
23-ST-31	T	C	Applied Stochastic Processes	4	3 Hours	100
23-ST-32	T	C	Design and Analysis of Experiments	4	3 Hours	100
23-ST-33	T	C	Machine Learning	4	3 Hours	100
23-ST-34 (A) 23-ST 34 (B)	T T	E E	Bayesian Inference OR Statistical Quality Control	4	3 Hours	100
23-ST-35	P	C	Practical III	4	3 Hours	100
Total				24		500
Semester IV						
23-ST-41	T	C	Asymptotic Inference	4	3 Hours	100
23-ST-42 (A) 23-ST-42 (B)	T T	E E	Econometrics and Time series OR Operation Research	4	3 Hours	100
23-ST-43 (A) 23-ST-43 (B)	T T	E E	Survival Analysis OR Categorical Data Analysis	4	3 Hours	100
23-ST-44 (A) 23-ST-44 (B)	T T	E E	Computer Intensive StatisticalMethods OR Analysis of clinical Trials	4	3 Hours	100
23-ST-45	P	C	Practical IV + Project	4	3 Hours	100
		Total		24		500

23-ST-31: Applied Stochastic Processes (from 2023-24) (4 credits)

Pre-Requisites: Linear Algebra, Differential equations.

Course Objectives: To study the sequences of dependent random variables, predictions, limiting behavior of such sequences.

Note: Emphasis be given to Applications of Stochastic Processes

Course Outcomes:

After completion of the course students will able to:

CO1) Understand the standard concept and apply the techniques and constructions of discrete andcontinuous time Markov chains to solve problems involving n-step transition probabilities, hitting probabilities, and stationary distributions.

CO2) Understand how to choose best stochastic process for specific situation.

CO3) Distinguish between transient and recurrent states in given finite and infinite Markov chains.

CO4) Apply the stochastic analysis to realistic problems.

CO5) Understand renewal theory and branching processes with applications.

Unit 1:

Stochastic processes, Markov property, Markov chains (MC), utility of stochastic processes and Markov Chain, finite MC, transition probabilities, initial distribution, illustrations such as random walk, Ehrenfest chain, gambler's ruin chain, queuing chain, birth death chain, branching chain, Chapman Kolmogorov equation, n-step transition probabilities, transition probability matrix (t. p. m.) hitting times, probability of ever return, transient and recurrent states, decomposition of state space, closed set of states, irreducible set of states, irreducible MC, absorption probabilities, martingales, classification of states of birth and death chains, , non-null and positive recurrent states, period of state, branching chain, queuing chain, random walk, gambler's ruin chain with absorbing , reflecting and elastic barrier, etc. probability of ruin cases (i) adversary is infinitely rich (ii) stakes are doubled or halved , expected gain, expected duration of the game. (15L)

Unit 2:

Elementary properties of stationary distributions, illustrations such as birth and death chains, Ehrenfest chain, particles in box, average number of visits to recurrent state, probability of absorption in persistent class starting from transient state, existence of uniqueness of stationary distributions, reducible chains, illustrations such as queuing chain finite chains, convergence to the stationary distribution. Steady state distribution, Concept of Ergodicity, utility and explanation with real life situation, Ergodic Markov chain, Ergodic theorem. (Without Proof)

Branching Chain: BGW (Bienayme-Galton-Watson) branching process, offspring distribution,mean and variance, generating function for

probability of ultimate extinction, nth generation size and related recurrence relations. (15L)

Unit 3:

Intensity rates, it's relation with transition probabilities. Kolmogorov consistency condition, Markov property in continuous time stochastic processes. Kolmogorov forward and backward equations.

Poisson process: Postulates and properties of Poisson process, probability distribution of N (t) the number of occurrences of the event in (0, t], Poisson process and probability distribution of inter-arrival time, Generalizations of Poisson process: pure birth process: Yule Furry process. Non- homogeneous Poisson processes.

Birth and death process: (i) Pure-Birth process, Yule Furry Process (ii) Pure death process, particular cases: Birth immigration process. (i) immigration-emigration process, (ii) linear growth process, (iii) linear growth with immigration, (iv) immigration death process. (15L)

Unit 4:

Renewal process: renewal process in continuous time, renewal function and renewal density,renewal equation, stopping time: Wald's equation, elementary renewal theorem and its applications: (i) Age and block replacement policies, (ii) Replacement on failure and block replacement, renewal theorems (Blackwell's and Smith's

Continuous time Markov chains: Markov processes with continuous state space: Introduction to Brownian motion and its properties, Transition probabilities Brownian motion process as limiting case of random walk. Wiener process and its properties. (15L)

Books Recommended:

1. Ross, S. (2000) Introduction to probability models, 7th edition (Academic Press)
2. Medhi J. (1982) Stochastic processes (Wiley Eastern)
3. Hoel P. G., Port, S.C. ,Stone, C.J. (1972) : Introduction to stochastic processes
4. Bhat B. R. (2000) stochastic models: Analysis and applications (New Age International)
5. Adke S.R., Manjunath, S.M. (1984) An introduction to finite Markov processes (Wiley Eastern)
6. Ross, S. (1996) Stochastic processes (John Wiley)
7. Taylor, H N and Karlin, S. (1984): An introduction to stochastic modeling (Academic Press)
8. Vidyadhar G. Kulkarni: Modelling and Analysis of Stochastic systems CRS Press Publications.
9. Tijms S: Stochastic modeling and its Applications, Wiley Publishers.

ST- 32: Design and Analysis of Experiments (from 2023-24) (4 Credits)

Pre-Requisites: Probability distributions, sampling, testing of hypotheses, control charts and inspection sampling plans.

Course Objectives: To learn the basic principles in the design of simple experiments. To learn different tests for comparing pairs of treatment means, factorial experiments, fractional factorial experiments, confounding, BIBD, PBIBD.

Course Outcomes:

After completion of the course students will able to:

CO1) Understand the concept of BIBD, connectedness, balancedness and orthogonality of design.

CO2) Understand the difference between fixed and random effect models.

CO3) Compare the pairs of treatment means using different methods. Construct Fractional factorial experiments and apply confounding in real life problems.

CO4) To use appropriate design for solving real life examples.

CO5) To learn the applications of different designs in agricultural experiments

Unit 1:

One way classification with equal and unequal number of observations per cell, Lenege's test, Bartlet's test, Newman Keuls Test, Duncans Multiple Range Test (DMRT), Dunnet test, Non Parametric One way ANOVA (Kruskal Wallis Test), Friedman test (Non- parametric alternative to the one-way ANOVA with repeated measures), two way classification with equal number of observations per cell (with and without interaction), Missing plot techniques.

BIBD intra block analysis, incidence matrix, symmetric BIBD, resolvable BIBD, (Results related to all types of BIBD), PBIBD with 2 associate classes (PBIBD (2)) (18 L)

Unit 2:

Connectedness, balancedness and orthogonality of design, random effect models for one factor, estimation of variance components and confidence interval for intra class correlation coefficient, random effect model for the two factor, estimation of variance components. 2^k full factorial experiments: diagrammatic presentation of main effects, and first and second order interactions, model analysis using ANOVA, total confounding of 2^k design in 2^p blocks $p \geq 2$, partial confounding in 2^p blocks; $p=2,3$. (15L)

Unit 3:

Fractional factorial experiments, resolution of a design (III, IV & V),

aberration of a design, Plackett- Burman designs. 3^2 designs: contrasts for linear and quadratic effects, statistical analysis of 3^2 design, 3^3 designs: contrasts for linear and quadratic effects, statistical analysis of 3^3 design, blocking of 3^2 in three blocks, blocking of 3^3 in 9 blocks, fractional factorial experiment in 3^p designs in $p = 2, 3$. (15L)

Unit 4:

Response surface methodology (RSM): linear and quadratic model, stationary point, canonical analysis, central composite designs(CCD), ridge systems, multiple responses, concept of rotatable designs, Box- Behnken design for 2 and 3 variables, blocking in Response surface design. Mixture experiments, Simplex lattice design and Simplex centroid design, Taguchi methods: concept of loss function, S/N ratio, orthogonal arrays, triangular tables, linear graphs, inner and outer arrays. (12L)

Books Recommended:

1. Dean, A. and Voss, D. (1999). Design and Analysis of Experiments, Springer.
2. George E. P. Box, Draper N.R. (1987). Empirical Model-Building and ResponseSurfaces, Wiley.
3. Hicks, C.R., Kenneth V. and Turner, Jr. (1999). Fundamental Concepts in theDesign of Experiments, Oxford University Press.
4. John P.W.M. (1971). Linear Models, Wiley.
5. Kshirsagar A.M. (1983). Linear Models, Marcel Dekker
6. Montgomery, D.C. (2001). Design and Analysis of Experiments, Wiley.
7. Ogawa J. (1974). Statistical Theory of the Analysis of Experimental Design,Marcel Dekker.

23-ST-33: Machine Learning (from 2023-24) (4 Credits)

Pre-requisites (Desirable): Knowledge of basic probability concepts and standard probability distributions, Basic concepts of non-linear programming. Knowledge of R-language or Python.

Course Objectives: Machine Learning (ML) deals with the design, analysis and validation of algorithms that enable computers (machines) to learn from data and automatically extract methods to perform intended tasks. Such algorithms that enable machines to learn methods from data are called learning algorithms. It is automatic algorithm development, which enables machines to develop their own algorithms. The input (data) to learning algorithms is called examples. The output from learning algorithms is called models or rules. These models (rules) are used in practice to extract hidden information in large data sets that arise in many application areas. Data Mining refers to this practical use of the ML algorithms. For an applied statistician (now a days known as a data scientist) ML algorithms provide additional set of tools for data analysis,

particularly when data is large. The main objective of this course is to introduce some standard learning algorithms for tasks such as classification, regression, clustering, outlier detection and association finding. It may be noted that this is a course on Statistical Inference – model free Statistical Inference, which can be studied by any one from any discipline.

Course Outcomes:

After completion of the course, students will be able to:

CO1) Apply appropriate learning algorithm for analyzing data.
CO2) Use appropriate R-packages for data analysis.
CO3) Design learning algorithms for new tasks.
CO4) Self-learn many other ML techniques.
CO5) Be a better data scientist.

Unit 1: Introduction to Machine Learning

Need for and meaning of Machine Learning (ML). Various ML tasks. Framework of ML environment .Relationship with other fields such as Data Mining, Statistics, Data Science, Big Data Analytics. Data Cleaning and its importance. (10L)

Unit 2: Classification

Introduction to Classification, construction of Decision/classification tree, Decision Tree Learning – Impurity measures,, tree pruning modifications for regression trees. Ensemble learning-Bagging and boosting, random forests, Cross validation. Naïve Bayes classifier, optimality of Bayes rule. Generative and discriminative approaches to classification problem. Nearest neighbor classifier, SVM Learning. Regression And its various types. Neural Network Learning - basic concepts, Perceptron learning and its limitations. (25L)

Unit 3: Clustering

Introduction to clustering, Types of clustering Cluster learning- k-means algorithm, Agglomerative hierarchical clustering. Cluster quality. Association analysis, market basket analysis, Apriori algorithm. (25L)

****There is Lab work in Practical course for 12 hours in the entire term where in students get opportunity to test the algorithms using R/ Python/ SQL/Software Packages such as Weka.

Books Recommended:

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar (2013) Introduction to Data Mining. (Indian Edition) Pearson Education (Published by Dorling Kindersley (India)
2. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani (2013) An Introduction to Statistical Learning: With Applications in R. (Springer)
3. ShaiShalev-Schwartz and Shai Ben-David (2014) Understanding Machine Learning: From Theory to Algorithms (Cambridge University Press)
4. Han J., Kamber M., and Pei J (2012) Data Mining: Concepts and

Techniques. (Elsevier) (2)Alex Smola and S.V.N. Vishwanathan (2008) Introduction to Machine Learning. (Third Edition) (Cambridge University Press)
5. Ian H. Witten and Eibe Frank (2005) Data Mining: Practical Machine Learning Tools and Techniques. (Second Edition) (Elsevier)

23-ST- 34(A): Bayesian Inference (from 2023-24) (4 credits)

Pre-Requisites: Probability models, parametric and non-parametric inference.

Course Objectives: Estimation using pre-knowledge about the parameters.

Course outcomes: Use these methods and techniques in data mining.

Course Outcome:

After completion of the course students will able to:

CO1) Understand difference between classical and Bayesian appproach

CO2) Bayesian computation

CO3) Credible intervals

Unit 1:

Subjective and frequentist probability , Bayesian inference set up, prior and posterior distributions, loss functions, principles of minimum expected posterior loss, quadratic and other loss functions, advantages of being Bayesian , improper priors ,Common problems of Bayesian Inference, point estimation, maximum aposterior estimator (MAP) ,HPD confidence intervals, credible intervals, predictions of future observations, Bayesian testing. (18L)

Unit 2:

Bayesian analysis with subjective priors, classes priors, conjugate class of priors, Jeffrey's prior, probability matching prior, robustness and sensitivity. (12L)

Unit 3:

Bayesian model selection BIC, Bayes factors, limit of posterior distributions, consistency andasymptotic normality of posterior distributions (12L)

Unit4:

Bayesian computing, E-M Algorithm, MCMC, MH Algorithms, Gibb' sampling, convergence diagnostics. (Note: Minimum 10 hours of computational practice) (18L)

Books Recommended:

1. Bolstad W M (2007).Introduction to Baysian Statistics 2nd edition Wiley.
2. Christensen R. Johnson W. Branscum A. and Hanson T. E. (2011). Baysian Ideas and Data Analysis: An introduction for Scientists and Statisticians , Chapman and Hall
3. Congdon P (2006). Baysian Statistical Modeling, Wiley.

4. Ghosh J. K., Delampady M. and T. Samantha (2006): An Introduction to Baysian Analysis: Theory and Methods, Springer.
5. Jim A (2009) Baysian Computation with R 2nd edition .Springer.
6. Rao C. R. and Day D. (2006). Baysian Thinking Modelling and Computation, Hand book of Statistics Vol.25.Elsevier.

23-ST- 34 (B): Statistical Process control (SPC) (from 2023-24) (4 credits)

Pre-Requisites: Probability distributions, sampling, testing of hypotheses, control charts and inspection sampling plans.

Course Objectives: To understand the basics of TQM. To study different types of control charts and sampling plans. Comparison of control charts. Process Capability study.

Course Outcome:

After completion of the course students will able to:

CO1) To use appropriate control charts

CO2) To use different sampling plans

CO3) To draw inference about process capability

Unit 1:

a) TQM Total quality Management : meaning and dimensions of quality, Quality improvement, Quality Philosophy, Introduction to TQM, six sigma, DMAIC, and other extension of TQM, quality systems, The ISO 9000 and other Quality systems.

b) Control Chart: Revision of theory of control charts, Concepts of stable industrial processes, Systematic variation, random variation, variation within and between subgroups, estimation of process parameters, Equivalence between control chart and testing of hypothesis problem. Choice of control limits Operating characteristic (O C curve) of control chart. Probability of false alarm, probability of catching shift in parameter. Concept of Run length, probability distribution of run length, average run length (ARL). Comparison of control chart using ARL,OC curve, criteria of detecting lack of controls (sensitizing rules),patterns on control charts with justification and its effect on Probability of false alarm. X -S chart with subgroup size (i) fixed (ii) variable, probability limits , S^2 chart Applications of control charts situations other than manufacturing. (15L)

Unit 2:

a) X-bar MR chart

b) CUSUM Chart: Chart statistic (Ci +, Ci −) and chart parameters (k, h), construction and working of tabular CUSUM chart for mean and variance, Statement of hypotheses. Estimation of shift in mean of process. Fast initial response or head start feature, Siegmund's approximation for ARL and determination of chart parameters. CUSUM chart for subgroup size n>1, comparison between Shewhart chart and CUSUM chart V mask procedure.

c) EWMA chart: Chart statistic its expectation and variance. Choice of chart parameters (λ, L). Construction and working of EWMA chart for mean and variance. EWMA chart for subgroup size n>1, Comparison of Shewhart

control charts with CUSUM charts. Simulation of ARL (δ).

d) Process capability: Different Process capability and performance indices Cp, Cpk. Cpm. Properties and relation between capability indices. Connection between proportion of defectives (DPPM) and Cp.Interval estimation of mean given Cpm ≥1.Estimation and confidenceintervals of estimators of Cp

e) and Cpk Testing of hypothesis about Cp. (15L)

Unit 3: Other control charts

a) Synthetic control chart: Confirming run length (CRL) chart for attributes, Synthetic controlchart , computations of chart parameters for given ARL(0),Steady state model, Computationsof ARL (δ), ATS (δ). Comparison of with Shewhart control chart and CUSUM charts.

b) Non-parametric control chart: Concept, construction of non-parametric chart using signtest.Control charts for auto correlated observations: Need, constructions of control chart for residuals after fitting first order auto correlated model.

c) Hoteling T^2Chart: Testing multivariate normality, Hotelling T^2multivariate control chart for mean vector when (i) dispersion matrix is (i) known (ii) unknown ARL (0), ARL (δ). T^2controlchart when subgroup size n=1

d) Control chart for dispersion matrix when mean vector is (i) known (ii) unknown. (15L)

Unit 4:

a) Attribute control charts: Revision of control charts for attributes, OC curve for P chart and C chart. Determination sample size for P chart by various criteria (i) probability of catching atleast 0.5 (ii) to get LCL >0 (iii) To have at least some defectives in sample with given confidence coefficient. (iv) minimizing ATS (δ) chart and O C Curve, U chart

b) Demerit control chart for number of defects.

c) Nelsons control chart for low defect counts.

d) General ideas of economic designing of control charts. Duncan's model for the economiccontrol chart

e) Acceptance Sampling Plan: Description of MIL STD and Dodge Roming sampling plans (i) Acceptance Sampling Plan for attributes with Curtailed inspection: Equivalence between sampling plans and testing of hypothesis problem.

f) Double and multiple and sequential sampling plans for attributes sampling plan, Operatingcharacteristic functions. AOQL, ATI, ASN. Continuous Sampling Plans,

g) Chain sampling plan.

h) Acceptance sampling plan for variable: parameters of plan. (i) Critical distance method,(ii)critical proportion method. (15L)

Books Recommended:

1. Bourke P.D. (1991) Detecting shifts in fraction non – confirming using run length chartwith100% inspection. Journal of Quality Technology 23 (3) 225-230

2. Besterfield, D. H..Besterfield – Michana, c, Besterfield, G. H. Besterfield-Sace, M (2001)TotalQuality Management; Pearson Education (Singapore)

Pte. Ltd. India 2nd Edition.

3. Logotheris, N. (1992) Managing Total Quality; Prentic Hall of India.
4. Montgomery ,D.C. (1985) Introduction to Statistical Quality Control (Wiley)
5. Oakland J.S. (1989) Total Quality Management: Butterworth – Heinemann.
6. Raid W. Amin a Marion R. Reynolds Jr. b; BakirSaadc :Nonparametric quality control charts based on the sign statistic :Communications in Statistics - Theory and Methods Vol.34,2005. 7. Wu, Yeu and Spedding (2001) Asymptotic control charts for detecting fraction non confirming increases JQT 33 (1)104-111

23-ST-35 Practical –III (from 2023-24) (4 credits)

Sr. No.	Title of Experiment
	Practical based on Stochastic Process:
1	Realization of Markov chain when TPM is given and computation of transition probabilities andStationary distribution of Markov chain. Gambler's Ruin problem.
2	Realization of birth and death process.(with constant birth and death rates).
3	Realization of Poisson process by two ways (i) till n Poisson event occur (ii)for fixed length timeinterval(0, t]
4	Realization of Gaussian and Brownian process
	Practical based on Bayesian inference
5A	Bayesian Analysis : i. Plotting prior, posterior density function and likelihood function, ii. Generating random sample from posterior distribution **iii.** Constructing highest posterior density credible interval
6A	Testing of hypotheses by computing Bays factor.
	Practical based on Statistical Process control (SPC)
5B	CUSUM, EWMA charts
6B	Synthetic control chart and Hotelling T^2 chart for mean vector.
	Practical based on Design of Experiments
7	Analysis of one way and two way classification. Multiple comparison tests.
8	**Analysis of BIBD (Intra block analysis) and PBIBD.**
9	2^k Factorial Experiments, analysis of single replicate of 2^k factorial experiments
10	Total and partial confounding in 2^k factorial experiments.
11	Analysis of 3^2 factorial experiments
12	Random effect model with one factor, estimation of variance.
13	Fitting first and second order response surface model, central composite design(contour,surface plots, canonical analysis of stationery points).
14	Taguchi methods: S/N ratio, orthogonal arrays, triangular tables, linear graphs, innerandouter arrays.
	Practical based on Machine Learning (Test the algorithms using R/ Python/ SQL/Software Packages such as Weka.)
15	Implementation of nearest neighbor classifier16 Implementation of Naïve Bayes classifier
16	Implementation of Naïve Bayes' classifier
17	Implementation of k means clustering
18	Implementation of A priori algorithm
19, 20	**Project progress report (equivalent to 2 Practicals)**

23-ST-41: Asymptotic Inference (from 2023-24) (4 Credits)

Course Objectives: Asymptotic analysis has always been very useful for deriving distributions in statistics in cases wherethe exact distribution is unavailable. More importantly, asymptotic analysis can also provide insight into the inference process itself, suggesting what information is available and how this information may be extracted. The asymptotic theory proceeds by assuming that it is possible (in principle) to keep collecting additional data, so that the sample size grows infinitely. Bayesian inference has found application in a wide range of activities, including science, engineering, philosophy, medicine, sport, and law.

Course Outcomes:

After completion of the course students will able to:

CO1) Understand the concept of consistency and asymptotic normality.

CO2) Understand method of moments and percentiles, maximum likelihood to Find consistentestimator and Cramer Huzurbazar theorem.

CO3) Apply likelihood ratio tests, Wald, Score and Bartlett's test in real life situations.

CO4) Compare various tests through relative asymptotic efficiency.

Unit 1:

Consistency: real and vector parameters, Invariance under continuous transformation; Methods of obtaining consistent estimators: method of moments, method of percentiles, mean squared error criterion; Asymptotic relative efficiency, Comparison of consistent estimators, minimum sample size required by the estimator to attain certain level of accuracy, Asymptotic Normality; Consistent Asymptotic Normal (CAN)estimators: real and vector parameters; invariance of CAN property undernonvanishing differentiable transformation. Delta method, Methods of obtaining CAN estimators: method of moments and method of percentiles. **(20L)**

Unit-2

Maximum likelihood estimation, restricted parameter space, Inconsistent MLEs, MLEs in irregular cases. Asymptotic distribution of MLE in special class of distributions: Cramer regularity conditions, Cramer- Huzurbazar theorem, Extension to vector-valued parameters, Super-efficient estimators, BAN estimators, CAN and BAN estimation for multi-parameter exponential family and applications, Solution of likelihood equations, Method of scoring, Newton-Raphson and other iterative procedures. (20L)

Unit-3

Asymptotic theory of tests of hypotheses: Tests based on MLEs, Likelihood Ratio Test (LRT), asymptotic distribution of LRT statistic, Wald Test, Rao'ss coretest, Pearson Chi-square test for goodness of fit, Bartlett's test for

homogeneity of variances, locally most powerful tests.
Variance stabilizing transformations (VST): their existence, their applications in obtaining large sample tests and estimators Asymptotic Confidence Intervals: based on CAN estimators, based on VST. Asymptotic Confidence regions in multi-parameter families. **(20L)**

Books Recommended:

Textbook:

1. Kale, B.K. and K. Muralidharan (2015), Parametric Inference: An Introduction, Alpha Science Intl Ltd.

Reference books:

2. Gupta Anirban Das (2008), Asymptotic Theory of Statistics and Probability, Springer, NewYork.
3. Manoj Kumar Srivastava, Abdul Hamid Khan and NamitaSrivastava (2014), Statistical Inference:Theory of Estimation, PHI Learning Pvt Ltd, Delhi.
4. Bolstad W. M. (2007) Introduction to Bayesian Statistics 2nd Ed. Wiley, New York.
5. Lee P.M. (2004) Bayesian Statistics: An Introduction, Hodder Arnold, New York.
6. Ferguson, T.S. (1996),A course on Large Sample Theory. Chapman and Hall, London.
7. Rao, C.R. (1973): Linear Statistical Inference and its Applications, Wiley, New York.
8. Lehmann, E.L. and Casella G. (1999), Theory of Point Estimation, Springer, New York.

23-ST- 42 (A): Econometrics and Time Series Analysis (from 2023-24) (4 credits)

Pre-Requisites: Linear Algebra, Differential equations.

Course Objectives: **To learn and develop scientific view to understand the time series data and its analysis. To learn stationary and non-stationary, and seasonal and non-seasonal time series models. Estimate model parameters and compare different models developed for the same dataset in terms of their estimation and prediction accuracy. To learn some basic concepts of econometrics.**

Course Outcomes:

After completion of the course students will able to:

CO1) Understand the concept of time series with its components and able to compute ACVF andACF.

CO2) Remove trend and seasonality using different methods to convert the time series **i**nto stationary.

CO3) Apply auto regressive, moving average, ARMA, ARIMA, SARIMA models, Box-Jenkinsapproach to forecast time-series data empirically.

CO4) Check and validate models with its residual analysis and diagnostic checking.

CO5) Apply econometrics concepts in real life data.

Unit 1:

Inference in Econometric Models: Simultaneous equation models – endogenous and exogenous models, Problems with OLS estimators, Identification problem and reduced models. Indirect Least Squares Method, 2 stage and 3 stage OLS estimation. Properties of the estimators. Indirect Inference in Econometric models. (15L)

Unit 2:

Time - series as a discrete parameter stochastic process. Exploratory time Series analysis, Auto covariance and autocorrelation functions and their properties. Methods of estimation and elimination of trend and seasonality: Graphical method, Moving average, exponential smoothing and least squaremethod. Testing the estimated noise sequence: The sample ACF, the Portmanteau tests, the turning point test, the difference sign test and the rank test. Holt -Winters smoothing. Forecasting based on smoothing, adaptive smoothing. (15L)

Unit 3:

Stationary processes: General linear processes, moving average (MA), auto regressive (AR) and autoregressive moving average (ARMA) processes. Causal and non-causal process, Stationarity and inevitability conditions. Non-stationary and seasonal time series models: Auto regressive integrated moving average (ARIMA) models, Seasonal ARIMA (SARIMA) models, Transfer function models (Time series regression). (15L)

Unit 4:

Forecasting in time series models, Durbin-Levinson algorithm, innovation algorithm (without proof).Estimation of mean, auto covariance and autocorrelation functions, Yule-Walker estimation, Estimation of ARIMA models parameters, maximum likelihood method, large sample theory (without proofs). Choice of AR and MA periods, FPE, AIC, AIC, BIC, residual analysis and diagnostic checking. Unit-root non stationarity, unit-root tests (Dickey-Fuller). (15L)

Books Recommended:

1. Brockwell, P.J. and Davis, R. A. *Introduction to Time Series Analysis*, Springer
2. Chatfield, C. (2001). *Time Series Forecasting*, Chapmann& hall, London 3.Chatfield, C. (2007). *Time Series Analysis using R*, Chapmann& hall, London
4. Fuller, W. A. (1996). *Introduction to Statistical Time Series*, 2nd Ed. John Wiley,
5. Hamilton N. Y. (1994). *Time Series Analysis*.Princeton University press. Princeton
6. Kendall, Sir Maurice and Ord, J. K. (1990). Time Series (Third Edition), EdwardArnold.
7. Lutkepohl, H. and Kratzing, M. (Ed.) (2004). *Applied Time Series Econometrics*,Cambridge University Press, Cambridge
8. Shumway, R. H.andStoffer D. S. (2010) Time Series Analysis & Its Applications,Springer, New York.
9. Tsay, R. S. (2010). *Introduction to time series .Wiley.*

23-ST- 42 (B): Operations Research (from 2023-24) (4 credits)

Pre-Requisites: LPP and Transportation problem

Course Outcomes:

After completion of the course students will able to:

CO1) Understand basics and formulation of linear programming problems and appreciate their limitations; solve linear programming problems using graphical method.

CO2) Apply simplex method to solve real life problems.

CO3) Solve artificial variable technique, duality theory, revised simplex method, sensitivity analysis, and transportation and assignment problems.

CO4) Understand the concept of non-linear programming problem, PERT/ CPM, simulation, investment analysis with real life application

Unit 1:

Revision of LPP and Transportation problem : Basic theorems (with proofs **)** related to LPP. Two Phase method, Duality in Linear programming, The Dual simplex method, Revised simplex method, Sensitivity Analysis. Ellipsoid method , polynomial time algorithm, Karmakar's polynomial time algorithm. Convergence and complexity.

Revision of Transportation problem: Post optimality analysis in TP. Dual of the transportation problem, The trans-shipment problem, Assignment model, the travelling salesman problem. (15L)

Unit 2:

Integer linear programming problem: Gomory fractional All integer, Mixed IPP, Branch andBound Method, cutting planes.

Dynamic Programming problem: Formulation of Dynamic Programming problem, Optimal subdivision problem, Solution of LPP by Dynamic programming problem, Application of Dynamic programming problem.sensitivity analysis. Bellman's optimality principle , Stochastic dynamic programming.

Nonlinear Programming Problem: Introduction , Local and Global optimum, Concave and Convex function, Kuhn – Tucker Condition, quadratic programming problem, Wolef's Method, Beales Method. **(22L)**

Unit 3:

Queuing Theory: Introduction, Applications, Waiting time and idle time, classification ofqueuing models, Kendall's notation for queues various queue disciplines.

(i) Model: M/M/1:FCFS/ ∞/∞ Single channel Poisson arrival with exponential Service time, infinite population. Derivation of probability of queue length, system length, waiting time in queue and that in system. Little's formulae (relation)

Cases (a) M/M/1: FCFS/a/∞ **(b)** M/M/1: FCFS/ a/b (a, b are finite). **(c)** Arrival rate is function of queue length (n): $\lambda_n=\lambda/(n+1)$ **(d))** Service rate is proportional to queue length (n):$\mu_n=n\mu$

(ii) Model: M/M/c: FCFS/ ∞/∞ Multi channel Poisson arrival with

exponential Service time, Derivation of probability of queue length, system length, waiting time in queue and that insystem

(iii) Model: M/M/∞: FCFS/ ∞/∞, expected system length and expected waiting time insystem.Equivqlence with Birth and Death process.

Simulation Technique: Introduction, definition, Advantages and disadvantages, Application of Simulation, Monte Carlo simulation, Generation of random number. Acceptance -Rejection method.Simulation from bivariate distributions

Network analysis: Review of CPM, PERT, Network flow, maximal flow, Transportation problemas network, Transshipment Problem as Network, linear programming formulation**.** **(23L)**

Books Recommended:

1.Taha. H.A.(1992) Operation Research 5thed Macmillan
2.Preamkumar Gupta and D.S.Hira
3.Bertsekas. D.(1999) : Nonlinear Programming 2nded Athena Scientific
4.Hadley .G(1987) Linear Programming Addison –Wesley
5.J.K.Sharma : 5thed Theory and applications

23-ST-43 (A): SURVIVAL ANALYSIS (from 2023-24) (4 credits)

Course objectives: The objectives of this course are to study the different models from Survival Analysis, to understand different types of censoring, learn to estimate and interpret survival characteristics.To provide the construction of parametric and non-parametric estimators of survival distributions, and probability density functions based on incomplete data. The models with right- censored, truncated and interval censored data will be considered.

Course Outcomes:

After completion of the course students will able to:

CO1) Understand the concept of censoring, life distributions and ageing classes.
CO2) Gained the ability to recognize the difference between parametric and non-parametric survival models.
CO3) Estimate nonparametric survival function of the data.
CO4) To estimate survival function, cumulative hazard rate function using the so-called Kaplan-Meier estimator.
CO5) Use the test of exponentiality against nonparametric classes in real life problems.

Unit1: Revision

Concepts of time, order and random censoring (left and right), survival function density function, hazard function (rate), cumulative hazard rate, mean residual life function, Equilibrium distribution function. Exponential distribution & it's no ageing properties: Lack of memory property, constant

failure rate, Cauchy-function equation, constant mean residual life function, TTT transform, identity function as a TTT transform

Revision of Ageing classes - IFR, IFRA, NBU, NBUE, DMRL, HNBUE and their duals, and inter relationship among these classes. Bathtub Failure rate.

Life distributions - Exponential Gamma, Weibull, Lognormal, Pareto, linear Failure rate, Makeham family, Lehman families (proportional hazard rate family), spacing, normalized spacing and results of an exponential distribution based on normalized spacing.

Revision of Parametric inference for complete data:

a) Exponential distribution:

b) Weibull: Obtaining MLE of scale and shape parameter of Weibull distribution and sample information matrix.

c) Gamma: Obtaining MLE of scale and shape parameter of Gamma distribution and sample information matrix.

Graphical method for checking exponetiality of data. (20L)

Unit 2:

Parametric inference for censored data:

i) Type I censoring: Exponential distribution

ii) Type II censoring: Exponential, gamma, Lognormal

iii) Random censoring: Exponential, Lehman family, Weibull distribution,

Non-Parametricestimation of survival Function

i) For complete data: Non parametric estimator of distribution function and survival function, distribution of empirical survival function, confidence band for survival function (by Using Kolmogorov – Smirnov statistics)

ii) For censored data: Actuarial estimator of survival Function, Estimator of variance of actuarial estimator (Greenwoods formula), product limit estimator and its variance, redistribution to right algorithm. (20L)

Unit 3:

Test for Exponetiality: Estimable function of degree r, Kernel, symmetric Kernel,U- statistic, variance of U- Statistic, one sample U-Statistic theorem, Hollander and Proschan Test, Test for exponetiality against positive ageing based n sample spacing, Analytical test for exponentiality against NBUE, Deshpande's Test, Two sample U- statistic theorem, Wilcoxon and Mann-Whitney test, Gehan'stest,Mantel-Haenzeltest, Log rank test, concept of covariates Semi-parametric regression for failure rate-Cox's proportional hazards model with one and several covariates. Base line model, link function, likelihood function proportional Hazard Rate model

Nelson-Aalen estimators, introduction to frailty models. (20L)

Books Recommended:

1. Deshpande, J.V, Purohit, S.G.,(2005),Life Time Data :Statistical Models and Methods
2. Klein J. P. and Moeschberger M.L. (1997) Survival Analysis: Techniques for censored andtruncated data.Springer, New York.
3. Collett D (2003) Modelling Survival Data in Medical

research 2nd edition ,Chapman andHall/CRC
4. Cox, D.R. and Oakes, D. (1984) Analysis of Survival Data, Chapman and Hall, New York.
5. Elandt-Johnson, R.E., Johnson N.L. (1980) Survival models and Data Analysis, John WileyandSons
6. Gross A.J. and Clark, V. A. (1975) Survival Distributions: Reliability Applications in theBiomedical Sciences, John Wiley andSons.
7. Miller, R.G. (1981) Survival Analysis,John Wiley andSons.
8. Therneau T M and Grambsch P M (2000) Modeling Survival data extending the Cox model.Springer, New York.
9. Duchateau L Johnson P (2008) The Frailty model. Springer, New York
10. Hanagal D D (2011) Modeling Survival Data using frailty models CRC press

23-ST 43(B) Categorical Data Analysis (from 2023-24) (4 credits)

Course Outcomes:

CO1) Appreciation of difference between linear models and logistic and log-linear models.

CO2) Knowledge of models for categorical data analysis and ability to fit them and interpret the results.

CO3) Awareness of dependence relationships amongst categorical variables.

CO4) Ability to use any related software to fit models for categorical data

Unit 1:

Introduction to Categorical data analysis: categorical response data, Probability distributions for categorical data, statistical inference for discrete data. Contingency tables: Probability structure for contingency tables, comparing proportions with 2x2 tables, odds ratio, tests for independence, exact inference, extension to three way and larger tables (15L)

Unit 2:

Generalized linear models (GLM): GLM for binary data and count data, Statistical inference and model checking, fitting GLMs. Logistic Regression: interpretation, inference, logistic regression withcategorical predictors (15L)

Unit 3:

Multiple logistic regression, building and applying logistic regression model, multi category logit models. Log-linear models for two way and three way tables, inference for log linear models, log linear-logistic connection, independence graphs and collapsibility (15L)

Unit 4:

Models for matched pairs: comparing dependent proportions, logistic regression for matched pairs, comparing margins of square contingency tables. Random effects modeling of clustered categorical data, extension to multinomial responses, hierarchical models. (15L)

Books Recommended:

1. A. Agresti, Analysis of Categorical Data, Wiley, 1990.
2. A. Agresti, An Introduction to Categorical Data Analysis, Wiley, New York, 1996.

3. E.B. Andersen, The Statistical Analysis of Categorical Data, Springer-Verlag, 1990.
4. T.J. Santner and D. Duffy, The Statistical Analysis of Discrete Data, Springer-Verlag, 1989.

23-ST-44(A): Computer Intensive Statistical Methods (from 2023-24) (4 credits)

Course objective: To study the various techniques of computation.

Course outcomes:

After completion of the course students will able to:

CO1) to apply various methods like Bootstrap, Jackknife method.

CO2) To imderstamd MCMC methods for missing values

CO3) Smoothing techniques.

Unit 1:

Bootstrap methods, estimation of sampling distribution, various types of confidence intervals,variance stabilizing transformation, Jackknife and cross-validation, Permutation tests. Bagging and Boosting methods with applications. Cross validation **(15L)**

Unit 2:

Missing Values and Imputations Techniques: Missing values and types of missingness,imputations methods for missing values, single and multiple imputations. MCMC methods formissing values, EM Algorithm and Applications: EM algorithm for incomplete data, EM algorithmfor mixture models, EM algorithm for missing values, stochastic EM algorithm. **(15L)**

Unit 3:

Review of ITM and ARM, Importance Sampling, Metropolis-Hastings andGibbs Sampling algorithms. Particle Filtering, Rejection algorithms for Approximate Bayes Computation(ABC-Rejection). **(15L)**

Unit 4:

Smoothing techniques: Kernel estimators, nearest neighbor estimators,

orthogonal and local polynomial estimators, wavelet estimators, Splines, Choice of bandwidth and other smoothing parameters. Statistical methods for Big Data analysis **(15L)**

Books Recommended:

1.Burren, Stef van (2012). Flexible Imputation of Missing Data. Chapman and Hall.
2.Chihara, L. and Hesterberg, T. (2011) Mathematical Statistics with Resampling and R. Wiley.
3.Davison, A.C. and Hinkley, D.V. (1997) Bootstrap methods and their Applications. Chapman andHall.
4.Effron, B and Hastie, T (2016). Computer-Age Statistical Inference-Algorithms, Evidence andData Science, Cambridge University Press.
5.Gilks, W. R., Richardson, S., and Spiegelhalter, D. (eds.) (1995) Markov Chain Monte Carlo inPractice. Chapman and Hall.

6.Good, P. I. (2005) Resampling Methods: A Practical Guide to Data Analysis. BirkhauserBosel.
7.Jim, A. (2009). Bayesian Computation with R, 2nd Edn, Springer.
8.McLachlan, G.J. and Krishnan, T. (2008) The EM Algorithms and Extensions. Wiley

23-ST-44(B): Statistical Analysis of Clinical Trials (from 2023-24) (4 Credits)

Course objective: To learn ethics of clinical trials, phases of clinical trials, cross over designs

Course Outcomes:

After completion of the course students will able to:

CO1) Learn data collection systems for good clinical practice

CO2) Knowledge of Pharmokintics, pharmodynamics

Unit 1:

Introduction to clinical trials: need and ethics of clinical trials, bias and random error in clinical studies, conduct of clinical trials, overview of Phase I-IV trials, multicenter trials.

Data management: data definitions, case report forms, database design, data collection systems for good clinical practice. Bioavailability, pharmacokinetics and pharmacodynamics, two-compartment model. **(15L)**

Unit 2:

Design of clinical trials: parallel vs. cross-over designs, hybrid design, cross-sectional vs. longitudinal designs, response surface experiments and group allocation design, objectives and endpoints of clinical trials, design of Phase I trials, design of single-stage and multi-stage

Phase II trials. Design and monitoring of Phase III trials with sequential stopping, design of bio- equivalence trials. Inference for2x2 crossover design: Classical methods of interval hypothesis testing for bioequivalence, Bayesian methods, nonparametric methods. **(15L)**

Unit 3:

Power and sample size determination, multiplicative (or log-transformed) model, ML method ofestimation, assessment of inter and intra subject variabilities, detection of outlying subjects.

Optimal crossover designs: Balaam's design, two-sequence dual design, optimal four-period designs, assessment of bioequivalence for more than two drugs, Williams design. **(15L)**

Unit 4:

Designs based on clinical endpoints: Weighted least squares method, log-linear models, generalized estimating equations. Drug interaction study, Dose proportionality study and steady-state analysis, Interim analysis and group sequential tests, alpha spending functions, Analysis of categorical data. (12L)

Books Recommended:

1. Chow S.C. and Liu J.P. (2009). Design and Analysis of Bioavailability and bioequivalence. 3rd Ed. CRC Press.
2. Chow S.C. and Liu J.P. (2004). *Design and Analysis of Clinical Trials*. 2nd Ed. Marcel Dekker
3. Fleiss J. L. (1989). *The Design and Analysis of Clinical Experiments*. Wiley.
4. Friedman L. M. Furburg C. Demets D. L. (1998). *Fundamentals of Clinical Trials*, Springer.
5. Jennison .C. and Turnbull B. W. (1999). *Group Sequential Methods with Applications toClinical Trails*, CRC Press.
6. Marubeni .E. and Valsecchi M. G. (1994). *Analyzing Survival Data from Clinical Trials andObservational Studies*, Wiley.

23-ST 45: Practical + Project (from 2023-24) (4 credits)

Sr. No.	Title of Experiment
	Practical based on Asymptotic Inference:
1	Verification of consistency and asymptotic normality of the estimators
2	Comparing methods of estimation, MSE and sample size considerations
3	Power functions and comparison of tests & confidence intervals (LR, Wald, Rao),
	Practicals based on Econometrics and Time Series Analysis:
4A	a) Smoothing the series using various filters :Other filters, data transfer, Box- Coxtransformation,differencing, checking stationarity and normality after transformation. (b)ACF/PACF, Analysis of series and residuals, residual analysis.
5A	(a) Order selection in time series : Use of A CF/PACF and ATC,BIC, fitting of AR, MAmodels(conditional least squares or maximum likelihood) (b) Fitting of ARMA, ARIMA, SARIMA, models (conditional least squares or maximumlikelihood)
6A	(a) Forecasting using fitted linear models (recurresively) ,Holt-Winters forecasts, constructionofforecast intervals. (b) Fitting heterioscadastic models : Checking for heterioscadecity from residuals , ARCH,GARCH
	Practical based on Operations Research:
4B	Integer programming, Non linear programming
5B	Dynamic programming,
6B	CPM and PERT, Simulation, Simulation of M/M/1 queue.
	Practicals based on Survival analysis:
7A	Parametric analysis of complete data and censored data
8A	Computation of Actuarial estimator of survival function and PL – estimator and their variances.
9A	Tests for exponentiality, Nelson- Aalen estimators.
	Practical based on Categorical Data Analysis:
7B	FittingGLMs and multiple logisticregression
8B	Logistic regression for matched pairs
9B	Log leaner models for two way and three way tables
	Practicals based on Statistical Analysis of Clinical Trials:
10	Testing of hypothesis for various type of clinical trial, Power of the test and sample sizedetermination of clinical trials.
11	Estimate survival function, cumulative survival function using Kaplan and Meier estimatorand comparison of survival function using log rank test.
12	(a). Hypothesis testing and estimation of confidences interval for bioequivalence study,nonparametric methods. (b) Estimation of the Pharmacokinetic parameters clinical trial

	Project (equivalent to 8 Practicals)

Project Guidelines:

1. Project may be done by individual student or in a group of students not more than 3.
2. As far as possible, students should use **LaTeX** for dissertation document preparation and paper presentation.
3. All the students should give their details in writing to the Project Coordinator/HOD just before the commencement of the semester or during the first week of semester. This should contain Names of the group members. Title of the project and name of the guide.
4. The project coordinator/ guide shall declare the dates of two rounds of internal presentations at the beginning of semester itself.

The project guide should meet his/ her group(s) at least once in a week and keep record the meeting, an attendance and the weekly progress of the project. Submit monthly progress report toHOD/ Project co-ordinator.

5. Students should try to use real data sets for their project problems. To the maximum possible extent, text book dada sets should be avoided. If possible, students should conduct actual experiment and generate data (not by simulation) or contact some of the research organizations/ industry to get real data sets or real statistical problems they are trying to solve and be part of that.
6. I**nternal Evaluation:** Guide will work as an internal examiner. There will be two presentations rounds for the Continuous Internal Assessment (CIA). These presentations will be graded out of 15 marks each (by Guide). Students are expected to submit the presentation to Guide at least one day before the presentation. It is advisable that both the presentations shall be attended by all the faculty members and students from other groups.
7. In the first presentation, students are expected to describe their project problem, the data they are going to analyze and the objectives of their project. In addition to this, they should also mention their methodology (without much detail). **Students are to read at least TWO research papers which addresses similar kind of problems and they should include main contents of the papers in their first presentation.**
8. In the second presentation, students should discuss the results of their analysis, finding and new methodology they have introduced (if any). Students should make sure that they have something innovative in their project work.
9. Assessment will also be done on followings aspects. Timely submission of the draft of project report in the proper format which includes (title,

abstract, key words, methodology, conclusion, references, limitations and source of data etc.) is essential.

10. The completed project report in **two copies (one for the candidate and other for examiner)** should be submitted to the Project coordinator / HOD on or before the last day of teaching of the semester. HOD in consultation with guide should ensure that whether the project is **free from plagiarism** and the project is worth presenting finally for end semester examination.

11. There shall be end semester examination for 70 marks (with guidelines similar to practical examination). The individual student or group (as the case may be) will give presentation of the project as per time table for 25 minutes .The final draft of the project report copy should be given to external examiner before presentation. The project shall be evaluated by **one external examiner and (other than the guide; the examiner will be from the other college appointed by SPPU) one internal examiner jointly.**

Aspects of Assessment and marks assigned (The following are the guidelines, somemodification can be done as and when required by the examiners)

Sr. No.	Description	Marks
1	Dissertation in the proper pro forma which includes (Title, abstract, Key words, Methodology, conclusion, references, limitations and source of data etc.)	5 M
2	Appropriateness of tools used for analysis, testing the assumptions needed for analysis. methodology, program coding (if any) and numerical computations.	10 M
3	General understanding about the problem in the project and the two research papers studied	10 M
4	Presentation	5 M
5	Validity of conclusions	5 M
Total		35 M

****After the presentation within two days , students should incorporate all suggestions / corrections suggested by the external examiner as well as the guide and submit the final copy to the department (within two days after the final presentation), failing which he /she will fail the course.

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MODERN COLLEGE OF ARTS, SCIENCE AND COMMERCE GANESHKHIND, PUNE-16

(AUTONOMOUS)

Syllabus for

Two Year M.Sc. Program in ZOOLOGY

(Faculty of Science)

As per the National Education Policy

To be implemented from Academic Year 2024-2025

BOARD OF STUDIES IN ZOOLOGY

Progressive Education Society's
MODERN COLLEGE OF ARTS, SCIENCE AND COMMERCE, GANESHKHIND, PUNE- 16
(AUTONOMOUS)

Preamble

Zoology is a major subject of Basic Sciences which deals with all aspects of animal biology. It includes an interesting range of highly diverse topics. The advancements in biological Sciences demands a zoology student to be a master of many areas in the subject. This Postgraduate degree program has been designed by the Board of Studies in Zoology with a tangible understanding of what is needed from zoologists and what zoologists need to pursue as a skilled career. It emulates closely the Benchmark Statement for Biosciences and the guidelines laid down by the University Grants Commission, New Delhi. This Newly designed Curriculum is an appropriate blend of the classical aspects in Zoology which has been the "backbone" knowledge required for all zoologists and the recent and specialized areas. The flexibility in the Curriculum allows the students to choose their areas of interest leading to enhanced employability. Students will be provided sufficient number of hours for their skill development through the Lab Courses and theProject component. The lab courses have differing flavours and priorities to make a good zoologist. This degree offers specialization in Entomology along with a range of core courses like Biochemistry, Molecular Biology, Comparative Animal Physiology, Developmental Biology, Environmental Biology etc. The field trip/surveys and study tours are included to give the student an enticing taste of what life is specially outside the walls of the classroom. On successful completion of the programme, the students are expected to understand the key life processes of human and other animal groups, the functioning of molecules, cells, tissues, organsand systems. Also the students will gain increased confidence to use initiative and judgement tomake decisions in complex and changeable situations and reflect critically and analytically on personal experience and make informed decisions about further study, training and employmentopportunities. The Master of Science (M.Sc.) in Zoology is a Postgraduate program under the Faculty of Science and Technology. The curriculum designed M. Sc. Zoology encompasses subjects like Physiology, Entomology, Genetics, Cell Biology, Developmental Biology, Endocrinology, Biochemistry, Molecular Biology, Freshwater Zoology, Environmental Biologyetc. Both classical and applied subjects of Zoology have been rightly blended to offer holistic understanding of the subject. The Choice Based Credit System (CBCS) will be implemented through this curriculum. This curriculum would certainly felicitate students to develop a strong base of the fundamentals and specialize in the desired area of their fondness and abilities. The students pursuing this program would get a privilege to select optional subjects of their choice. This curriculum will allow students to acquire the skill in handling scientific instruments planning and performing in the laboratory and exercising critical judgement, independent thinking and problem solving skills.

Instructions for the Students:

The students seeking admission to M.Sc. Zoology course is hereby informed that they are supposed to adhere to the following rules:

1. A minimum of 75 % attendance for lectures / practical is the pre-requisite for grant of term.
2. There shall be tutorial / practical / surprise test / home assignment / referencing of research papers / seminar / industrial visits/Field Visit / training course/viva-voce as a part of internal assessment in each semester. The students are supposed to attend all the tests. The students should note that re-test will not be permitted to the student absent for the test/s unless the case is considered by competent authority.
3. The students opting for dissertation course shall follow the rules framed for the same.
4. The students are supposed to attend all the Industrial Workshops / Laboratory Workshops / Training Programme/ symposia/ seminar/ field visit / study tour organized by the department/ college. The students shall attend these programmes at their own cost.

Eligibility:

The candidate should have a B.Sc. degree with Zoology as principal subject or B.Sc. (General) degree with Zoology as one of the subsidiary subjects. Graduates in any life science related subjects such as Biotechnology, Bioinformatics, Life science, Biochemistry, Microbiology, Agriculture, Veterinary sciences, Biology, Botany etc. Admission: Admissions will be given as per the selection procedure / policies adopted by the respective college, in accordance with conditions laid down by the University of Pune. Reservation and relaxation will be as per the government rules.

Examination

[A] Pattern of Examination Evaluation of Students:

1) The In-semester and End-Semester examinations will be of 20 marks each for 2 credits and 40 marks for 4 credits and for End-semester 30 marks for 2 credits and 60 marks for 4 credits.
2) Student has to obtain minimum of 40 % separately in both the In-Semester and End-Semester.
3) Internal marks remain unchanged and internal assessment cannot be repeated. If student remain absent during internal assessment examination, he/she will have second chance with the permission of the competent authority. But it will not be right of the student. It will be under the discretion of the competent authority and internal departmental assessment committee. In case he/she wants to repeat Internal, he/she can do so only by registering for the said courses.
5) There shall be revaluation of answer script of end semester examination, but not of internal assessment papers.

i. In-semester Examination:

Internal assessment for each course would be continuous and dates for each tutorials/practical tests etc. will be pre-notified in the time table for teaching or placed separately as a part of time table. Department / College Internal Assessment Committee will coordinate this activity.

a) Theory Courses:

Students should be encouraged to participate in various academic activities. A teacher mustselect a variety of the procedures for conducting internal assessment suggested as follows.

a) Multiple choice questions
b) Combination of objective and subjective questions.
c) Open book test (concerned teacher will decide the allowed books)
d) Tutorial
e) Surprise test specified topics in a given notified period
f) Oral

g) Assignments
h) Review of research paper
i) Seminar presentation
j) Journal/Lecture/Library notes Student has to preserve the documentation of the internal assessment except midterm test answer script. It is the responsibility of the student to preserve the documents.

b) Practical Courses:

It is a continuous evaluation process. Practical courses will be evaluated on the basis of the following:

1. Performance assessment of each experiment on the basis of attendance, punctuality, journal completion, practical skills, results, oral and analysis.
2. Assessment on practical course be conducted before the end-semester examination.
3. Assessment of each experiment shall be done for each practical weekly.
4. Assessment of the Activity will be based on any one of the following (per practical course).

i. Special training programs in recognized research institutes such as NCL, NIO, NIV, ZSI, BNHS, etc.
ii. Project on Research Methodology
iii. Industrial/Institution Visit report
iv. Field visit report/ study tour repor.

The student strength of practical batch should be 12
Project Course: Project will be evaluated by the examiner/s in consent with the project guide if required.

ii. End-Semester Examination:

The End-semester examination programme will be scheduled as per the notifications and guidelines issued by the Examination section of University of Pune.

[B] Standard of Passing

Student has to obtain 40% marks separately in In-Semester and End-Semester assessment.

Program outcomes (POs):

After successfully completing the M.Sc. Zoology program students will be able to:

PO1. Zoology knowledge: Apply the knowledge of Zoology, Life Sciences and allied subjects tothe

understanding of complex life processes and phenomena.

PO2. Problem analysis: Identify, review research literature, and analyse complex situations ofliving forms.

PO3. Design/development of solutions: Design processes/strategies that meet the specified needswith appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge andresearch methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in real situations.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources,and ICT tools for understanding of the subject.

Programme Specific outcomes

PSO1: Understand the impact of the natural and anthropogenic activities in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.Identify a range of invertebrates and vertebrates and justify their conservation.

PSO2: Apply ethical principles and commit to professional ethics and responsibilities andnorms of the work/research practice.

PSO3: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Structure with Credit Distribution of the Postgraduate Science Program in Zoology- M.Sc inZoology under NEP to be implemented from 2023-2024

M.Sc First year Zoology

Course type	Course code	SEMESTER I	Course Code	SEMESTER II	Credits
Mandatory major	**ZOO51101**	Biochemistry and biotechniques (4C) (T)	**ZOO52101**	Molecular Biology and Bioinformatics (4C) (T)	4+4
Mandatory major	**ZOO51102**	Cell and Developmental Biology (4C) (T)	**ZOO52102**	Endocrinology and Comparative Animal Physiology (4C) (T)	4+4
Mandatory major	**ZOO51103**	Advanced Genetics (2C) (T)	**ZOO52103**	Parasitology (2C) (T)	2+2
Mandatory major	**ZOO51104**	Scientific Communication (2C) (T)	**ZOO52104**	Environmental Biotechnology (2C) (T)	2+2
Mandatory major	**ZOO51105**	Zoology Lab- I (2C) (P)	**ZOO52105**	Zoology Lab- III (2C) (P)	2+2
Major elective	**ZOO51201**	Limnology (2C) (T)	**ZOO52201**	Neurobiology	2+2
Major elective	**ZOO51202**	Zoology Lab- II (2C) (P)	**ZOO52202**	Zoology Lab- IV (2C) (P)	2+2
RM	**ZOO51301** **ZOO51302**	Research Methodology (2C) (T) Research Methodology (2C)(P)		--	2+2
RP			**ZOO52401**	**OJT/FP- 4C**	4
				Total credits	**44**

M.Sc Second year Zoology

Course type	Course code	SEMESTER III	Course Code	SEMESTER IV	Credits
Mandatory major	**ZOO63101**	Entomology (4C) (T) **OR** Fishery Science	**ZOO64101**	Advanced Entomology(4C) (T) **OR** Fishery management and technology	4+4
Mandatory major	**ZOO63102**	Systematics and Evolutionary Biology (4C) (T)	**ZOO64102**	Mammalian Reproductive Physiology (4C) (T)	4+4
Mandatory major	**ZOO63103**	Insect physiology and Biochemistry (4C) (T)	**ZOO64103**	Arachnology (2C) (T)	4+2
Mandatory major	**ZOO63104**	Special Zoology Lab- I (2C) (P)	**ZOO64104**	Special Zoology Lab- III(2C) (P)	2+2
Major Elective	**ZOO63201**	Immunology (2C) (T)	**ZOO64201**	Histology and Histochemistry (2C) (T)	2+2
Major Elective	**ZOO63202**	Special Zoology Lab- I I(2C) (P)	**ZOO64202**	Special Zoology Lab- IV(2C) (P)	2+2
RP	**ZOO63501**	Research project (4C)	**ZOO64501**	Research project (6C)	4+6
				Total credits	**44**

Course Name: Neurobiology

Course code: ZOO52201

No. of credits: 2

Semester :II

Sr. No.	Name of the topic	Number of lectures
1	**Nervous System: Plan and cellular basis** 1.1 Cells of the Nervous system 1.2 Connection through simple nerve nets Neural circuits - Convergent, divergent and reciprocal neural circuits 1.3 Nervous system components – Central peripheral and autonomous nervous systems, structure of a typical cranial and spinal nerve.	**(08L)**
2	**Neurons and Glia:** 2.1 Introduction to neurons and glia. 2.2 Structural and functional diversity of neurons 2.3 General morphology of a typical neuron 2.4 Types of glia based on their structure and function – Astrocytes, Oligodendrocytes, Microglia and Schwann cells 2.5 Electrical properties of the neuron – signal generation and propagation 2.6 Ionic concentrations, Donnan's equilibrium, equilibrium potential, Nernst equation, Goldman-Hodgkin-Katz equation, Resting membrane potential, Depolarization and hyperpolarization. 2.7 Action potential – generation and propagation 2.8 Electrophysiological techniques to understand the electrical properties of the neuron – Patch-clamp and Voltage-clamp techniques	**(10L)**
3	**Types of synapses – electrical & chemical** 3.1 Chemical Synapse: Neurotransmitter release from presynaptic terminal: 3.2 Depolarization of presynaptic terminal, calcium influx 3.3 Post Synaptic receptors 3.4 Signal transduction and second messenger systems 3.5 Synaptic potentials (graded potentials) and their integration(EPSP, IPSP)	**(06 L)**
4	**Synaptic transmission:** 4.1 Neurotransmitters:, Structure, distribution, metabolism 4.2 Types of receptors, agonist and antagonists 4.3 Molecular mechanisms of action - Acetylcholine, biogenic amines, catecholamines, serotonin, amino acids	**(06 L)**

	4.4 Neurotransmitter discharge by vesicle, exocytosis, synaptic vesicle recycling 4.5 Neuroactive peptides as transmitters.	

Practicals in Neurobiology

1.Demonstration of the nervous system of invertebrate- Cockorach/ Earthworm 1P

2.Demonstration of brain and spinal cord of vertebrate from locally available fish 1P

3.Study of cells of the nervous system using electron micrographs 1P

4.Study of permanent slides of histology of nervous system 1P

5.Preparation of stained sections of brain / spinal cord of any vertebrate tissue. 2P

6.Nissl granule staining of neuronal cell / tissues 2P

7.Whole mount of ganglia of invertebrates 2P

Course Type: Mandatory Major (Special paper- SEMESTER III)

Course Code and Course Name:

ZOO63101: Entomology- I (Special Paper)

4 Credits: 60 Lectures

Semester III

After successfully completing this course, students will be able to:

CO1: Define entomology and Insects and understand origin and evolution of insects and their relation to other arthropods.

CO2: Give outline of Classification of insects up to family with distinguishing characters and examples of each order and family.

CO3: Explain the structure, chemical composition and functions of Integument and Derivatives of Integument.

CO4: Explain the structure, modifications of insect body regions and their appendages.

CO5: Explain the Comparative anatomical and histological structure of various body systems.

Sr. No.	Name of the topic	Lectures allotted
1.	**Introduction to Entomology:** 1.1 Definition 1.2 Origin, Evolution and Inter- relationship of insects with other arthropods.	(04L)
2.	**General outline of Classification and Phylogeny of insects up to family :** 2.1 Apterygote insects (4 orders) 2.2 Exopterygote insects (16 orders) 2.3 Endopterygote insects (9 orders).	(19L)
3.	**Integument:** 3.1 Structure, chemical composition and functions. 3.2 Derivatives of Integument: Cuticular appendages & Processes.	(02L)
4.	**Comparative study of:** 4.1 Head and its appendages	(09L)

	4.2 Thorax and its appendages 4.3 Abdomen and its appendages.	
5.	**Comparative anatomical and histological study of the following:** 5.1 Digestive system 5.2 Respiratory system 5.3 Circulatory system 5.4 Excretory system 5.5 Reproductive system 5.6 Nervous system and Sense organs.	(18L)
6.	**Endocrine and Exocrine glands** 6.1 Hormonal action.	(04L)
7.	**Light and Sound producing organs** 7.1 Thermoregulation in insects 7.2 Insect communication- types of communication in insects	(04L)

REFERENCE BOOKS:

1. A Text book of Entomology-By H. H. Ross (John Wiley and Sons, Ins. New York,).
2. An Introduction to Entomology- By J. H. Comstock (Ithaca, New York).
3. General & Applied Entomology- By K. K. Nayar, T.N. Anathakrishnan & B.V. David, (Tata McGraw-Hill, New Delhi).
4. eneral Entomology, 2nd edition- By M.S. Mani Oxford & IBH Publishing Company, New Delhi.
5. Imm's text book of entomology by O. W. Richards and R. G. Davies (Methuen and com, London) vol. I and II
6. Introduction to comparative Entomology- By R. M .Fox and J. W. Fox (Reinhold, New York)
7. Modern Entomology, 2nd edition- By D. B. Tembhare (Himalaya Publication House, Bombay).
8. Principles of insect morphology- By R. E. Snodgrass (Tata Mc-Graw Hill Bombay).
9. The Insect: Structure & Function- By R. F. Chapman (E.L.B.S., & E.U.P. London).

Course Type: Mandatory Major (Special paper- SEMESTER III)

Course Code: ZOO63101

Course Title: Fishery Science

Course outcomes:

CO1: Understand the common fishes of India.

CO2: Knowledge of the general characters and evolution of fishes.

CO3: Explain the fish morphology, anatomical modifications and physiology.

CO4: Illustrate the physiology of reproductive and endocrine organs in fish.

CO5: Discuss the signs, symptoms and control measures of common diseases in fish.

Sr. No.	Name of the topic	Number of lectures
1	**General characters and Classification of fishes up to orders** 1.1 Major groups of Fishes: Major groups of living Fishes and extinct Fishes – Phylogeny of Fishes	(04 L)
2	**Gross external anatomy of fishes**: Skin and its derivatives, scales and their significance 2.1 Form and function of muscles, gills and gas bladder 2.2 Skeleton – Endoskeleton – Neurocranium and visceral skeleton	(04L)
3	**Locomotion in fishes:** 3.1 Body form and locomotion, fins and locomotion 3.2 Migration of fishes, anadromous and catadromous migrations	(04L)
4	**Fish growth and Age** 4.1 Factors responsible for growth 4.2 Age and growth relationship 4.3 Natural fish food organism & their role in fish growth: Plankton, Benthos.	(04L)
5	**Fish nutrition and digestion**	(08L)

	5.1 Nutritional requirement of fish 5.2 Feed and feed formulation 5.3 Different type of feed 5.4 Artificial feeding 5.5 Natural food of fishes and feeding habits 5.6 Feeding adaptations and stimuli for feeding 5.7 Anatomy and histology of digestive system and physiology of digestion	
6	**Respiratory mechanism:** 6.1 Respiratory gills and lungs. 6.2 Accessory respiratory organs: 6.3 Origin of air breathing organs; skin, buccopharynx, opercular cavity and air bladder	(04L)
7	**Blood vascular system**: 7.1 Circulation of blood, modification in relation to air breathing 7.2 Circulatory system, heart and accessory pumps	(04L)
8	**Excretion and Osmo-regulation** 8.1 Structure and function of the excretory organs – Major excretory products of fishes. 8.2 Osmotic and ionic regulation – acid base balance – Patterns of nitrogen excretion	(04L)
9	**Reproductive system** 9.1 Modes of reproduction, reproductive cycle, structure of gonads and maturity stages 9.2 Spawning seasons and grounds, modes of spawning 9.3 Environmental factors controlling reproduction and factors affecting development.	(04L)
10	**Nervous system and sense organs:** 10.1 Organization of the central and peripheral nervous systems. 10.2 Olfactory, taste buds, touch receptors, photoreceptors, lateral line and internal ear	(06L)
11	**Endocrine system:**	(04L)

	11.1 Pituitary gland, urohypophysis, adrenal gland, gonads, and thyroid gland	
12	**Fish pathology** 12.1 Different fish pathogens: Viral, Bacterial, Fungal and Parasitic 12.2 Different fish diseases: Pathogenic, Nutritional, Parasitic and Environmental. 12.3 Prophylactic measures to control fish diseases.	(10L)

Suggested Readings:

1. Jhingran: Fish and Fisheries of India (1985, Hindustan Publishing Corporation)

2. Khanna and Singh: Textbook of Fish Biology and Fisheries (2003, Narendra Publishing

3. Singh: Advances in Fish Research, Vol. I and II (1993 and 1997, Narendra Publishing House)

4. Srivastava: A Textbook of Fishery Science and Indian Fisheries (1985, Kitab Mahal)

5. Srivastava, Gopalji: Fishes of U.P. and Bihar (2002, Vishwavidyalaya Prakashan)

6. Gupta and Gupta: General and applied Ichthyology (Fish and Fisheries) (2006, Chand)

7. Santhanam: Fisheries Science (1990, Daya Publishing House

8. Cheng, T.C. The Biology of Animal Parasites. Saunders, Philadelphia, 1964.

9. Reichenbach, H.H. Fish Pathology. T.F.H. (Great Britain) Ltd., England, 1965.

10. Conroy, D.A. & R.L. Herman. Textbook of Fish Diseases. Ibid, 1968.

Course Code and Course Name:

ZOO63102: Systematics and Evolutionary Biology(4C) (T)

(4 Credits: 60 Lectures) Semester III

After successfully completing this course, students will be able to:

CO1: Explain principles, methods of biological classification and diversity in kingdom Animalia.

CO2: Explain the importance of taxonomic keys and taxonomic characters.

CO3: Explain the principles of zoological classification and nomenclature

CO4: Discuss the various taxonomic procedures and molecular phylogenetics & phylogeography.

CO5: Illustrate the methodologies used in systematics.

Sr. No	Name of the Topic	Lectures allotted
1	**Science of Biosystematics** 1.1 Concept of Biosystematics. 1.2Terms used in systematic biology 1.3 Historical review of taxonomic philosophies 1.4 Future of taxonomic studies 1.5 Stages in taxonomy 1.6 Tasks of taxonomist 1.7 Systematics as a profession.	07L
2	**Kingdoms of Life:** 2.1 Systematics and taxonomy. 2.2 Importance and basis of classification. 2.3 Heirarchy of classificationand classification systems. 2.4 Types of classification-artificial, natural and phylogenetic 2.5 General outline of kingdoms including Monera & Protista. 2.6 Broad outline & Diversity in kingdom Animalia (Major and Minor Phyla.	08L
3	**Taxonomic Procedures:** 3.1 Collection-Purpose, value, scope of collection 3.2 Content of collection 3.3 Significance of museum collections 3.4 Legal aspects of collecting animals 3.5 Post collection processes. 3.6 Preparation and packaging of specimens of specimen for posting. 3.7 Importance of collections/ museum specimens of the world and India 3.8 Documentation of biodiversity 3.9 Preservation-Methods, taxidermy, factors responsible for the deterioration of museum specimens. 3.10 Curating of collections-museum collection policy, preparation of material for study, housing and cataloging. 3.11 Identification-Systematic process of sorting and labelling, procedure of identification; identification services.	10L
4	**Taxonomic Keys:** 4.1 Types of taxonomic keys, their merits and demerits.	04L
5	**International code of Nomenclature** 5.1 Identification, Description, Naming of taxa. 5.2 Principles and rules of International Code of Zoological Nomenclature (ICZN) 5.3 Binominal system, type material, author citation, 5.4 Criteria for publication, types of names 5.5 Principle of priority and its limitations. 5.6 Curation of taxonomic collections. 5.7 Taxonomic revision. 5.8 Taxonomic literature. 5.9 The relevance of systematics in conservation programmes.	07L
6	**Methodologies in systematics:** 6.1 Morphology based taxonomy, Numerical taxonomy, Cytotaxonomy and chemotaxonomy	06L

	6.2 Molecular systematic, DNA fingerprinting & Molecular markers for detection/evaluation of polymorphism, RFLP, RAPD, etc. 6.3 Evolutionary taxonomy, Molecular phylogenetics & phylogeography.	
7	**History of Origin of life** 7.1 Speciation: Biological Species concept, Subspecies, Monotypic and Polytypic species, Sibling species. 7.2 Isolation: Reproductive and geographical isolation and their role in speciation process (pre mating and post mating). 7.3 Speciation modes–Sympatric, Allopatric and Parapatric. Type concept –name bearing types (primary and secondary) and their applications. 7.4 DNA bar coding for identification of species.	09L
8	**Animal distribution** 8.1 Bathymetric and discontinuous distribution. 8.2 Barriers and dispersals -types and their impact on animal distribution. 8.3 Zoogeographical realms –names and distribution of animal according to Wallace scheme 8.4 Distinct events in evolution: Adaptative radiations with special reference to Darwin's finches. 8.5 Origin of birds. Evolution in horse. Xeric (camel and lizard); Arboreal (sloth bear) adaptation.	09L

Reference Books:

1. Kato., The biology of biodiversity, Springer.
2. Avise J.C., Molecular markers, Natural history and evolution, Chapman and Hill, NY.
3. Wilson A.O., biodiversity, Academic Press, Washington.
4. Principals of systematic Zoology by Ernst Mayr.
5. Futuyama, D. J. (1986). Evolution, Systematics and Animal Behaviour. EvolutionaryBiology. Sinauer Associates Inc.
6. Strickberger, M. W. (2007). Evolution. CBS Pub.
7. Colbert, E. H.; Morales, M. & Minkoff, E. I. (2001). Evolution of the Vertebrates, Science.
8. Moody, P. A. (2002). Introduction to Evolution, Kalyani Pub.
9. Dobzhansky, T.; Ayala, F. J.; Stebbins G. L. and Valentine, J. W. (1979). Evolution,Surjeet Pub.
10. Mayr, E. & Ashlock, P. D. (1991) Principles of Systematic

Zoology (2nd edition) McGrawHill Int.
11. Simpson, G. G. (1962) Principles of Animal Taxonomy, Oxford IBH.
12. Darlington, P. J. (1966) Zoogeography (4th edition) John Wiley.

Course Code and Course Name:

ZOO63103: Insect Physiology and Biochemistry

(4 Credits: 60 Lectures)

Semester III

After successfully completing this course, students will be able to:

Insect Physiology and Biochemistry

CO1: Explain the structure, Chemistry of integument and sclerotization.

CO2: Describe the process of digestion and metabolism

CO3: Explain the characteristics of haemolymph and types of haemocytes.

CO4: Illustrate the structure, physiology and biochemistry of flight muscle.

CO5: Demonstrate the process of excretion, detoxification and water balance

CO6: Justify the role of insect hormones in physiological processes.

Sr. No.	Name of the topic	Lectures allotted
	Insect Physiology and Biochemistry	
1.	**Integument:** 1.1 Structure, Chemistry, cuticle formation, sclerotization, functions.	07 L
2.	**Alimentary canal:** **2.1** Digestion and absorption of proteins, Carbohydrates and lipids 2.2 Functions of the digestive system	07 L
3.	**Gaseous exchange:** 3.1 Tracheal system, spiracles, cutaneous gas exchange 3.2 Respiratory pigments, gaseous exchange in terrestrial, aquatic and endoparasitic insects 3.3 Other functions of the tracheal system	08 L
4.	**Fat body:**	08L

	4.1 Structure, development, physiology, biochemistry 4.2 Functions and role of fat body in carbohydrate metabolism. 4.3 Integration of carbohydrate, fat and acid metabolism	
5.	**Haemolymph:** 5.1 Physico-chemical characteristics of plasma 5.2 Types and structure of haemocytes, functions.	05 L
6.	**Muscle:** 6.1 Structure, physiology and biochemistry of flight muscles	06 L
7.	**Excretion and water balance:** 7.1 Structure and function of Malpighian tubules. 7.2 Water balance and nitrogen excretion.	06 L
8.	**Endocrine system** **8.1** Neurosecretory hormones chemistry, function and mechanism of hormone action, 8.2 Moulting and juvenile hormones 8.3 Chemistry and physiology, other peptide and steroid hormones	08 L
9.	Microsomal and extra-microsomal enzymes insecticide degradation and detoxification.	05 L

REFERENCE BOOKS:

1. Fundamentals of insect physiology, Blum N.S., John Wiley and sons, NY
2. An introduction to insect physiology, Bursell, e. academic press, NY
3. Insect biochemistry and function Candy D.J. and Kilby D.A. Chapman and hall, London
4. Comprehensive insect physiology, biochemistry and pharmacology, Kerkut G.A and Gilbert L.I., Vol 1 to 13 Pergamon press, Oxford, NY
5. The Insects: Structure and Function. Forth ed., Chapman R. F. (1998), Cambridge University Press, UK.
6. Insect Physiology. Prakash, M. (2008), Discovery Publishing House Pvt. Ltd., New Delhi.
7. Physiological Systems in Insects. Second ed., Klowden, Marc (2007), Elsevier, USA
8. The Principles of Insect Physiology, Seventh ed. Wigglesworth, V.B. (1972), Chapman and Hall, London.

Course Code and Course Name:

ZOO63201: Immunology

(2 Credits: 30 Lectures) Semester III

After successfully completing this course, students will be able to:

CO1: Enlist the primary and secondary immune organs.

CO2: Understand the concepts of immunity, self-nonself immune response, autoimmune disease.

CO3: Explain the theories of antibody synthesis and generation of antibody diversity.

CO4: Knowledge of the principle and application of the common techniques used in Immunology

Sr. No.	Name of the topic	Lectures allotted
1.	**Introduction to Immune system.** 1.1. Overview of Immunology 1.2. Innate and Adaptive immunity; Humoral immunity and cell mediated immunity 1.3. Primary and secondary lymphoid organ. Tissue, cells and molecules of the human immune system. 1.4. Immediate response to infection: inflammation, cell migration, acute phase response interferons and NK cell. 1.5. Concept of immunity (self- non self, antigen) and active and passive immunization (natural and artificial)	07L
2.	**Antibody structure** 2.1 Antibody classes, subclasses 2.2 Structure-function relationship 2.3 Iso, Idio and Allo types., T cell receptors.	04L
3.	**Theories of antibody synthesis** 3.1 Generation of antibody diversity (molecular basis) 3.2 Antibody class switching.	03L

4.	**Major Histocompatibility complex (MHC)** 4.1 HLA and disease association 4.2 Immune deficiencies and disorders. 4.3 Antigen processing & Immunogenetics.	05L
5.	**Immunological Tolerance –concept and types** 5.1 Autoimmunity- concept and its types with examples.	02L
6.	**Hypersensitivity** and its types	01L
7.	**Immunological memory** 7.1 Types of vaccines and vaccination	02L
8.	**Immunotechniques** **8.1** Antigen-antibody reaction 8.2 Complement system and complement fixation test.	02L
9.	**Hybridoma principle and application** 9.1 ELISA, immunofluorescence, immunoelectrophoresis, RIA 9.2 Monoclonal-polyclonal antibody and its application.	04L

REFERENCE BOOKS:

1. Immunology: Kindt T. J., Goldsby R.A. , Osborme B. A., Kuby J. : freeman WH publications.
2. Essential immunology, IvonRoitt, Blackwell Scientific publication, London.
3. Immunology, Roitt I. V., Butterworth Publishers, USA.

Course Code and Course Name:

ZOO63104: Special Zoology Lab- I (2C) (P)

(Practicals in Entomology/ Fishery Science, Systematics and Evolutionary Biology)

Semester III

	Module-I: Practical Entomology- I	
1.	Method of collection, preservation & presentation of insects.	**(02P)**

2.	Study of Taxonomy and diagnostic features up to family of Apterygote, Exopterygote and Endopterygote insects (at least one insect from each order). **(Compulsory- 3)**	**(02P)**
3.	Study of generalized insect: Grasshopper/ Cockroach i. Systematic position, Habit, Habitat and Important morphological features. **ii.** Dissection so as to study: Digestive, Nervous and Reproductive system and Retro-cerebral complex. **(Compulsory)**	**(02P)**
4.	Temporary mounting of mouth parts, antenna, legs, wings, spiracles and tympanum of a generalized insect and study of modifications **(Compulsory)**	**(01P)**
5	Study of head capsule: Structure of head capsule, head orientations and modifications. Study of types of mouthparts and antennae. **(Compulsory- 1)**	**(02P)**
6.	Study of abdominal appendages.	**(01P)**
	Module-I: Practicals in Fishery Science	
1.	Demonstration of Digestive system of suitable locally available fish	**(02P)**
2.	Demonstration of Urinogenital system of of suitable locally available fish	**(02P)**
3.	Study of Weberian ossicles of *Catla*	**(01P)**
4.	Mounting of the different types of scales of fishes.	**(01P)**
5.	Study of Gill rakers of fishes of different feeding habit.	**(02P)**
6.	Study of Pharyngeal teeth in fishes.	**(01P)**
7.	Determination of RLG and Gut content analysis	**(01P)**
8.	Gonado Somatic index/ Condition factor/Fecundity of *Rohu, Catla, Mrigal*.	**(02P)**
	Module-II: Practicals Systematics and Evolutionary Biology	
1.	To Study specimens of Minor phyla. **(Compulsory)**	**1**
2.	Study of museum specimens and slides of invertebrates, (2 examples from each phyla). **(Compulsory)**	**2**
3.	Study of museum specimens (protochordates and chordates,1or 2 examples of each phyla) **(Compulsory)**	**2**
4.	Identification of animals with the help of keys-House fly, Honey bee etc. **(Compulsory)**	**1**
5.	Identification of animals with the help of keys- Cockroach, Earthworm.	**1**
6.	Method of collection, Preservation, and Curetting of any insect Specimen	**2**

	(Compulsory)	
7.	Visits to Scientific Institute like Zoological Survey of India/ Animal Museum and Report writing.	**2**

Course Code and Course Name:

ZOO63202: Special Zoology Lab- I I(2C) (P)

(Practicals in Insect Physiology Biochemistry and Immunology)

Semester III

	Module-I: Practicals in Insect Physiology and Biochemistry	No. of practicals
1.	To Study specimens of Minor phyla. **(Compulsory)**	**1P**
2.	Study of museum specimens and slides of invertebrates, (2 examples from each phyla). **(Compulsory)**	**2P**
3.	Study of museum specimens (protochordates and chordates,1or 2 examples of each phyla) **(Compulsory)**	**2P**
4.	Identification of animals with the help of keys-House fly, Honey bee etc. **(Compulsory)**	**1P**
5.	Identification of animals with the help of keys- Cockroach, Earthworm.	**1P**
6.	Method of collection, Preservation, and Curetting of any insect Specimen **(Compulsory)**	**2P**
7.	Visits to Scientific Institute like Zoological Survey of India/ Animal Museum and Report writing.	**2P**
	Module-I: Practicals in Immunology	

Sr. No.	**Name of the topic**	**Lectures allotted**
1.	Double diffusion or Ouchterlony technique (using kit). **(Compulsory)**	(2P)
2.	Demonstration of Immunoelectrophoresis (using kit). **(Compulsory)**	(2P)
3.	Histology of lymphoid organs: skin, spleen, thymus, ileum lymph node and bone marrow. **(Compulsory)**	(1P)

4.	To study the differential count of WBCs. **(Compulsory)**	(1P)
5.	Cell counting and viability testing using splenocytes (from goat spleen)	(2P)
6.	To estimate the antigen concentration by rocket electrophoresis (kit using). **(Compulsory)**	(2P)
7.	To study the immunology of blood transfusion (universal donor, universal recipient, Bombay blood group and erythroblastosis foetalis). **(Compulsory)**	(1P)
8.	Demonstration of Various routes of egg inoculations for vaccine production using dye. (amniotic, yolk sac, allantoic and chorio-amniotic)	(1P)

Course type: Mandatory major (Special Paper- Semester IV)

Course Code and Course Name:

ZOO64101: Advanced Entomology(4C)

(4 Credits: 60 Lectures) Semester III

After successfully completing this course, students will be able to:

CO1: Explain Gametogenesis, Fertilization and oviposition.

CO2: Explain embryonic developmental stages such as Cleavage, Blastoderm and Germ band formation; Gastrulation, Blastokinesis, differentiation of germ layers, Segmentation and Appendages formation and organogenesis.

CO3: Explain post-embryonic developmental stages such as Nymph, Naiad, larva, Pupa and Metamorphosis.

CO4: Explain specialized reproductive mechanisms.

CO5: Explain Hadorn's experiments with imaginal disc, Regeneration and Aging. CO6: Explain Occurrence initiation, Preparations for diapauses and its Controls.

Sr. No.	**Name of the topic**	**Lectures allotted**
1	General outline of classification and phylogeny of insects upto family of Exopterygote insects (16 orders)	**(08L)**
2.	**Gametogenesis :** **2.1** Spermatogenesis, Seminal transfer and spermatophore formation 2.2 Oogenesis, Structure and Types of insect eggs. Fertilization and oviposition.	**(08L)**

3.	**Insect embryonic development:** **3.1** Cleavage and Blastoderm formation 3.2 Germ band formation 3.3 Gastrulation, Embryonic membranes, Blastokinesis 3.4 Dorsal closure and dorsal organ 3.5 Fate/ differentiation of germ layers 3.6 Segmentation, Appendages formation and organogenesis in brief.	**(10L)**
4.	**The post embryonic development:** Eclosion from the egg. 4.1The developmental stages: Nymph, Naiad, larva, Pupa, Emergence from the pupa/ cocoon. 4.2 Metamorphosis and Growth, hormonal control of metamorphosis in insects, different types of insect pheromones and its function	**(14L)**
5.	**Types of reproduction and Specialized reproductive mechanism:** **5.1** Oviparity, viviparity, polyembryony, paedogenesis and parthenogenesis.	**(05L)**
5.	**Hadorn's experiments with imaginal disc** 5.1 Regeneration and Aging. 5.2 Determination and pattern formation in the imaginal discs of *Drosophila*	**(07L)**
6.	**Diapause:** Occurrence, Initiation and Preparations for diapauses. 6.1 Diapause development and Controls 6.2 Difference between quiescence and diapause 6.3 Hormonal regulation of diapause and development in insects	**(08L)**

REFERENCE BOOKS:

1. 'The Insect- structure and Function'- by R.F. Chapman , ELBS, London
2. 'A Text book of Entomology'- by H. H. Ross (John Wiley and Sons, Ins. New York,
3. 'Imms' Text Book of Entomology- by O. W. Richards and R. G. Davies, (Methuen &Cc., London,), Vols. I & II.
4. 'Embryology of Insects and Myriapods'- by O. A. Johanson and F.H. Butt, (McGraw Hill, New York,).
5. 'The ecology of insect populations in theory and practice'- by L.R. Clarks P. W. Geier, R.D. Hughes, R.F. Morris (Methuen, London).

6. 'Developmental system: Insects' Vol. I and II- by S. J. Counce and C.H. Waddington (Academic Press, London,).

Course type: Mandatory major (Special Paper- Semester IV)

Course Code and Course Name:

ZOO64101: Fishery management and technology (4C)

(4 Credits: 60 Lectures) Semester III

Course outcomes:

CO1: Knowledge of different sophisticated cutting edge techniques such as craft, gears, different fish detection methods used in aquaculture and fisheries

CO2: Understanding of the different techniques of fish preservation and processing.

CO3: Knowledge of the use of fish by-products.

CO4: Analysis of financial matters related to fisheries and idea to develop for the betterment of fisherman.

CO5: Knowledge of advanced techniques used in aquaculture and fisheries.

Sr. No.	Name of the topic	Number of lectures
1	**Introduction and scope of fisheries in India** 1.1 Types of fisheries : Inland and Marine Riverine fisheries: Major river systems in India, ichthyofauna, and recent catch statistics. Problems encountered in fisheries 1.2 Cold water fisheries: Cold water fishery resources of India. Representative species of fishes of cold water bodies of India. 1.3 Reservoir and Lacustrine fisheries: Definition and ecological features of reservoirs and lakes. Major reservoirs and lakes in India with emphasis on capture fisheries. 1.4 Estuarine fisheries: Definition and classification of estuaries, capture fisheries resident and migrant species, Fisheries of brackish water lake and backwaters. Problem of brackish water fishery. 1.5 Marine fishery resources in India: Marine capture fishery resources at inshore, offshore and deep sea. EEZ, PFZ and continental shelf, maritime states in India. 1.6 Conservation of marine fishery resources: Deep sea fishing policies of India.	(10 L)

	1.7 Problems of overfishing. Conservation and management of marine fishery resources.	
2	**Fishing gears and crafts** 2.1 Biological factors in fishing 2.2 Types of fishing gears 2.3 Preparation and maintenance of fishing nets 2.4 Types of fishing crafts and methods	(04L)
3	**Fish Population Dynamics** 3.1 Fish populations and factors affecting the population structures 3.2 Estimation of fish yield and control of over-fishing	(03L)
4	**Fish culture:** 4.1 Selection of cultivable fish, monoculture(unisex culture), composite culture, culture of Indian major carps 4.2 Culture of common carps, culture of cat fishes, paddy cum fish culture, mari culture, cage culture, integrated fish farming	(04L)
5	**Induced Breeding of Fishes:** 5.1 History of hypophysation. Methods of pituitary extract preparation, dosage determination, injection to the brood fishes, spawning and hatching. 5.2 Use of different synthetic hormones and analogues for induced spawning - Stripping and fertilization. 5.3 Bundh breeding, types of bundh breeding techniques and problems of bundh breeding.	(04L)
6	**Hatchery Technology of fishes:** Indian Major Carps, *Tilapia* and Trout hatchery. 6.1 Design and function of incubators, glass jar hatchery, Chinese hatchery and other hatchery systems. 6.2 Hatchery technology for different species: Indian major and minor carps, Exotic carps, Catfishes, Tilapia, Mahseer and Trout. 6.3 Marine fish seed production: Seabass, milkfish, mullets, cobia and silver pompano	(05L)
7	**Post Harvest Technology and Marketing strategies:** 7.1 Principles and importance of fish preservation.	(05L)

	7.2 Fish spoilage- post mortem changes and rigor mortis, post rigor spoilage. Methods of fish preservation- Icing, Freezing, Cold storage, Drying, Salting, Smoking, Canning and Fish Pickling. 7.3 Fish transportation: Recent advances in the process of transportation 7.3 Fish product and Byproduct: Fish Oil, Fish liver oil, Fish meal, Fish manure, Fish flour, fish glue, isinglass.	
8	**Quality Assurance and Export of Fishery Products:** 8.1 Quality control – basic concepts, quality and quality control. 8.2 Sanitation procedures in seafood processing plants. 8.3 Waste management in fish processing industries. Risk factors in seafood biotoxins, seafood pathogens, endogenous parasites. 8.4 Methods of evaluating fish freshness and quality – organoleptic, physical, chemical, microbiological and instrumental methods. 8.5 Quality control programmes - pre-shipment inspection, IPQC, MIPQC, HACCP and ISO Series in seafood industry. 8.6 Quality standards in India and major importing countries like USA, Japan and EU. 8.7 Export of fishery products from India – major countries, important products, export documents and procedures.	(05L)
9	**Ornamental Fish production and management:** 9.1 Different varieties of exotic and indigenous ornamental fishes. 9.2 Principles of a balanced aquarium. 9.3 Fabrication, setting up and maintenance of freshwater aquarium. 9.4 Water quality management. Water filtration system – biological, mechanical and chemical.	(04L)
10	**Introduction To Aquaponics** 10.1 Principles of aquaponics; biological components and water quality of aquaponics 10.2 Different types & techniques of aquaponics- media bed technique, nutrient film technique, deep water culture technique; installation of indoor aquaponics unit 10.3 Fish and Plant health management, monthly activities. Design & management of hydroponic system, integrated hydro-aquaponics.	(04L)
11	**FAD's, Fish finding devices and conservation:**	(04L)

	11.1 Fish aggregating devices and artificial reefs; Impact of artificial reefs on fish stock improvement; By-catch Reduction Devices (BRD). 11.2 Fish finder, GPS navigator, sonar, gear monitoring equipment; remote sensing.	
12	**Fisheries training and education in India:** 12.1 Training Institutes, Universities, Research Organizations, etc. 12.2 Institutional funding to fisheries and aquaculture sector 12. 3. Socio-economic conditions of fishermen and fish farmers 12.4 Fishermen Co-operative Societies Role of government agencies – Role of NABARD and other central government agencies in the upliftment of fisher folk. 12. 5 Role of state government agencies in various fishery activities – Loans and credits, policies 12. 6 Integrated coastal zone management, ocean policy, role of NGO's CRZ	(04L)
13	**Responsible Fisheries and Fisheries Legislation:** Concept of Responsible Fisheries 13.1 Monsoon trawl ban, closed season, mesh size regulations, juvenile fishing 13.2 Economic Zone (EEZ), Coastal Regulation Zone (CRZ), Integrated Coastal Zone Management (ICZM). MSY, MEY, Over fishing, Recruitment over fishing 13.2 Aqua-ranching. Indian fisheries Act.1976. Coast Guard Act.1978, Maritime zones of India Act.1981.	(04L)

Recommended readings:

1.CRC Hand Book of Mariculture Crustacean Aquaculture : James P.Mcvey

2. Selection and Breeding Programs in Aquaculture : Trygve G. Jedrem

3. Pond Aquaculture Water quality Management : Claude E. Boyd & C.S.Tucker

4. General & Applied Ichthyology: S. K. Gupta & P.C. Gupta

5. Marine Aquaculture , Opportunity for Growth: National Research council

6. Text Book of Fishery science And Indian Fisheries : C.B. L. Shrivastava

7. Fish & Fisheries of India : V.G. Jhingran

8. Pillay, T. V. R. (1993). Aquaculture. Fishing News Books.

9. Srivastava, C. B. L. (1999). Fish Biology. Narendra Pub. House.

9. Ayappan,S.(2011):Hand book of fisheries & Aquaculture, ICAR Publication.

Course Code and Course Name:

ZOO64102: Mammalian Reproductive Physiology

(4 Credits: 60 Lectures)

Semester IV

After successfully completing this course, students will be able to:

Mammalian Reproductive Physiology

CO1: Explain the male and female reproductive systems and sexual dimorphic characteristics

CO2: Explain the sexual cycles with examples CO3: Illustrate the reproductive dysfunctions.

CO4: Diagrammatically represent the hormonal regulation of reproductive processes like pregnancy, lactation and parturition.

CO5: Prepare the flow chart to demonstrate the hormonal coordination of reproductive Processes

CO6: Justify the artificial control of reproduction.

Sr. No.	Name of the topic	Lectures allotted
	Mammalian Reproductive Physiology	
1.	**Reproductive Systems:** 1.1 Anatomy of Male Reproductive System 1.2 Accessory organs and their function Spermatogenesis, Function of Sertoli cells 1.3 Blood Testis barriers, inhibin, Leydig cell, Capacitation. 1.4 Functions of Androgens.	08L
	1.5 Anatomy of Female Reproductive System.	
2.	**Reproductive patterns:** 2.1 Environmental factors and breeding, continuous and seasonal breeders.	04L
3.	**Sexual cycles:** 3.1 Puberty, oestrous and menstrual cycles and its hormonal regulation. 3.2 Ovarian cycle and its hormonal regulation. 3.3 Cycling of non-pregnant uterus and vagina.	06L
4.	**Hormonal regulation:**	08L

	4.1 GnRH, pituitary gonadotropins, behavioural effects 4.2 Testicular hormones, testosterone derivatives, inhibin 4.3 Ovarian hormones: Pituitary gonadal axis 4.4 Oestrogen, progesterone's feedback relationships 4.5 Prostaglandins and their role in reproduction.	
5.	**Fertilization and Gamete Transportation** 5.1 Pregnancy: conception and blastocyst formation 5.2 Implantation and delayed implantation 5.3 Hormonal regulation in pregnancy.	08L
6.	**Placenta:** formation 6.1 Types and functions	06L
7.	**Parturition;** birth process 7.1 Ferguson reflex, neuroendocrine control, purperium	05L
8.	**Lactation:** 8.1 Anatomy and growth of mammary glands 8.2 Lactogenesis and galactopoiesis. 8.3 Hormonal regulation and suckling reflex	04L
9.	**Reproductive dysfunctions:** 9.1 Aging and reproduction. 9.2 Climacteric, anatomical, endocrine and genetic disorders.	03L
10.	**Artificial control of reproduction:** increasing reproductive potential 10.1 Artificial insemination 10.2 In vitro fertilization and embryo transfer 10.3 Induced breeding 10.4 Physical, physiological, surgical, chemical methods of contraception in male, female. 10.5 Infertility: its causes and treatment, 10.6 Recent advances in female contraception. 10.7 Prenatal diagnostic test for genetic disorders-foetal ultra-sonography, Amniocentesis, Chorionic villi sampling,	08L

Course Title: Arachnology (2C) (T)

Course Code: ZOO64103

Course outcomes:

- Knowledge of the different types of arachnids with respect to their morphology and anatomy
- Understanding the fundamentals of arachnid biology
- Evaluation of all families, and typical genera and species of arachnids
- Analysis of field sampling techniques specific for arachnid fauna
- Application of the methods and concepts in field and laboratory based arachnid experimental research.

Sr. No.	Name of the topic	Number of lectures
1.	**Arachnid Taxonomy and Classification:** 1.1 Definition- Outline to the taxonomy and classification in brief 1.2 Acariformes: Characteristics, morphology and taxonomy 1.3 Introduction to the classes and representative types- scorpions, mites, spiders, pseudoscorpions and harvestmen	**(07 L)**
2.	**Arachnid Anatomy:** 2.1 Introduction to the arachnid anatomy	**(03 L)**
3.	**Arachnid physiology:** 3.1 Digestive system and diet preferences 3.2 Respiratory system: organs and structure 3.3Reproduction and adaptations 3.4Circulatory system 3.5Nervous system	**(10 L)**
4.	**Introduction to Order Araneae and Order Palpigradi** 4.1 Definition, characteristics, life cyle, phylogeny	**(03L)**
5.	**Arachnid Ecology** 5.1 Features and facts 5.2 Methods of field collection of Arachnids	**(04 L)**

	5.3Methods of laboratory preservation	
6.	**Arachnids as pests** **(03)** 6.1 Pests of crops – identification, Life cycle and management 6.2 Control measures – physical, mechanical and biological	

References:

- Mason, Adrienne 1999. The World of the Spider. Sierra Club Book, S.F. Stunning photos, well informed text, I was her consultant.
- Preston-Mafham, R. & K. 1984. Spiders of the World. Facts on File, NY.
- Preston-Mafham, K. & R. 1996. The Natural History of Spiders. Crowood Press, UK Beautiful photos, interesting text.
- Foelix, R.F. 1996. Biology of Spiders. 2nd Ed. Oxford University Press, NY. Most authoritative arachnology text, but dry reading.
- Gertsch, W.J. 1979. American Spiders. 2nd Ed. Van Nostrand Reinhold, NY.
- Fauna of India, Zoological Survey of India, Tikader and Bastawade
- Field guide to spider genera of India- Ayan Mondal, Debomay Chanda, Atul Vartak
- Arachnids- Janet Becaloni

Course Title: Histology and Histochemistry(2C) (T)

Course Code: ZOO64103

After successfully completing this course, students will be able to:

CO1: Explain the fundamental tissues in details.

CO2: Describe the process of histological preparations. CO3: Illustrate the tools used in histological preparations.

CO4: Justify the use of various stains and dyes used in histochemical detection of biomolecules.
CO5: Justify the importance of Immunohistochemistry.

CO6: Draw the structures of various tissues and label them.

Sr. No.	Name of the topic	Lectures allotted
1.	**Scope and importance of Histology and Histochemistry** 1.1 Fundamentals of histology: Epithelial, connective, muscular, nervous and other specialized tissues.	05L
2.	**Tools in histology:** 2.1 Principles, design and functioning of microtomes, automated microtomes, ultra-microtome, cryostat, problems and troubleshooting.	04L
3.	**Techniques in histology**: 3.1 General principles for the preparation of Tissue for Histological studies. 3.2 Fixation – Principle, Aims and Objectives of fixatives. Chemical action of fixatives on cells and tissue components 3.3 Processing of fixed samples, dehydration (procedure and significance), embedding, block making, 3.4 Temporary and permanent preparations, whole mount preparation	05L
4.	**Staining** (staining methods histochemical and immunohistological methods) 4.1 Dyes and dye binding reactive groups, mordants and mordanting	02L
5.	**Fundamentals of histochemical techniques:** 5.1 Histochemical classification of Carbohydrates and Principle for the Identification of Carbohydrates- glycogen (Periodic acid/Shift method (PAS)	02L
6.	**Histochemical localization of Mucopolysaccharides** by KMNO4/AB and PAS method.	02L
7.	**Histochemical classification of Proteins** 7.1 Principles and mechanism for the identification of total Proteins and Glycoproteins (Bromophenol Blue & Congo red method). 7.2 Importance of Enzyme histochemistry. -Localization of enzymes in tissues, Alkaline and Acid phosphates.	04L
8.	**Histochemical localization of Nucleic Acids**, DNA and RNA (Feulgen reaction &Pyronin method).	02L
9.	**Application of Histochemical methods** for the detection of various types of Carcinoma and Immunofluorescent techniques	02L

10.	**Histochemical classification of Lipids**. 10.1 Principle for the demonstration of Lipids in various animal tissues (Copper pthyalocyanin method and Sudan Blank- B method)	02L

Reference books: -

1. Text book of Histology Roland lesson DL. WB Saunders Company, Tokyo.
2. Histology: Roland lesson and Thomas Leesan WB Saunders company Co., Canada
3. Histochemistry Vol. I II III A G E pearse Churchill Livingstone NY
4. Histochemistry in Focus,A source book of Technics and Research needs (2007), K.Shyamasundari and K.Hanmantha Rao,MJP Puplishers,Chennai.
5. An introduction to Functional Histology, Bourne, G.H. (1988), Churchil, London.
6. Histochemical Techniqes, Cassilmann,W.G.B (1988), Methuen, London

Course Code and Course Name:

ZOO64104: Special Zoology Lab- III(2C) (P)

(Practicals in Advanced Entomology/ Fishery Management and Technology, Mammalian reproductive physiology)

Semester III

	Module- I : Practicals in Advanced Entomology	
1.	Histological studies of male reproductive system (Testes, Vas deference, Ejaculatory duct, Accessory gland and spermatogenesis). **(Compulsory)**	**(01P)**
2.	Histological studies of female reproductive system (Ovariole, lateral oviduct, common oviduct, Accessory glands, bursa copulatrix, spermatheca). **(Compulsory)**	**(01P)**
3.	Study of types of Eggs in insects. **(Compulsory)**	**(01P)**
4.	Early embryology of insect: cleavage, blastula, germ band, gastrula, embryo- 1 day old, 2 day old and 3 day old in suitable insect.	**(01P)**
5.	Study of post embryonic development of insects: Collection and study of types of Nymph, naiads, larvae and pupae. **(Compulsory)**	**(02P)**

6.	Dissection of Grasshopper: The digestive system, Nervous system, Male and Female Reproductive System; Temporary mountings of antenna, halter, legs and ovipositor. **(Compulsory)**	**(03P)**

	Module-I: Practicals in Fishery Management and Technology	No. of practicals
1.	Identification of important fish species of brackish water, fin-fishes and shellfish and their seed.	1P
2.	Identification of fishing crafts, gears, fishing accessories, (floats/sinkers/hook/synthetic and natural fibres, twines, ropes, iron wares).	1P
3.	Analysis of water parameters (Pond water, riverine water, lake water) by titration	2P
4.	Determination of D.O, Free CO2, Total alkalinity, Total Hardness, Salinity, Organic Carbon, Nitrogen, Phosphate, Sulphate, Chloride, BOD, COD	2P
5.	Histological techniques: Preparation of Permanent Histological slide of infected organs of fishes.	2P
6.	Dissection and collection of fish pituitary gland, preservation, extract preparation, doses determination and injection to the brood fishes.	2P
7.	Analysis of Data, Drawing of Graphs, Charts, Histograms in relation to abundance and catch particular of fish.	1P
8.	Field visit of any places of east coast and west coast of India in respect of marine fisheries / Aquaculture/ Fish processing industry	2P

	Module-I: Practicals in Mammalian reproductive physiology	
Sr. No.	**Name of the topic**	**Lectures allotted**
1.	Double diffusion or Ouchterlony technique (using kit). **(Compulsory)**	(2P)
2.	Demonstration of Immunoelectrophoresis (using kit). **(Compulsory)**	(2P)
3.	Histology of lymphoid organs: skin, spleen, thymus, ileum lymph node and bone marrow. **(Compulsory)**	(1P)
4.	To study the differential count of WBCs. **(Compulsory)**	(1P)
5.	Cell counting and viability testing using splenocytes (from goat spleen)	(2P)
6.	To estimate the antigen concentration by rocket electrophoresis (kit using). **(Compulsory)**	(2P)
7.	To study the immunology of blood transfusion (universal donor, universal recipient, Bombay blood group and erythroblastosis foetalis). **(Compulsory)**	(1P)

8.	Demonstration of Various routes of egg inoculations for vaccine production using dye. (amniotic, yolk sac, allantoic and chorio-amniotic)	(1P)

Course Code and Course Name:

ZOO64202: Special Zoology Lab- IV(2C) (P)

(Practicals in Arachnology, Histology and histochemistry)

Semester III

	Module- I : Practicals in Arachnology	
1.	Study of representative arachnid groups- taxonomy and phylogeny	(02P)
2.	Identification of arachnids with a suitable dichotomous /pictorial key	(02P)
3.	Study of mite/ scorpion/spider digestive system	(01P)
4.	Study of mite/ scorpion/spider nervous system	(01P)
5.	Study of mite/ scorpion/spider urinogenital system	(01P)
6.	Study of arachnid pests of crops	(02P)
7.	Study of control measures of arachnid pests- physical, mechanical and biological	(01P)
8.	Field visit and collection of representative arachnid groups (Submission of 5 specimens)	(02P)

	Module-I: Practicals in Histology and Histochemistry	**No. of practicals**
1.	Study of different types of tissue with help of permanent slides **(Compulsory)**	(2P)
2.	Preparation of different reagent/stains for histology **(Compulsory)**	(2P)
3.	Block preparation and sectioning **(Compulsory)**	(2P)
4.	Effect of fixatives, fixation of tissues	(1P)
5.	Comparative study of effect of fixative on a given tissue	(1P)
6.	Mucolpolysaccharide staining, AB pH 1.5, 2.5 **(Compulsory)**	(1P)
7.	Proteins and lipid staining by Sudan black **(Compulsory)**	(1P)
8.	Nucleic acid staining: methyl green, pyronine, feulgen stain **(Compulsory)**	(1P)
9.	Effect of fixatives on tissue sections- liver	(1P)

Progressive Education Society's

Modern College of Arts, Science and Commerce

Ganeshkhind, Pune – 411 016

(Autonomous)

Syllabus for

MSc-II : Mathematics

Introduction:

Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects Board of studies in Mathematics of P. E. Society's Modern College of Arts , Science and Commerce , Ganeshkhind , Pune-16 has prepared the syllabus of MSc(Mathematics) Part II. To develop the syllabus the U.G.C. Model curriculum is followed.

Program Objectives:

- A student should be able to recall basic facts about mathematics and should be able to display knowledge of conventions such as notations, terminology and recognize basic geometrical figures and graphical displays ,state important facts resulting from their studies.
- A student should get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved, mathematical reasoning.
- A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical Sciences.
- A student be able to apply their skills and knowledge, that is, translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.
- A student should be made aware of history of mathematics and hence of its past, present and future role as part of our culture.

Program Specific Outcomes (PSOs):

Program Outcomes:

Student will

PCO1 : Be Proficient in using Pure Mathematical concepts and apply in various fields

PCO2 : Be able to use Mathematical ideas and tools in solving and interpreting the problems.

PCO3: Be able to use Mathematical knowledge for continuing further study.

PCO4: Be able to develop a positive attitude towards Mathematics as a valuable subject.

Examination Pattern:

30:70 [Continuous Internal Evaluation: Formative, Summative and End semester exam (ESE)]

Evaluation of Students:

1) The Internal evaluation will be in form of continuous assesement format of 30 marks and End-Semester examinations will be of 70 marks making total to 100.
2) Student has to obtain 40% marks in the examination of In-Semester and End-Semester assessment. Separate passing is mandatory
4) Internal marks remain unchanged and internal assessment cannot be repeated. If student remain absent during internal assessment examination, he/she will have chance with the permission of the competent authority. But it will not be right of the student. It will be under the discretion of the competent authority and internal departmental assessment committee. In case he/she wants to repeat Internal, he/she can do so only by registering for the said courses.

In-semester Examination: Internal assessment for each course would be continuous and dates for each tutorials/practical tests etc. will be pre-notified in the time table for teaching or placed separately as a part of time table. Department/ College Internal Assessment Committee will coordinate this activity.

Suggested internal assessment tools for courses:

The concerned teacher shall announce the units for which internal assessment will take place. A teacher may choose one of the methods given below for the assessment.

1. Students Seminar
2. Short Quizzes / MCQ Test

3. Home Assignments
4. Tutorials/ Practical
5. Oral test
6. Research Project
7. Group Discussion
8. Open Book Test
9. Study Tour
10. Written Test
11. PPT presentation
12. Field Visit
13. Industrial Visit
14. Viva

Teaching Methodology:

1. Classroom Teaching
2. Guest Lectures
3. Group Discussions
4. Surveys
5. Power Point Presentations
6. Visit to Institutions / Industries
7. Research Papers & Projects
8. E-content

Subject List

SEMESTER III

Sr. No.	Subject Type	Subject Code & Title	Credits			Total No.of Lectures
			Theory	Practical	Total	
1	Theory	23 MTUT 131: Functional Analysis	4		20	60
2	Theory	23 MTUT 132: Field Theory	4			60
3	Theory + Practical	23 MTUT 133: Programming with Python	2	2		90
O=Optional Courses (Any Two)						
4	Theory	23 MTUTO 134: Discrete Mathematics	4			60
5	Theory	23 MTUTO 135: Mechanics	4			60
6	Theory	23 MTUTO 136: Advanced Complex Analysis	4			30
7	Theory	23 MTUTO 137: Integral Equations	4			30
8	Theory	23 MTUTO 138: Differential Manifolds	4			30

SEMESTER IV

Sr. No.	Subject Type	Subject Code & Title	Credits			Total No. of Lectures
			Theory	Practical	Total	
1	Theory	23 MTUT 141: Fourier Series and Boundary Value Problems	4		20	60
2	Theory	23 MTUT 142: Differential Geometry	4			60
3	Theory + Practical	23 MTUT 143: Introduction to Data Science	2	2		90
O=Optional Courses (Any Two)						
4	Theory	23 MTUTO 144: Number Theory	4			60
5	Theory	23 MTUTO 145: Algebraic Topology	4			60
6	Theory	23 MTUTO 146: Representation Theory of Finite Groups	4			60
7	Theory	23 MTUTO 147: Coding Theory	4			60
8	Theory	23 MTUTO 148: Probability and Statistics	4			60

Extra Credit Courses

Sr. No.	Subject Type	Semester	Extra Credit Courses	Credits
			Name of the course	
1	Theory	III	Constitution	01
2	Theory	III	Cyber Security III	01
3	Theory	III	Skill Development –I	01
4	Theory	IV	Cyber Security IV	01
5	Theory	IV	Skill Development –II	01

Syllabus

Subject Code: 23 MTUT131

Subject: FUNCTIONAL ANALYSIS **(4 Credit Course)**

Total Lectures=60

Course Outcomes:

CO1: Upon the successful completion of the course students will learn the concept of normed Linear spaces and various properties operators defined on them.

Unit	Topic	No of lecture (60)
I	**Banach Spaces** 1.1 The definition and some examples. 1.2 Continuous linear transformations. 1.3 The Hahn-Banach theorem. 1.4 The natural imbedding of N in N**. 1.5 The open mapping theorem. 1.6 The conjugate of an operator.	25
II	**Hilbert Spaces** 2.1 The definition and some simple properties. 2.2 Orthogonal complements. 2.3 Orthonormal sets. 2.4 The conjugate space H*.	25

	2.5 The adjoint of an operator. 2.6 Self-adjoint operators. 2.7 Normal and unitary operators. 2.8 Projections.	
III	**Finite-Dimensional Spectral Theory** 3.1 Matrices. 3.2 Determinants and the spectrum of an operator. 3.3 The spectral theorem. 3.4 A survey of the situation.	10

Recommended Book:

G. F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw Hill. Chapters: 9, 10, 11.

Reference Books:

1) B. V. Limaye, Functional Analysis, Wiley Eastern Ltd.

2) George Bachman, Lawrence Narici, Functional Analysis, Dover Publications.

3) E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley, 1989.

Subject Code: 23 MTUT132

Subject: FIELD THEORY **(4 Credit Course)**

Total Lectures=60

Course Outcomes: Upon the successful completion of the course students will:

CO1: Learn basic properties of field extensions

CO2: Learn the concepts of field automorphism and Galois theory

Unit	Topic	No of lectures (60)
1	**Algebraic Extension of fields:** 1.1 Irreducible polynomials and Eisenstein criterion, adjunction of roots, 1.2 Algebraic extensions, algebraically closed fields.	**12**
II	**Normal and Separable extensions:** 2.1 Splitting fields, 2.2 Normal extensions, multiple roots, finite fields, separable extensions.	**12**
III	**Galois Theory** 3.1 Automorphism groups and fixed fields, 3.2 Fundamental theorem of Galois theory, 3.3 Fundamental theorem of algebra.	**20**

IV	**Applications of Galois theory to classical problems** 4.1 Roots of unity and cyclotomic polynomials, cyclic extensions, 4.2 polynomials solvable by radicals, symmetric functions, 4.3 Ruler and compass constructions	**16**

Recommended Book:

P. B. Bhattacharyya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra , Cambridge University Press, Second Edition. Chapter no: 15, 16, 17 and 18.

Reference Books:

1. D. Dummit and R.M.Foote, Abstract Algebra, 2nd Edition, Wiley Eastern Ltd.

2. T. A. Hungerford, Algebra, Graduate Texts in Mathematics, Vol. 73, SpringerVerlag, 1980 (Indian Reprint 2004).

3. O. Zariski and P. Sammuel, Commutative Algebra, Vol. 1, Van Nostrand. 4. I. S. Luthar, I. B. S. Passi, Algebra, Vol.

4, Field Theory, Narosa Publishing House

5. M. Artin, Algebra, Prentice Hall India, Second Edition.

Subject Code: 23 MTUT133

Subject: PROGRAMMING WITH PYTHON **(2+2=4 Credit Course)**

Total Lectures=60

Course Outcomes: Upon the successful completion of the course students will Learn

CO 1. Basic symbols, Operators, and Functions

CO 2. Writing a python script

CO 3. To find roots of Some Nonlinear Equations

CO 4.To find the Direct and iterative Solution of Linear Equations

Sr. No	Topic	No of lectures (90)
I	**UNIT-I: Introduction to Python, Python Objects** 1.1 Features of Python: Easy; Type and Run ; Syntax; Mixing; Dynamic Typing; Built in Object Types; Numerous Libraries and Tools. 1.2 Chronology and Uses: Chronology; Uses. 1.3 Installation of Anaconda. 1.4 Basic Data Types Revisited: Fractions. 1.5 Strings. 1.6 Lists and Tuples: List; Tuples; Features of Tuples.	**4**

II	**UNIT-II: Conditional Statements** 2.1 if, if-else, and if-elif-else constructs. 2.2 The if-elif-else Ladder. 2.3 Logical Operators. 2.4 The Ternary Operator 2.5 The get Construct. 2.6 Examples.	**4**
III	**UNIT-III: Looping** 3.1 While. 3.2 Patterns. 3.3 Nesting and Applications of Loops in Lists.	**4**
IV	**UNIT-IV: Functions** 4.1 Features of a functions: Modular Programming; Reusability of Code; Manageability. 4.2 Basic Terminology: Name of Functions; Arguments; Return Value. 4.3 Definition and Invocation: Working. 4.4 Type of Functions: Advantage of Arguments. 4.5 Implementing Search. 4.6 Scope. 4.7 Recursion: Rabbit Problem; Disadvantages of Using Recursion	**6**
V	**UNIT-V: Iterations, Generators, and Comprehensions** 5.1 The Power of "For". 5.2 Iterators. 5.3 Defining an Iterable Object. 5.4 Generators.	**4**

	5.5 Comprehensions.	
	UNIT-VI: File Handling 6.1 The File Handling Mechanism. 6.2 The Open Function and File Access Modes. 6.3 Python Functions for File Handling: The Essential Ones; The OS Methods; Miscellaneous Functions and File Attributes. 6.4 Command Line Arguments. 6.5 Implementation and Illustrations.	**5**
	UNIT- VII: Strings 7.1 The Use of "For" and "While". 7.2 String Operators: The Concatenation Operator (+); The Replication Operator; The Membership Operator. 7.3 Functions for String Handling: len(); Capitalize(); find(); count; Endswith(); Encode; Decode;Miscellaneous Functions.	**5**
	UNIT-VIII: Introduction to Object Oriented Paradigm 8.1 Creating New Types. 8.2 Attributes and Functions: Attributes; Functions. 8.3 Elements of Object- Oriented Programming: Class; Object; Encapsulation; Data Hiding; Inheritance; Polymorphism; Reusability.	**5**

	UNIT-IX: Classes and Objects 9.1 Defining a Class. 9.2 Creating an Object. 9.3 Scope of Data Members. 9.4 Nesting. 9.5 Constructor. 9.6 Constructor Overloading. 9.7 Destructors.	**5**
	UNIT-X: Inheritance 10.1 Introduction to Inheritance and Composition : Inheritance and Methods, Composition. 10.2 Inheritance: Importance and Types: Need of Inheritance; Types of Inheritance. 10.3 Methods: Bound Methods; Unbound Method; Methods are Callable Objects; The Importance and Usage of Super; Calling the Base Class Function Using Super. 10.4 Search in Inheritance Tree. 10.5 Class Interface and Abstract Classes.	**6**
	UNIT-XI: Operator Overloading 11.1 _init_Revisited: Overloading _init_(Sort of). 11.2 Methods for Overloading Binary Operators. 11.3 Overloading the += Operator 11.4 Overloading the > and < Operators. 11.5 Overloading the _boolEan_ Operators: Precedence of _bool_over _len_.	**6**

	11.6 Destructors	
	UNIT-XII: Exception Handling 12.1 Importance and Mechanism: An exaple of Try/Catch; Manually Raising Exception. 12.2 Built In Exceptions in Python: 12.3 The Process: Exception Handling: Try/Except; Raising Exceptions. 12.4 Crafting User Defined Exceptions. 12.5 An Example of Exception Handling.	**6**

Recommended book:

H. Bhasin: Python Basics, MERCURY LEARNING AND INFORMATION Dulles, Virginia Boston, Massachusetts New Delhi Chapter 1: 1.2, 1.4, 1.5. Chapter 2: 2.2 to 2.4. Chapter 3: 3.2 to 3.7;Chapter 4: 4.2 to 4.4 Chapter 5: 5.2, to 5.8. Chapter 6: 6.2 to 6.6. Chapter 7: 7.1, to 7.6; Chapter 8: 8.1, to 8.4. Chapter 9: 9.1, 9.2, 9.3, 9.4. Chapter 10: 10.1, to 10.8.; Chapter 11: 11.1to 11.5. Chapter 12: 12.2, to 12.8.; Chapter 13: 13.2, to 13.6.

Reference Books:

1. Beginning-Python, Second Edition by Magnus Lie Hetland

2. The Complete Reference Python by Martin C. Brown

3. Head First Python by Patrick Barry

4. Learning Python, O‟Reilly by Mark Lutz

5. Python in a Nutshell, O‟Reilly by Alex Martelli

Subject Code: 23 MTUTO134

Subject: DISCRETE MATHEMATICS **(4 Credit Course)**

Total Lectures=60

Course Outcomes: Upon the successful completion of the course students will:

CO1: Understand the fundamentals of Graphs

CO2: Learn the structure of graphs and familarize the basic concepts

CO3: Understand the trees, Euler tour and Hamilton cycle and some of their applications

CO4: Learn Matchings and Coverings in Bipartite Graphs.

CO5: Understand directed graph planar graph and their properties

Units	Topic	No of lectures (60)
I	**UNIT-I: Topics in Graph Theory** 1.1 Graphs; Graphs as Models; Matrices and Isomorphism; Decomposition and Special Graphs; Degree of a vertex; Counting and Bijections. 1.2 Paths, Cycles, Trails: Connection in Graphs; Bipartite Graphs; Eulerian Circuits; Hamiltonian Cycles. 1.3 Directed Graphs: Definition and Examples; Vertex Degrees; Eulerian Digraphs.	**15**

II	**UNIT-II: Trees** 2.1 Trees: Properties of Trees; Distance in Trees and Graphs. 2.2 Enumeration of Trees: Spanning Trees in Graphs; Minimum Spanning Trees; Shortest Paths; Connectivity; Edge Connectivity.	**12**
III	**UNIT-III: Matchings** 3.1 Maximum Matchings ; Hall‟s Matching Condition .	**3**
IV	**UNIT-IV: Basic Counting Principles** 4.1 Two Basic Counting Principles. 4.2 Simple Arrangements and Selections. 4.3 Arrangements and Selections with Repetitions. 4.4 Distributions.; Binomial Identities	**10**
V	**UNIT-V: Generating Functions** 5.1 Generating Functions Models 5.2 Calculating Coefficients of Generating Functions. 5.3 Partitions. ; Exponential Generating Functions.	**10**
VI	**UNIT-VI: Recurrence Relations** 6.1 Recurrence Relations Models. 6.2 Solutions of Linear Recurrence Relations. 6.3 Counting with Venn Diagrams. 6.4 Inclusion-Exclusion Formula	**10**

Recommended Books:

1.Douglas B. West: Introduction to Graph Theory; 2nd Edn; PHI Learning Pvt. Ltd. Section 1.1, 1.2, 1.3 (Counting and Bijections) , Section 7.2 (Hamiltonian Cycles) Section 1.4 (Definitions, Vertex Degrees, Eulerian

Digraphs) Section 2.1 (Properties of Trees; Distance) , Section 2.2 (Enumeration of Trees; Spanning Trees) Section 2.3 (Minimum Spanning Tree, Shortest Path) Section 4.1 (Connectivity, Edge-Connectivity); Section 3.1 (Maximum Matchings; Hall‟s Matching Condition) 2. Alan Tucker: Applied Combinatorics 6th Edn; Wiley India. Sections 5.1 to 5.5; 6.1 to 6.4; 7.1, 7.3; 8.1 to 8.2.

Reference Books:

1. B. Kolman, R. Busby, S.C. Ross: Discrete Mathematical Structures, 6th Edn , Pearson Edn. 2. John Clark, D. A. Holton: A First Look at Graph Theory, World Scientific , 1991.

Subject Code: 23 MTUTO135

Subject: MECHANICS **(4 Credit Course)**

Total Lectures=60

Unit	Topic	No of lectures (60)
I	**Unit –I : Lagrange's Formulation** 1.1 Equation of Motion and conservation Theorems, Equation of Motion of a Particle, Equation of Motion of a System of Particle, 1.2 Conservation Theorem of Linear Momentum of the system of particles, Angular Momentum of the system of Particle, Constraint Motion, Examples of motion under constraints, Holonomic and Non – Holonomic Constraints, Scleronomic and Rheonomic Constraints, Degrees of Freedom and Generalized Co – ordinates, 1.3 Transformation Relations, Virtual work, Principle of Virtual Work, D „ Alembert"s Principle, Conservation of Energy, Kinetic Energy as a Homogeneous quadratic function of generalized velocities, Another way of proving conservation Theorem for Energy, Lagrange"s Equations for Non – holonomic Constraints.	18
II	**Variational Principles** 2.1 Generalization of Theorem, Minimum surface of revolution, Brachistochrine Problem. 2.2 Isoperimetric problems, variational problems with moving boundaries, 2.3 Functional dependent on functions of two dependent variables.	12
III	**Unit-III : Hamilton's Principle** 3.1 Hamilton"s Principle for Non – Conservative and Conservative Systems, Configuration Space and Phase Space, Lagrange"s Equations of Motion from Hamilton"s Principle, Hamiltonian Formulation, Hamiltonian Function,	18

	Hamilton‟s Canonical Equations of Motion for partially 3.2 Conservative and Partially Non – Conservative System, Derivation of Hamilton's Equations of Motion from Hamilton‟s Principle, Physical Meaning of the Hamiltonian. 3.3 Conservative and Scleronomic system, Non–conservative and Rheonomic system,partially conservative, Partially Non –conservative system, Cyclic co – ordinates in Hamiltonian, Routh‟s Procedure, Principle of Least Action.	
IV	**Unit IV : Two Body Central Force Motion** 4.1 Reduction of Two body problem to an equivalent one Body problem, Equation of Motion and the First Integral 4.2 Kepler‟s Laws of Planetary Motion, Kepler‟s First second and Third Law, Deduction of Kepler‟s Laws, Escape velocity, 4.3 Newton‟s law of Gravitation from Kepler‟s Laws of Planetary Motion, Differential Equation of the orbit of a Particle, Virial Theorem	12

Recommended Book:

Problems in Classical Mechanics by L. N. Katkar (Narosa Publication) Chapter 1 To 4

Reference Books:

1) Classical Mechanics (3rd Ed.) by Herbert Goldstein, Charles Poole, John Safko (Pearson Education)

2) Classical Mechanics by Gupta, Kumar and Sharma (A Pragati Edition])

3) Classical Mechanics by Rana Joag (Mc Graw Hill India)

4) Classical Mechanics by R. N. Tiwari and B. S. Thakur (PHI)

Subject Code: 23 MTUTO136

Subject: ADVANCED COMPLEX ANALYSIS **(4 Credit Course)**

Total Lectures=60

Course Outcomes: Upon the successful completion of the course students will:

CO1:Learn the concept of (complex) differentiation and integration of functions defined on the complex plane and their properties.

CO2: Be thorough in power series representation of analytic functions, different versions of Cauchy's Theorem.

CO3:Get an idea of singularities of analytic functions and their classifications.

CO4:Learn different versions of maximum modulus theorem.

Units	Topic	No of lectures (60)
1	**Unit-I Cauchy's Theorem and it Applications:** 1.1 Revision 1.2 Further Applications : Sequences of holomorphic functions, Holomorphic functions defined in terms of integrals, Schwarz reflection principle, Runge's approximation theorem	12
2	**Unit-II Conformal Mappings:** 2.1 Conformal equivalences and examples:The disc and upperhalf plane,further examples, The Dirichlet in a strip 2.2 The Schwarz lemma, automorphism of the disc and upper half plane,Automorphism of the disc, Automorphism of the upper half plane	20

3	**Unit-III The Riemann mapping :** 3.1 The Riemann mapping theorem, Necessary conditions and statement of the theorem, Montel's theorem, proof of the Riemann mapping theorem 3.2 Conformal mappings onto polygons: Some examples, The Schwarz- Christoffle integral, boundary behaviour, The mapping formula	**20**
4	**Unit-IV An introduction to elliptic functions:** 4.1 Elliptic functions: Liouville's theorem, The Weierstrass function	**8**

Recommended Book

1. Stein and Shakarchi, Complex Analysis, Princeton University Press, 2006 Chapter 2 : Sections 1 to 4 Revision, Section 5, Chapter 8: Sections 1, 2, 3, 4 Chpater 9: Section 1

Reference Books :

1. J. B. Conway , Functions of one complex variable, 2nd edition, GTM 11,Springer Verlag, 1973

2. A. R Shastri, Basic complex analysis of one variable, McMilan Publishers,India, Ltd. 2011

Subject Code: 23 MTUTO137

Subject: INTEGRAL EQUATIONS **(4 Credit Course)**

Total Lectures=60

Units	Topic	No of lectures (60)
1	**Unit-I Introductory Concepts** 1.1 Definitions 1.2 Classification of Linear Integral Equations 1.3 Solution of an Integral Equation 1.4 Converting Volterra Equation to ODE 1.5 Converting IVP to Volterra Equation 1.6 Converting BVP to Fredholm Equation	**12**
2	**Unit-II Fredholm Integral Equations** 1.7 Introduction 1.8 The Decomposition Method 1.9 The Direct Computation Method 1.10 The Successive Approximation Method 1.11 The Method of Successive Substitutions 1.12 Comparison between Alternative Methods 1.13 Homogeneous Fredholm Equations	**20**

3	**Unit-III Volterra Integral Equations** 1.14 Introduction 1.15 The Decomposition Method 1.16 The Series Solution Method 1.17 Converting Volterra Equation to IVP 1.18 The Successive Approximation Method 1.19 The Method of Successive Substitutions 1.20 Comparison between Alternative Methods 1.21 Volterra Equation of the First Kind	**20**
4	**Unit-IV Integro-Differential Equations** 1.22 Introduction 1.23 Fredholm Integro-Differential Equations 1.24 Volterra Integro-Differential Equations	**8**
	Unit-V Singular Integral Equations 1.25 Definitions 1.26 Abel‟s Problem 1.27 The Weakly-Singular Volterra Equations	

Recommond Book:

1. Abul-Majid Wazwaz, A First Course In Integral Equations, World Scientific Publications, 1997. Chapter-1 -5.

Reference Books:

Kanwal Ram P., Linear Integral Equations, Birkhauser publication 1997. 1. Abdul J. Jerri, Introduction to Integral Equations With Applications, Wiley-Interscience; 2 edition (September 3, 1999)

Subject Code: 23 MTUTO137

Subject: DIFFERENTIAL MANIFOLDS **(4 Credit Course)**

Total Lectures=60

Units	Topic	No of lectures (60)
1	**Unit-I: Differential Manifolds** 1.1 The Volume of a Parallelopiped. 1.2 The Volume of a Parameterized-Manifold. 1.3 Manifolds in Rn. 1.4 The Boundary of a Manifold. 1.5 Integrating a Scalar Function over a Manifold.	**25**
II	**Unit -II: Differential Forms** 2.1 Multilinear Algebra. 2.2 Alternating Tensors. 2.3 The Wedge Product. 2.4 Tangent Vectors and Differential Forms. 2.5 The Differential Operator. 2.6 The Action of a Differential Map.	**20**
III	**Unit- III: Stokes' Theorem** 3.1 Integrating Forms over Parameterized Manifolds. 3.2 Orientable Manifolds. 3.3 Integrating Forms over Oriented Manifolds.	**15**

	3.4 The Generalized Stokes‟ Theorem.	

Recommended Book:

James R. Munkres, Analysis on Manifolds (Westview Press), ISBN 0-201-31596-3. Chapter 5. Chapter 6 (except section 31). Chapter 7 (except section 36 and 38).

Reference Books:

1) Michael Spivak, Calculus on Manifolds, CRC Press (Taylor and Francis Group), Chapman and Hall Book, 1965.

2) Guillemin and Pollack, Differential Topology, AMS-Chelsea Publishing, 2010.

Semester IV

Subject Code: 23 MTUT141

Subject: FOURIER SERIES AND BOUNDARY VALUE PROBLEMS **(4 Credit Course)**

Total Lectures=60

Unit	Topic	No of lecture (60)
I	**Unit-I Fourier Series** 1.1 Piecewise Continuous Functions ,Fourier Cosine Series, Examples, 1.2 Fourier Sine Series, Examples, 1.3 Fourier Series, Examples, 1.4 Adaptations to other Intervals	10
II	**Unit-II Convergence Of Fourier Series** 2.1 One-Sided Derivatives, Property of Fourier Coefficients 2.2 Two Lemmas, Fourier Theorem , Discussion of the theorem and its Corollary, Convergence on other intervals, Lemma 2.3 Absolute and uniform convergence of Fourier series, Differentiation of Fourier series, Integration of Fourier series	10

III	**Unit-III The Fourier Method** 3.1 Linear Operators, Principle of Superposition 3.2 A Temperature Problem, A Vibrating String Problem	08
	Unit-IV Boundary Value Problems 4.1 A Slab with Faces at Prescribed Temperatures, Related Problems, A Slab with Internally Generated Heat, Steady Temperatures in a Rectangular Plate 4.2 Cylindrical Coordinates, String with Prescribed Initial Conditions, Resonance, Elastic Bar 4.3 Double Fourier Series, Periodic Boundary Conditions	12
	Unit -V Orthonormal Sets 5.1 Inner Products and Orthonormal Sets, Examples 5.2 Generalized Fourier series, Examples 5.3 Best approximation in the Mean, Bessel‟s Inequality and Parseval‟s Equation 5.4 Application to Fourier series	10
	Unit-VI Sturm-Liouvilles Problems and Applications 6.1 Regular Sturm-Liouville Problems, Modifications, Orthogonality of Eigen functions, Real-Valued Eigen functions and Non negative Eigen Values, Methods of solution,	10

	6.2 Examples of Eigen functions Expansions, A Temperature Problem in Rectangular Coordinates , Another Problem, Other Coordinates 6.3 Modification of the Method, Another Modification	

Recommended Book:

J.W.Brown & R.V.Churchill: Fourier Series and Boundary Value Problems. VIIth Edition, McGraw Hill Education(India) Private Limited,New Delhi.Chapter-1 (Art. 1 to 8) ,Chapter-2 (Art. 9 to 18), Chapter-4 (Art. 29 to 32), Chapter-5 (Art. 34 to 43), Chapter-7 (Art. 52 to 58), Chapter-8 (Art. 59 to 69)

Reference Book:

Murray Spiegel, Fourier Analysis with Applications to Boundary Value Problems,

Schaum‟s Outline Series, McGraw Hill.

Subject Code: 23 MTUT142

Subject: DIFFERENTIAL GEOMETRY **(4 Credit Course)**

Total Lectures=60

Course Outcomes: Upon the successful completion of the course students will:

CO1: Understand how calculus of several variables can be used to develop the geometry of n dimensional oriented n- surface in $\mathbb{R}n+1$.

CO2: Understand locally n- surfaces and parametrized n- surfaces are the same.

CO3: Develop a knowledge of the Gauss and Weingarten maps and apply them to apply them to describe various properties of surfaces.

Unit	Topic	No of lectures (60)
1	**Unit-I** 1.1 Graphs and Level Sets, 1.2 Vector Fields, 1.3 The Tangent Space, 1.4 Surfaces.	**15**
II	**Unit-II** 2.1 Vector Fields on Surfaces; 2.2 Orientation, 2.3 The Gauss Map, 2.4 Geodesics, 2.5 Parallel Transport.	**15**

III	**Unit-III** 3.1 The Weingarten Map, 3.2 Curvature of Plane Curves, 3.3 Arc Length and Line Integrals.	**20**
IV	**Unit-IV** 4.1 Curvature of Surfaces.	**15**

Recommended Book:

J.A. Thorpe, Elementary Topics in Differential Geometry, First Indian Reprint, Springer Publication. Chapters: 1 to 12.

Reference Books:

1) Erwin Kryszig, Differential Geometry, Dover Publications Inc.

2) Christian Bar, Elementary Differential Geometry, Cambridge University Press.

3) Andrew Pressley, Elementary Differential Geometry, Springer.

4) T.J. Willmore, An Introduction to Differential Geometry, Dover Publications Inc.

Subject Code: 23 MTUT143

Subject: INTRODUCTION TO DATA SCIENCE **(2+2=4 Credit Course)**

Total Lectures=60

Sr. No	Topic	No of lectures (90)
I	**UNIT 1. Data science in a big data world** 1.1. Benefits and uses of data science and big data 1.2. Facets of data 1.3. The data science process 1.4. The big data ecosystem and data science	**08**
II	**UNIT 2. The data science process** 2.1. Overview of the data science process 2.2. Retrieving data 2.3. Cleansing, integrating, and transforming data 2.4. Exploratory data analysis .	**10**
III	**UNIT 3. Machine learning** 3.1. What is machine learning 3.2. The modelling process 3.3. Types of machine learning 3.4. Semi-supervised learning	**08**

IV	**UNIT 4. Handling large data** 4.1. General techniques for handling large volumes of data 4.2. General programming tips for dealing with large data sets 4.3. Case study Predicting malicious URLs	**14**
V	**UNIT-V: First steps in big data** 5.1. Distributing data storage and processing with frameworks 5.2. Case study: Assessing risk	**10**
VI	**UNIT-VI: Text mining and text analytics and Data visualization** 6.1. Text mining techniques 6.2. Data visualization options	**10**

Recommended Book:

1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Manning Publications Co., 1st edition, 2016

Reference Books:

1. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013

2. Introduction to Machine Learning, Ethem Alpaydin, Third Edition 2018 PHI Learning Private Limited

Subject Code: 23 MTUTO144

Subject: NUMBER THEORY **(4 Credit Course)**

Total Lectures=60

Course Outcomes: Upon the successful completion of the course students will:

CO1: Be able to effectively express the concepts and results of number theory.

CO2: Learn basic theory of arithmetical functions and Dirichlet multiplication.

CO3: Understand distribution of prime numbers and prime number theorem.

CO4: Learn the concept of quadratic residue and Quadratic reciprocity laws.

CO5: Get a basic knowledge in Cryptography

Units	Topic	No of lectures (60)
I	**UNIT-I: Unique Factorization** 1.1 : Unique Factorization in Z, Unique Factorization in k[x]. 1.2 : Unique Factorization in a Principal Ideal Domain. 1.3 : The Rings Z[i] and Z[ω].	**10**
II	**Unit II: Congruence** 2.1: Congruence in Z., The congruence $ax \equiv b(m)$. 2.2: The Chinese Remainder Theorem.	**10**
III	**Unit III: Quadratic Reciprocity** 3.1: Quadratic Residues. 3.2: Quadratic Reciprocity.	**10**

IV	**Unit IV: Some Functions of Number Theory** 4.1: The Greatest Integer Function. 4..2: Arithmetic Functions. 4.3: The Mobius Inversion Formula	**10**
V	**Unit V: Algebraic Numbers** 5.1: Algebraic Numbers. 5.2: Algebraic Number Fields. Algebraic Integers. 5.3: Quadratic Fields.,	**08**

Recommended Books:

1. Kenneth Ireland, Michael Rosen: A Classical Introduction to Modern Number Theory, Springer, 4th Indian Reprint, 2013. Unit I: Chapter 1: Arts 1 to 4., Unit II: Chapter 3: Arts 1 to 4.

2. Ivan Niven; Herbert Zuckerman; Hugh Montgomery: An Introduction to Theory of Numbers, John Wiley and Sons, 5th Edition. Unit III: Chapter 3: Arts 3.1 and 3.2, Unit IV: Chapter 4: Arts 4.1 to 4.3, Unit V: Chapter 9: Arts 9.1 to 9.6

Reference Books:

(1) S.G.Telang: Number Theory, Tata McGraw Hill.

(2) M.B.Nathanson: Methods in Number Theory, GTM , Springer 3rd Indian Reprint, 2009

Subject Code: 23 MTUTO145

Subject: ALGEBRAIC TOPOLOGY **(4 Credit Course)**

Total Lectures=60

Unit	Topic	No of lectures (60)
I	**Unit-I: The Fundamental Group** 1.1 Homotopy of Paths. 1.2 The Fundamental Group. 1.3 Covering Spaces. 1.4 The Fundamental Group of the Circle. 1.5 Retractions and Fixed Points. 1.6 The Fundamental Theorem of Algebra. 1.7 The Borsuk-Ulam Theorem. 1.8 Deformation Retracts and Homotopy Type. 1.9 The Fundamental Group of Sn	25
II	**Unit-II: The Seifert-van Kampen Theorem** 2.1 Direct Sums of Abelian Groups (only revision). 2.2 Free Products of Groups (only revision). 2.3 Free Groups 2.4 The Seifert-van KampenTheorem. 2.5 The Fundamental Group of a Wedge of Circles. 2.6 The Fundamental Groups of the Torus and the Dunce Cap.	20
III	**Unit-III: Classification of Covering Spaces** 3.1 Equivalence of Covering Spaces.	15

	3.2 The Universal Covering Spaces. 3.3 Covering Transformations. 3.4 Existence of Covering Spaces**.**	

Recommended Book:

James R. Munkres, Topology, Second Edition, Pearson Prentice Hall. Chapter 9: Sections: 51, 52, 53, 54, 55, 56, 57, 58, 59. Chapter 11: Sections: 67, 68 (Only revision), 69, 70, 71, 73. Chapter 13: Sections: 79, 80, 81, 82.

Reference Books:

1) Allen Hatcher, Algebraic Topology, Cambridge University Press, 2002.

2) M.A. Armstrong, Basic Topology, Springer International Edition, 2004.

3) J. J. Rotman, An Introduction to Algebraic Topology, Springer, 1988.

4) E. H. Spanier, Algebraic Topology, Springer, 1994.

Subject Code: 23 MTUTO146

Subject: REPRESENTATION THEORY OF FINITE GROUPS **(4 Credit Course)**

Total Lectures=60

Units	Topic	No of lectures (60)
1	**Unit- I Basics of Group Theory and Linear Algebra [8 Hours]** 1.1 Group actions, General linear group, basic definitions and examples of group actions and orbits under group actions, 1.2 General linear group	08
2	**Unit-II Group Representations: [12 Hours]** 2.1 Irreducible and Indecomposable representations, 2.2 Maschke‟s theorem and complete, reducibility, Schur‟s lemma	20
3	**Unit-III Character Theory and Orthogonality relations: [25 Hours]** 3.1 Orthogonality relations, characters and class functions, 3.2 The regular representation, permutation representation, representations of Abelian groups.	20

4	**Unit-IV Fourier Analysis on Finite Groups : [15 Hours]** 4.1 Periodic functions and Fourier transform, 4.2 Convolutions, Fourier Inversion, 4.3 Dual group.	**8**

Recommended Book :

Benjamin Steinberg, Representation Theory of Finite Groups Unit-I 2.1 to 2.3; Unit-II 3.1, 3.2; Unit-III 4.1to 4.5; Unit-IV 5.1 to 5.3.

Reference Books:

1. J. P. Serre, Linear Representations of Groups

2. James Leibeck, Representation Theory Michael Artin, Algebra.

Subject Code: 23 MTUTO147

Subject: CODING THEORY **(4 Credit Course)**

Total Lectures=60

Units	Topic	No of lectures (60)
I	**Unit-I Error detection:** 1.1 Correction and decoding: Communication channels, Maximum likelihood decoding, 1.2 Hamming distance, Nearest neighbour / minimum distance decoding, Distance of a code.	**12**
II	**Unit-II Linear codes:** 2.1 Vector spaces over finite fields, Linear codes, Hamming weight, Bases of linear codes, 2.2 Generator matrix and parity check matrix, Equivalence of linear codes, Encoding with a linear code, Decoding of linear codes, 2.3 Cossets, Nearest neighbour decoding for linear codes, Syndrome decoding**.**	**18**
III	**Unit-III : Bounds in Coding Theory :** 3.1 Main coding theory problem, lower bounds, sphere covering bounds, Gilbert Varshamov bound, Hamming Codes, 3.2 Hamming bound and Perfect codes Singleton bound and MDS codes	**16**

IV	**Unit-IV Cyclic codes:** 4 .1 Definitions, Generator polynomials, 4.2 Generator and parity check matrices, 4.3 Decoding of cyclic codes, Burst-error-correcting codes.	**10**
V	**Unit-V Some special cyclic codes:** 5.1 BCH codes, Definitions, Parameters of BCH codes.	**04**

Recommended Book:

San Ling and Chaoing xing, Coding Theory- A First Course (Cambridge University

Press, 2004) (Sections 2.1, to 2.5); (Sections 3.1. to 3.4 and Sections 4.1, to 4.8); (Sections 5.1, to 5.4) , (7.1, to 7.4); (8.1, 8.1.1 and 8.1.2)

Reference Books:

1) San Ling and Chaoing xing, Coding Theory- A First Course

2) Raymod Hill, A First Course in Coding Theory (Oxford)

3) Lid and Pilz, Applied Abstract Algebra Second Edition

Subject Code: 23 MTUTO148

Subject: PROBABILITY AND STATISTICS **(4 Credit Course)**

Total Lectures=60

Units	Topic	No of lectures (60)
1	**Unit I: Introduction to Probability** 1.1 Sample space, events, probability of an event, additive rules, conditional probability, 1.2 Multiplicative rule, Bayes' rule. .	5
II	**Unit II: Random Variable** 2.1 Concept of a random variable, discrete probability distribution, continuous probabilitydistribution, joint probability distribution, 2.2 Independent random variables, Chebyshev's theorem, Mean of a random variables, Variance and Covariance, Mean and Covariance of linear combinations of random variables, Functions of random variables, transformations of variables, 2.3 Moments and Moment Generating Functions, definition of Expectation, theorems on Expectation and its related problems, Variance in terms of Expectation and related problems, 2.4 Covariance in terms of Expectation and related problems, Variance of a Linear Combination.	16
III	**Unit III: Some Discrete Probability Distributions** 3.1 Binomial and Multinomial distributions, Hypergeometric distribution, Negative Binomial distribution, Geometric distribution,	12

	3.2 Poisson distribution and Poisson process.	
IV	**Unit IV: Some Continuous Probability Distributions** 4.1 Continuous Uniform distribution, Normal distribution, area under the normal curve, applications of the Normal distribution, normal approximation to the binomial distribution, 4.2 Gamma distribution, Exponential distribution, Chi-squared distribution.	**13**
V	**Unit V: Linear Regression and Correlation** 5.1 Simple Linear Regression, lines of Regression, Least Squares and Fitted Model, 5.2 properties of Least Squares Estimators, Regression Coefficients, choice of Regression model, data plot and transformations, 5.3 Karl Pearson‟s Coefficient of Correlation, Properties and Problems, Spearmen‟s Rank Correlation Coefficient, Method of Concurrent Deviations.	**14**

Recommended Book:

Recommended Book:

Probability and Statistics for Engineers and Scientists, by R. Walpole, R.H. Myers,

S.L. Myers,and K. Ye (Seventh Edition, Pearson India). Chapters: 2, 3, 4, 5, 6.1 – 6.8, 7.3, 11.

Reference Books:

Introduction to Probability and Statistics for Engineers and Scientists, by Sheldon

M. Ross(Fourth Edition).

A first course in Probability, by Sheldon M. Ross (Nineth Edition).

Mathematical Statistics, by Parimal Mukhopadhyay.

Statistics for the Life Sciences, by M. Samules, J. Witmer and A. Schaffner (Fifth

Edition,Pearson India)

Progressive Education Society's

Modern College Of Arts, Science and Commerce, Ganeshkhind, Pune – 411 016 (Autonomous)

Syllabus for

M. Sc. II Chemistry

Introduction:

Programme Objectives:

Programme Specific Outcomes (PSOs):

After completing M.Sc. Chemistry Programme, students will be able to:

Knowledge Outcomes:

PO1: Demonstrate and apply the fundamental knowledge of the basic principles in various fields of Chemistry

PO2: Create awareness and sense of responsibilities towards environment and apply Knowledge to solve the issues related to Environmental pollution.

PO3: Apply knowledge to build up small scale industry for developing endogenous product.

PO4: Apply various aspects of chemistry in natural products isolations, Pharmaceuticals, dyes, textiles, polymers, petroleum products, forensic etc. and also to develop interdisciplinary approach of the subject.

Skill Outcomes:

It would help students to -

PO5: Collaborate effectively on team-oriented projects in the field of Chemistry or other Related fields.

PO6: Communicate scientific information in a clear and concise manner both orally and in writing.

PO7: Inculcate logical thinking to address a problem and become result oriented with a positive attitude.

PO8: Explain environmental pollution issues and the remedies thereof.
PO9: Apply the knowledge to develop the sustainable and eco-friendly technology in Industrial Chemistry.

Generic Outcomes:

PO10: To develop their critical reasoning, judgment and communication skills.

PO11: To augment the recent developments in the field of green and eco-friendly reactions, pharmaceutical, Bioinorganic Chemistry and relevant fields of research and development.

PO12: To enhance the scientific temperament among the students so as to develop a research culture and implementation of the policies to tackle the burning issues at global and local level.

Examination Pattern:

Suggested internal assessment tools for courses:

The concerned teacher shall announce the units for which internal assessment will take place. A teacher may choose one of the methods given below for the assessment.

1. Library notes
2. Students Seminar
3. Short Quizzes / MCQ Test
4. Home Assignments
5. Tutorials/ Practical
6. Oral test
7. Research Project
8. Group Discussion
9. Open Book Test
10. Study Tour
11. Written Test
12. PPT presentation
13. Field Visit
14. Industrial Visit
15. Viva

Teaching Methodology:

1. Classroom Teaching
2. Guest Lectures
3. Group Discussions
4. Power Point Presentations
5. Visit to Institutions / Industries
6. Research Papers & Projects
7. E-content

Subject List

SEMESTER III

Sr. No.	Subject Type	Subject Code & Title	Credits			Total No.of Lectures
			Theory	Practical	Total	
1	Theory	**23-CHO-301** Organic Reaction Mechanism and Pericyclic Chemistry	4		20	60
2	Theory	**23-CHO-302** Spectroscopy of Organic Compounds	4			60
3	Theory	**23-CHO-303** Organic Stereochemistry and Asymmetric Synthesis	4			60
4	Theory	**23-CHO-304A** Protection - De-protection, Chiron Approach and Carbohydrate Chemistry OR **23-CHO-304B** Retrosynthetic Analysis and Advanced Heterocyclic Chemistry	4			60
5	Practical	**23-CHO-305** **Practical I**: Ternary Mixture Separation and Convergent Syntheses		4		60

SEMESTER IV

Sr. No.	Subject Type	Subject Code & Title	Credits			Total No. of Lectures	
			Theory	Practical	Total		
1		Theory	**23-CHO-401** Biogenesis and Total Synthesis of Natural Products	4		20	60
2	Theory	**23-CHO-402** Name Reactions in Organometallic Chemistry	4			60	
3	Theory	**23-CHO-403A** Aspects of Medicinal Chemistry **OR** **23-CHO-403B** Applied Organic Chemistry	4			60	
4	Practical	**23-CHO-404 Practical: Select any two Sections from I, II, III** Section-I: Solvent Free Green Organic Syntheses Section-II: Practical Organic Syntheses Section-III: Project /Industrial Training		4		60	
5	Practical	**23-CHO-405**: **Practical III**: Divergent Organic Syntheses and Isolation of Natural Products		4		60	

Syllabus

Semester-III

Subject Code: 23-CHO-301
Subject: Organic Reaction Mechanism and Pericyclic chemistry (4 Credit Course)
Total Lectures=60

Unit	Topic	No. of lectures (60)

	Section I: Organic Reaction Mechanism	
1	Methods for determining Reaction Mechanisms • Kinetic and non-kinetic methods	6
2	Free Radicals • Generation, stability, reactivity • Free radical substitution • addition to multiple bonds, radicals in synthesis • Inter- and intra-molecular bond formation via mercury hydride • tin hydride, thiol donors • cleavage of C-X , C-Sn, C-S, O-O bonds • Oxidative coupling • C-C bond formation in aromatics • SNAr reactions • Free Radicals in Organic Synthesis	14
3	Linear Free Energy Relationships	6
4	• Hammet plots, Hammet equation • substituent constants, reaction constants • use of Hammet plots, calculation of k and K • Deviations from straight line plots • Taft equation, solvent effects	4
	Section II: Pericyclic Chemistry	
1	• Analysis by correlation diagrams • FMO approach • Electrocyclic, Cycloaddition reactions • Diels alder reactions • concept of secondary orbital overlap • Sigmatropic and ene reactions • 1,3-dipolar additions, Claisen , Cope rearrangement and problem solving	30

Reference Books:

1. Mechanism and structure in Organic Chemistry E. S. Gould (Holt, Rinehart andWinston)
2. Advanced Organic Chemistry –J. March, 4th edition
3. Advanced Organic Chemistry- Part A: Structure and Mechanism- F. A. Carey and R. J.Sundberg, 5th Edition, Springer 2007)
4. A guidebook to mechanism in Organic Chemistry- Peter Sykes
5. The Hammett Equation by C. D. Johnson
6. Organic Chemistry-J. Clayden, N. Greeves, S. Warren, P. Wothers, Oxford UniversityPress
7. Radical in Organic Synthesis- B. Giese, Pergamon Press (1986)
8. Advanced Organic Chemistry, Part A by F. A. Carey and R. J. Sundberg
9. Conservation of orbital symmetry by R. B. Woodward and R. Hoffmann
10. Pericyclic Reactions By A. P. Marchand, Roland E. Lehr
11. Organic reactions and orbital symmetry, 2nd Ed. T. L. Gilchrist and R. C. Storr
12. Pericyclic Reactions by A Mechanistic and Problem-Solving Approach by Sunil Kumar Vinod Kumar

S.P. Singh

Subject Code: 23-CHO-302

Subject: Spectroscopy of Organic Compounds (4 Credit Course)

Total Lectures=60

Unit	Topic	No of lectures (60)
	Section-I: NMR Spectroscopy	
1	**NMR in Stereochemistry Determination:** • Homotopic, enatiotopic and distereotopic protons • Chemical and Magnetic equivalence • First and second order splitting • Complex multiplicity patterns and coupling constants in asymmetric compounds • Simplification of complex spectra, NOE • Diastereomerism, Atropy or axial chirality • % Enantiomeric excess, chiral NMR solvents etc. in structure elucidation.	**10**
2	**^{13}C NMR spectroscopy** - APT, DEPT and INEPT	**06**
3	**^{15}N, ^{19}F and ^{31}P NMR spectroscopy** • Fundamentals and applications in structure elucidation of organic compounds, catalysts and biomolecules	**06**
4	**2D NMR** spectroscopy in structure elucidation: • (a)Homonuclear: COSY, TOCSY, 2D-INADEQUATE, 2D-ADEQUATE, NOESY, ROESY • (b) Heteronuclear: HSQC, HMQC, HMBC	**08**
	Section-II: Mass Spectrometry	
1	**Mass Spectrometry** • Principle • Ionization methods like EI, CI, ES, MALDI and FAB-Fragmentation of typical organic compounds • Stability of fragments,	**08**

	• Rearrangements • Factors affecting fragmentation • Ion analysis, ion abundance, • High-Resolution mass spectrometry in determination of molecular formula.	
2	**Applications of Mass Spectrometry** • Determination of the elemental composition • Isotopic Abundance in structure establishment • Analysis of Biomolecules: Proteins and Peptides, Oligonucleotides and Oligosaccharides	**08**
3	**Problems solving:** Structure elucidation using UV, IR, (^{1}H and ^{13}C) NMR and 2D NMR (COSY /HETCOR only), APT, DEPT and MS data as well as spectra.	**14**

Reference Books :

1. Spectrometric Identification of Organic Compounds by R. M. Silverstein, G. C. Basslerand T. C. Morrill, John Wiley.
2. One and Two dimensional NMR Spectroscopy by Atta-Ur-Rehman, Elsevier (1989).
3. Organic Structure Analysis-Phillip Crews, Rodriguez, Jaspars by Oxford University Press(1998).
4. Organic Structural Spectroscopy by Joseph B. Lambert, Shurvell, Lightner, Cooks,Prentice- Hall (1998).
5. Organic Structures from Spectra by Field L.D. Kalman J.R. and Sternhell S. 4th Ed. JohnWiley and Sons Ltd.
6. Mass Spectrometry Basics by Christopher G. Herbert Robert A.W. Johnstone
7. Mass Spectrometry Principles and Applications by Edmond de Hoffmann and VincentStroobant.
8. Introduction to Spectroscopy by Pavia

Subject Code: 23-CHO-303

Subject : Organic Stereochemistry and Asymmetric Synthesis (4 Credit Course)

Total Lectures=60

Unit	Topic	No of lectures (60)
	Section I- Organic Stereochemistry	
	• Conformations of polysubstituted cyclohexane • six membered rings with SP^2 carbon • heterocycles with N and O • anomeric effect • stereochemical principles involved in reactions of six membered rings and other than six membered rings • concept of I- Strain	**08**
	A) Stereochemistry of fused and bridged ring systems: • Nomenclature & synthesis • stereochemical aspects of Perhydrophenanthrene, Perhydroanthracene, hydrindane, • Steroids; Bridged system (bi, tri and polycyclo system) including heteroatoms, • Bredt's Rule **B) Conformations of following compounds with justification of each:** cis and trans -1,3- and l,4-di-t-butyl-cyclohexanes; Cis-4-di-t-butyl- cis-2,5-dihydroxycyclohexane; Twistane; bicyclo- [2.2.2]octane; Trans-anti-trans-Perhydro-anthracene and the lactone; cyclohexane-l,4-dione; 1,2,2,6,6-penta-methyl-4- hydroxy-4-phenylpiperidine; ψ-tropine; 2-hydroxy-2-phenyl quinolizidine; 4-t-butyl-4- methyl-l,3-dioxane; cis- and trans-2,5-di-t-butyl-l,3-dithianes;cis-2,5-di-t-butyl-l,3,2-dioxaphosphorinan-2-one	**12**
	Determination of configuration • Cram's rule, Cram's cycle model, Cram's dipolar model • Felkin-Anh Model • Resolution and analysis of stereomers - formation of racemization and methods of resolution	**10**
	Section II- Asymmetric Synthesis	

	Introduction of Asymmetric Synthesis • Chiral pool and Chiral auxillaries. • Asymmetric Organocatalysis • Asymmetric Aldol Reaction, Enantioselective, diastereoselective and doublediastereoselective Aldol reactions.	**15**
	Transition Metal-Catalyzed Reactions • Homogeneous Asymmetric Hydrogenation • Transition Metal-Catalyzed Homogeneous Asymmetric Hydroxylation and Epoxidation • Asymmetric Phase-Transfer and Ion Pair Catalysis	**15**

Reference Books :

1. Stereochemistry of Carbon compounds - E. L. Eliel
2. Stereochemistry of carbon compounds - E. L. Eliel and S. H. Wilen
3. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers 1st. Ed
4. Stereochemistry of organic compounds –Nasipuri
5. Stereochemistry of organic compounds-P. S. Kalsi
6. Organic stereochemistry – Jagdamba Singh
7. Topics in Stereochemistry (Volume 2) By Norman L. Allinger and Ernest L. Eliel
8. Topics in Stereochemistry (Volume 8) By Ernest L. Eliel and Norman L. Allinger
9. Catalytic Asymmetric Synthesis, 3rd ed,Ed: I. Ojima, John Wiley & Sons, New Jersey,2010
10. Catalysis in Asymmetric Synthesis by Vittorio Caprio and Jonathan M. J. Williams, Angew. Chem. Int. Edn. 2008, 47, 4638–4660
11. Principles and Applications of Asymmetric Synthesis by Guo-Qiang Lin, Yue-Ming Li, Albert S. C.Chan, A John Wiley & Sons, Inc., Publication.
12. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers 2nd. Ed

Subject Code: 23-CHO-304A

Subject : A) Protection - De-protection, Chiron Approach and Carbohydrate Chemistry

(4 Credit Course)

Total Lectures=60

Units	Topic	No. of Lectures (60)
	Section I: Protection - De-protection, Chiron approach	
1	**Protection and de-protection of functional group in organic synthesis:** **Hydroxyl group**- alkyl ether, benzyl ether,acyl, PMB, Trityl, TMS, TBDMS, THP, MOM, MEM, MIPether; **Diol** - Acetone,Cyclohexanone **Amines**- Benzyl, Acyl, CBZ, BOC, FMOC **Carboxyl group**-Ester, DCCI, DIPCDI **Ketone and aldehydes**- Glycol, Thioglycol, Ketal,Acetal; Othroesters as protecting groups, Protection de-protection approach - In Solid phase synthesis of polypeptide; polynucleotide, cyclitols, and amino-sugars	**15**
2	**Chiron approach** Introduction The concept of chiral templates and chironswherein the carbon skeleton is the chiral precursor Utilization of the basic concepts in synthesis of (S) Propanediol, (R) and (S)–Epichlorohydrin, L(+)-Alanine, (-)Multistratin, (-) Pentenomycin and (-) Shikimic acid	**15**
	Section - II: Carbohydrate Chemistry	
1	**Basics of Carbohydrates**: Introduction of sugars, structures of monosaccharides, triose, tetrose, pentose, hexose, D/L forms of aldoses and ketoses in Fisher projections, cyclic hemiacetal forms of monosaccharides, representation of monosaccharide structure (Fisher, Zig-zag, Mills, Haworth projection and Chair conformation), The structure of Glucose, the anomeric configuration, mutarotation (D-Glucose), Conformations of monosaccharides, the anomeric effect. Modified monosaccharides, Alditols, Cyclitols, Nomenclature of monosaccharides, Cyclic forms of the α and β-D-aldoses	**10**

2	**Synthesis of Glycosides**: glycosyldonar acceptor concept, general methods for glycosyl bond formation: Glycosyl halides, Trichloroacetimides, Glycals and Glycal derivatives, Thioglycosides, Phosphites, n-Pentyl glycosides, SulfoxidesDiazarines, Alkylation of reducing sugars	**10**
3	Mannosides, Synthesis of 2-Deoxy Sugars, Orthogonal strategy in Oligosaccharide synthesis, Effect of protecting groups on glycosylation stereoselectivity and coupling efficiency, Intramolecular glycosylation, Total synthesis of natural products:Oligosaccharides and Glycoconjugates	**10**

Reference Books :

1. Greene's protective groups in organic synthesis – Peter G. M. Wuts and Theodor R. A.Green 4th Edn. Wiley-India
2. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press)
3. Modern organic synthesis-An introduction- George S. Zweifel, Michael H. Nantz.
4. Advanced Organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5^{th} edition (2007)
5. Chiron Approach in organic synthesis – S. Hanessianh
6. Organic Chemistry – R. P. Morrison and R. N. Boyd
7. Organic Chemistry – I. L. Finar, volume II.
8. Essentials of Carbohydrate Chemistry and Biology: Thisbe K. Lindhorst, WILEY-VCH,2000, Chapter 3.
9. Monosaccharide's: Their Chemistry and their Roles in Natural Products: Peter M. Collins,Robert J. Ferrier: John Wiley & Sons, 1995
10. Carbohydrate in Chemistry and Biology: Part 1 Chemistry of Saccharides Vol.1.WILEY- VCH, 2000
11. The Organic Chemistry of Sugars; By: Daniel E. Levy Peter FugediPublication: Taylor & Francis, Published on 2006
12. Handbook of Chemical Glycosylation by Alexei V. Demchenko, Wiley VCH, 2008

Subject Code: 23-CHO-304B

Subject:) Retrosynthetic Analysis and Advanced Heterocyclic Chemistry (4 Credit Course)

Total Lectures=60

Unit	Topic	No. of lectures (60)
	Section I: Designing Organic Syntheses	
1	**Concepts of Retrosynthesis** • Retrosynthetic analysis • disconnection approach • Synthons,multiple step synthesis, functional group intercoversion • Illogical two group intercoversion • C-C disconnection • Donor and acceptor Synthons • two group disconnection • 1,3-dicarbonyls, 1,5 related functional group disconnection • Umpolung, convergent synthesis, special methods for small rings • Heteroatom and Heterocyclic compounds • problems	20
2	**Application of Retrosynthetic Approach:** Retrosynthesis and synthesis of following Molecules: • Strychnine • Reserpine • Asteltoxin • Indolizomycin	10
	Section II: Advanced Heterocyclic Chemistry	
1	• Systematic nomenclature (Hantzsch-Widman System) for monocyclic, fused and bridged heterocycles • Tautomerism in aromatic heterocycles • Strain-bond angle, torsional strains and their consequences in small ring heterocycles	08

2	General chemical behaviour of heterocyclic compounds and their applications in: • Biological systems (Anthocyanins, Flavones, Neurotransmitters) • Natural Products (Alkaloids: Nicotin, Quinine), • Drugs and Medicines (Omeprazole, Amlodipine, Cilostazol)	08
3	**Synthesis, reactions and structural effects of heterocyclic rings** • Common Methods in Ring Synthesis of Aromatic Heterocyclic Systems, Typical ring synthesis involving C – Heteroatom, C – C bond formations • Electrocyclic processes in heterocyclic Synthesis: 1,3 -dipolar cycloadditions producing five - membered heterocycles, Nitrenes in heterocyclic synthesis, Palladium catalysis in the synthesis of Benzo - Fused heterocycles, Fischer synthesis, Epoxidation, Use of Sulphur Ylides, Azides for small rings • Three and four membered heterocylces: Aziridines, Oxiranes, Thirienes, Azetidines, Oxitanes and Thietanes • Five-memberedand benzo-fused five memberedheterocycles:Oxazole, Isoxazole, Thiazole, Pyrazole, Imidazole, Benzothiazole and Benzimidazole • Six membered and benzo-fused six membered heterocycles:Pyrazine, Pyridazine, Pyrimidine, Quinazoline, Quinoxaline, Aziridines, Quinoline	14

Reference Books:

1. Designing Organic Syntheses by Stuart Warren
2. Organic Chemistry from Retrosynthesis to Asymmetric Synthesis, by Vitomir Sunjic,Springer; 1st ed. 2016 edition
3. Classics in Total Synthesis by K.C. Nicolaou and E.J.Sorensen
4. Heterocyclic Chemistry by T. Gilchrist
5. An Introduction to the Chemistry of Heterocyclic Compounds by RM Acheson
6. Heterocyclic Chemistry by J A Joule and K. Mills
7. Principles of Modern Heterocyclic Chemistry by A Paquette
8. Organic Chemistry by J. Clayden, N. Greeves & S. Warren

Subject Code: 23-CHO-305

Subject: Practical I: Ternary Mixture Separation and Convergent Syntheses

(4 credit course)

Total Hours=120 (30P x 4hrs)

Units	Topic	Practical Hours
	Section-I: Ternary Mixture Separation	
1	Separation of minimum 06 mixtures containing three components. The mixtures should also involve separation of nitrophenols, amino acids, low boiling and water soluble and insoluble compounds solids and liquids with **multifunctional groups**. The mixture separation should be carried out on micro-scale using ether or water.	**60**
	Section-II: Convergent Synthesis	
1	**Convergent Synthesis 1(Three Stage Synthesis)** Stage I: 2-methoxy naphthalene to 1-formyl-2-methoxy naphthalene(V.H Formylation) Stage II: o- Anisidine to 2-methoxy-4-nitroaniline Stage III: Synthesis of Schiff's base from 1-formyl-2-methoxy naphthalene, 2-methoxy-4-nitroaniline (One pot synthesis: MCR)	**20**
2	**Convergent Synthesis 2(Three Stage Synthesis)** Stage I: 4-Nitro toluene to 4-amino toluene (Reduction by using Sn/HCl) Stage II: Phenol into 2-hydroxy benzaldehyde (Reimer-Tiemann reaction) Stage III: Synthesis of amidoalkyl-2-naphthols from β-Naphthol,4-amino toluene andof 2-hydroxy benzaldehyde	**20**

	(One pot synthesis: MCR)	
3	**Convergent Synthesis 3(Three Stage Synthesis)** Stage I: Benzene to acetophenone (F.C acylation) Stage II: 4-Nitrochlorobenzene into 4-amino chlorobenzene (Reduction by usinghydrazine) Stage III: Quinoline synthesis by using acetophenone, 4-amino chloro benzene andstyrene (One pot synthesis: [3 + 2 + 1] cycloaddition reaction)	**20**

Semester IV

Subject Code: 23-CHO-401

Subject: Biogenesis and Total Synthesis of Natural Products (4 Credit Course)

Total Lectures=60

Sr.no	Topic	No. of Lectures (60)
	Section I: Biogenesis and structure determination	
1	**Terpenoids:** Mono-, Sesqui-, Di-, tri-terpenoids and cholesterol	**10**
2	**Alkaloids:** Derived from ornithine, lysine, nicotinic acid, tyrosine and tryptophan.	**10**
3	**Structure Determination of Pinnaic acid**	**10**
	Section II : Total synthesis	
1	A case study: Longifolene – (All eight syntheses from Advanced Organic Chemistry Carey, Sundberg; Part B	**10**
2	Hirsutellone B (Angew. Chem. Int. Ed. 2009, 48, 6870 –6874	**10**
3	Ribisins A and B : (J. Org. Chem. 2019, 84, 15165−15172)	**10**

References:

1. Natural Product Biosynthesis: Chemical Logic and Enzymatic Machinery by ChristopherT Walsh, Yi Tang
2. From Biosynthesis to Total Synthesis: Strategies and Tactics for Natural Products- EditorAlexandros L. Zografo

3. Medicinal Natural Products: A Biosynthetic Approach, 3rd Edition By Paul M. Dewick
4. Angew. Chem. Int. Ed. 2001, 40 (23), 4450-4452
5. Angew. Chem. Int. Ed. 2001, 40, (23), 4453-4456
6. Angew. Chem. Int. Ed. 2007, 46, 5746–5749

Subject Code: 23-CHO-402

Subject: Name Reactions in Organometallic Chemistry (4 Credit Course)

Total Lectures=60

Sr. No.	Topic	No. of Lectures (60)
1	Transition metal complexes in organic synthesis; Pd, Ni, Fe, and Cu only (C-C, C- N, C-O bond formation reactions with catalytic cycle, ligand and % mole concepts)	12
2	C=C formation reactions: Wittig, Horner-Wordworth-Emmons, Shapiro, Bamford- Stevens, McMurry, Julia-Lythgoe and Peterson olefination reactions	08
3	Multi-component reactions: Ugi, Passerini, Biginelli and Mannich reaction, Ring formation reactions: Pausan-Khand, Bergman and Nazerov cyclization	06
4	Click chemistry: criterion for click reaction, Sharpless azides cycloadditions.	06
5	Click reactions in synthesis of bioconjugates (sugars and proteins)	06
6	Metathesis: Schrock and Grubbs catalyst, Olefin cross coupling (OCM), ring closing (RCM) and ring opening (ROM) metathesis, application in polymerization and synthesis of small organic molecules	08
7	Use of Boron and Silicon reagents in organic synthesis	08
8	Other important reactions: Baylis Hilman, Eschenmoser-Tanabe fragmentation, Mitsunobu reaction	06

Reference Books :

1. C–N bond forming cross-coupling reactions: an overview: by Jitender Bariwalab and Erik Van der Eycken Chem. Soc. Rev., 2013, 42, 9283
2. Iron Catalysis in Organic Synthesis Chem. Rev. 2015, 115, 3170–3387

3. Recent advances in homogeneous nickel catalysis Nature 2014, Vol 509, Page 299-309
4. Aerobic Copper-Catalyzed Organic Reactions Chem. Rev. 2013, 113, 6234−6458
5. Transition Metals for Organic Synthesis Volume 1 *Edited by M. Beller and C. Bolm* WILEY-VCH Verlag GmbH & Co. KGaA ISBN: 3-527-30613-7
6. Multicomponent Reactions Edited by Jieping Zhu, Hugues Bienayme WILEY-VCHVerlag GmbH & Co. KGaA
7. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (OxfordPress)
8. Some modern methods of organic synthesis – W. Carruthers (Cambridge)
9. Organic synthesis – Michael B. Smith
10. Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition(2007).
11. Strategic Applications of named reactions in organic synthesis-Laszlo Kurti andBarbara Czako
12. Name Reactions Jie Jack Li (Fourth Expanded Edition), Page No: 1-582.
13. Organic Synthesis Using Transition Metals, by Roderick Bates, Second Edition, AJohn Wiley & Sons, Ltd., Publication.

Subject Code: 23-CHO-403 A)

Subject : Aspects of Medicinal Chemistry (4 Credit Course)

Total Lectures=60

Sr. No	Topic	Practical
	Molecular Biology	
1	Reagent and buffer preparation	1
1	Estimation of Nucleic acids by UV-Vis spectrophotometry	1
2	Determination of melting temperature of DNA	1
3	Bacterial DNA isolation by alkaline lysis/ lysozyme method and purity check by using A 260/280.	2
4	Bacterial DNA agarose gel electrophoresis	1
5	Estimation of DNA by diphenylamine method	1
6	Isolation of RNA from Yeast or Yeast Tablets	1
	Environmental Biotechnology	
1	Study of pollution indicator plants in terms of morphology and anatomy (any 5-7 plants)	1
2	Community sampling-By Quadrate method for plants : Percentage of frequency, density, abundance . frequency class diagram and comparison with Raunkiaers frequency chart, Simpson's index of dominance.	2
3	Microbial (Bacterial, Algal and Fungal) community estimation	1
4	Study of polluted and unpolluted soil by i) Physical properties : Colour, Texture, Water holding capacity	1
	ii) Chemical properties: pH, Organic content, chlorides and Alkalinity	2
5	Testing genotoxicity of water sample : Polluted and non Polluted	1

Reference Books :

1 Introduction to Environmental Biotechnology (2007) Chattergy PHI Learning Pvt. Ltd, Delhi

2 Textbook of environmental studies for undergraduate courses (2005) Erach Bahrucha Universities Press, Hyderabad

3 Scragg A. Environmental Microbiology Oxford Univ Press. (2005).

4 Evans & Furlong. Environmental Biotechnology.Theory & Applications 2nded 2011. Wiley-Blackwell.

14. Lab manual on molecular biology January 2016 Edition: First Edition, Media Associates Delhi-53Editor: Ruhi Dixit, KartikayBisen, Ashwani Kumar, Ashim Borah, Chetan KeswaniISBN: 978-81-909182-7-5

Semester IV

Subject Code: 23 BBT -401

Subject: Cell Biology II (2 Credit Course)

Total Lectures=30

Unit	Topic	No of lecture
1	**Cell Cycle** • Introduction to cell cycle • Phases and Check points of cell cycle	4
2	**Cell Division in Plant & Animal** • Mitosis • Meiosis	7
3	**Cell Signaling** • Signaling molecules • Signaling receptors: Cell surface receptors • Autocrine, syncrine & paracrine signaling • G-protein signaling (one example) • Calcium Signaling	12
4	**Cell Death** • Aging, Apoptosis and Necrosis • Neoplasia • Autophagy • Ferroptosis • Pyroptosis	7

Reference books:

1. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., KReiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA
2. Molecular Biology of the Cell, 5th Edition (2007)BruceAlberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA
3. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA
4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA
5. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
6. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.
7. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press& Sunderland, Washington, D.C.; Sinauer Associates, MA.
8. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Subject Code: 23 BBT-402

Subject: Molecular Biology II (2 Credit Course)

Total Lectures=30

Unit	Topic	No of lectures
I	**Synthesis of RNA: Transcription:** • Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination • Transcription in Eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing. • Splicing mechanisms, Splicing of tRNA precursors, Splicing of rRNA precursors	**8**
II	**Synthesis of Protein: Translation** • Structure of ribosome and assembly • Protein Synthesis in Prokaryotes: properties of the prokaryotic Initiator tRNA-fMet, Charging of tRNA, amino acyl tRNA synthetases • Protein Synthesis in Eukaryotes: Mechanism of initiation, elongation and termination of polypeptides, • Fidelity of translation, Inhibitors of translation. • Posttranslational modifications of proteins	**10**
III	**DNA damage and repair** • Causes and types of DNA damage • Mechanism of DNA repair: Photo reactivation, base excision repair, nucleotide excision repair, mismatch repair, SOS repair, recombination repair	**5**
IV	**Regulation of activity of Genes and Gene products in Prokaryotes**: a) General aspects of gene Regulation: inducible and repressible system b) The lactose operon : Catabolite repression c) The Arabinose operon: Positive , negative regulation d) The Tryptophan operon : Regulation by attenuation.	**7**

Reference Books :

1. Genes X, 10th edition (2009), Benjamin Lewin, Publisher - Jones and Barlett PublishersInc. USA
2. Molecular Biology of the Gene, 6th Edition (2008), James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick, Pearson Education,Inc. and Dorling Kindersley Publishing, Inc. USA
3. Molecular Biology, 5th Edition (2011), Weaver R., Publisher-McGrew Hill Science.USA
4. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi, Oxford University Press. India
5. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. JohnWiley & Sons. Inc.

6. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology.VIIIEdition. Lippincott Williams and Wilkins, Philadelphia.
7. Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.
8. Principles of Gene manipulation and Genomics. - S.B. Primrose and R.M. Twyman.BlackwellPublication

Subject Code: 23 BBT 403

Subject : Immunology (2 Credit Course)

Total Lectures=30

Unit	Topics	No. of lectures (30)
I	**Immunology: Basic definitions and fundamentals of the immune system** • Definitions - Infection, Invasion, Pathogen, Immunity, Antigen, Antibody • Concept of Host pathogen interaction • Organization of Immune system: a) Structure and function of the cells and tissues of immune system. b) Structure and function of Primary and Secondary lymphoid organs • Types of immunity: a) Innate and Acquired immunity b) Cell mediated and Humoral immunity • Immune Response: Primary and Secondary • Phagocytosis	07
II	**Components of the immune system:** • Antigens: Types and properties of an antigen. Factors affecting immunogenicity. • Immunoglobulin: Structure and their types. Properties and function of different Immunoglobulin classes. • Complement system: Components, function and pathways. • Major Histocompatibility Complex: Types, structure and function • Cytokines: Types, properties and their function	08

III	**Antigen-Antibody Interactions** • General characteristics of Antigen-Antibody reaction • Concept of Lattice hypothesis and Zone phenomenon • Principle and example of different diagnostic tests: i. Precipitation, Agglutination, Immunodiffusion and Complement fixation test ii. Radioimmunoassay, Immunofluorescence, ELISA iii. Western blotting	07
IV	**Clinical Immunology** • Hypersensitivity reactions: Types of Hypersensitivity and clinical manifestation. • Autoimmunity: Mechanisms, Types of autoimmune diseases • Concept of Immunotherapy • Vaccine Technology: • Adjuvant- Properties and role with suitable example • Concept with suitable example of Killed and Live attenuated vaccines, Combined vaccines • Modern Techniques: Concept of Subunit vaccines, Recombinant DNA Vaccines, Conjugate vaccines, Polyvalent vaccines, Monoclonal antibodies, Chimeric antibodies with suitable example	8

Reference Books

1. Ananthanarayan R and Paniker CKJ. Textbook of Microbiology. University PressPublication.
2. Roitt I. Essential Immunology. 10th Ed. Blackwell Science.
3. Kuby. Immunology. 4th edition. W. H. Freeman & company.
4. Sudha Gangal and ShubhangiSontakke, Textbook of basic and clinical immunology,1st edition (2013), University Press, India

Subject Code: 23 BBT- 404

Subject : Animal Development (2 Credit Course)

Total Lectures=30

Unit	Topics	Lectures
I	• History of developmental biology, • Model organisms in study of developmental biology: frog, chick, mouse, Drosophila, Sea urchin, Zebra Fish , *Caenorhabditis elegans*	2

II	**Reproduction and Development**: • Basics of gametogenesis: Oogenesis, spermatogenesis and spermiogenesis • Detailed structure of gametes • Fertilization process in sea urchin and mammals • Types of eggs, types and patterns of cleavage • Morphogenetic movements	9
III	**Gastrulation** • In frog, chick, *Drosophila* up to formation of threegerminal layers	8
III	**Basics of neurulation**	2
IV	**Concept of pattern formation** • Maternal effect genes and their role in Drosophila pattern formation	2
V	• Concept of Stem cells, Progenitor cells, cell lineages, determination, commitment and differentiation, re differentiation and trans-differentiation	1
VI	**Different types of regeneration with one example of each type**	2
VII	**Theories of ageing**	1
VIII	• Apoptosis during Embryonic development, intrinsic an extrinsic pathways	2
IX	**Abnormal development and teratogenesis in animals**	1

Reference Books:

1. Development Biology, 9th edition, (2010),Gilbert S.F.(Sinauer Associates, USA)
2. Principles of Development, 5thedition (2018), Wolpert L and Tickle C, Publisher: OxfordUniversity Press, USA.
3. An introduction to embryology, 5th edition, B. I. Balinsky, B.C. Fabian (2012) CengageLearning India

Subject Code: 23 BBT-405

Subject: Plant Development (2 Credit Course)

Total Lectures=30

Unit	Topic	No. of lectures
1	**Plant as a living system** • Principles and Unique features of plant development • Comparison of Plant and animal development,	3

2	**Plant development at:** • Cellular, organ and whole-plant levels • Whole plant as an interacting dynamic system	2
3	**Major phases of plant development** **i) Vegetative development:** • Zygote to seed embryo to seedling till vegetative maturity • Pattern formation in plants- vegetative	3
	ii) Reproductive development: • Shift from vegetative to reproductive phase • Structure of flower • Induction- perception of inductive stimuli and subsequent changes, • Pattern formation in plants- flowering	4
4	• Microsporogenesis, development of male gametophyte and male gamete • Megasprogenesis, development of female gametophyte and female gamete • Double fertilization and triple fusion • Development of endosperm	5
5	**Concept of** • competence, • Determination, • Commitment, • Differentiation, • De-differentiation and • Re-differentiation (partial/ terminal) *in vivo* with one example each	3
6	**Model systems to understand plant development :** • *Arabidopsis* Molecular regulation of development in *Arabidopsis*	6
7	**Parthenogenesis-** • Haploid , Diploid • Parthenocarpy – Natural , Induced • Importance of seed and seed dispersal • Applications of Plant development in Biotechnology	4

Reference Books:

1. Development Biology, 9th edition, (2010), Gilbert S.F.(Sinauer Associates, USA)
2. Principles of Development, 4th edition (2010), Wolpert L and Tickle C, Publisher: OxfordUniversity Press, USA.
3. Bhojwani S.S. and Bhatnagar S.P.(2009) – Embryology of Angiosperms (Vikas Publ House,New Delhi)
4. Burgess J. (1985) An Introduction to Plant Cell Development (Cambridge Univ Press, UK)

5. Taiz L, Zeiger E (2010) – Plant physiology (Sinauer Associates, USA).
6. Sharma HP (2009) – Plant embryology: Classical and experimental (alpha sci)
7.Steeves TA & Sussex IM (2004) – Patterns in plant development.
(Cambridge Univ Press,Cambridge, New York)
8 The molecular life of plants by Jones et al Wiley
9. Biochemistry and Molecular Biology of Plants, 2nd Edition - Bob Buchanan et al Wiley
10. Plant Physiology, Taiz and Zeiger Sixth edition Sinaeur

Subject Code: 23 BBT : 406

Subject : Microbial Biotechnology (2 Credit Course)

Total Lectures=30

Unit	Topic	No. of Lectures
I	**History and Scope of Microbial Biotechnology**	1

II	**Food and Dairy Microbiology** **A) Food Microbiology** • Role of microorganisms in food spoilage, Factors affecting growth of microbes in food (intrinsic and extrinsic factors), Spoilage of meat and poultry, Fruits and vegetable, Canned food. • Principles of Food Preservation. • Methods of preservation Chemical and Physical methods. **B) Dairy Microbiology** • Milk: Definition, Composition of milk, Normal and abnormal microflora of milk, Sources of contamination of milk, International standards of Milk. • Milk Spoilage- Flavour and colour defects, Stormy fermentation, Sweet curdling, Ropiness. • Grading of milk- Direct and Indirect Tests • Preservation of Milk- Pasteurization and efficiency of pasteurization. • Microbial processing of milk- Curd,Yogurt, Butter, Kefir, Cheese. • Food borne diseases- Food infection and intoxication	7
III	**Medical Microbiology** • Medical Microbiology: Normal flora, • Diseases of various systems Tuberculosis, Leprosy, Typhoid, Polio, Syphilis, Tetanus, causative agent, symptoms, morphology, pathogenesis, diagnosis and treatment.	7
IV	**Microbes in Waste treatment Processes** • Water borne diseases: Indicators of faecal pollution, Routine bacteriological analysis of water for potability: Presumptive, Confirmed, Completed test, Membrane Filter Technique and Eijkman tests. • Bacteriological standards of drinking water.(WHO, BSI) • Sewage and Industrial waste water: Types of wastes, relevance of COD and BOD determination in analysis of waste water • Methods and principles of treatment of sewage (primary, secondary and tertiary treatment methods • Microbial consortium for effluent treatment.	8

V	**Applications of Microbial Biotechnology** • Geomicrobiology-Ore leaching (methods and examples), MEOR. • Bioweapons • Biofertilizers and Biopesticides and Microbial plant growth Promoters(gibberellins and IAA) • GMOs-Norms and applications • Microbial Sweeteners (Thaumatin, Monelin) • Microbial toxins and their applications • Microbial Polysaccharide production: any 2 examples Concept of Synthetic Biology and Bio metabolite Production	7

References Books :

1. Food Microbiology, Frazier & Westhoff, 4th edition, Tata McGraw Hill Publications
2. Modern Food Microbiology, James Jay, 7th edition, Springer Publications
3. Advances in Biotechnology, S. N. Jogdand, Himalaya Publishing House
4. Milk & Milk Products, C. Eckles, 4th edition, Tata McGraw Hill Publications
5. Prescott, S.C. and Dunn, C.G., (1983) Industrial Microbiology, Reed G. AVI tech books
6. General Microbiology - Stanier R.Y., 5th edition, (1987)Macmillan Publication, UK.
7. Fundamental Principles Of Bacteriology**,** Salle,A.J.,McGraw Hill Company, New York
8. Tortora, G.J., Funke, B.R., Case, C.L, 1992. Microbiology: An introduction 5th Edition,Benjamin Pub. Co. NY
9. Davis B.D., Delbacco, 1990 Microbiology 4th edition, J.B. Lippincott Co. NY
10. Wolfgang K. Joklik, 1992, Zinsser Microbiology 20th Edition, McGraw-Hill ProfessionalPublishers
11. Dey, N.C and Dey, TK. 1988, Medical Bacteriology, Allied Agency, Calcutta, 17thEdition
12. Ananthnarayana, R. and C.E, Jayaram Panikar, 1996 Text book of microbiology, 5th edition, Orient Longman. .Park and Park, Preventive and Social medicine. 2013, Publisher: Banarsidas Bhanot, Jabalpur
13. Ingraham J.L. and Ingraham C.A. (2004) Introduction to Microbiology. 3nd Edition. Thomson Brooks / Cole.
14. Madigan M.T, Martinko J.M. (2006) Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
15. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Publishing Co.
16. Standard Methods for the Examination of Water and Wastewater (2005) 21st edition, Publication of the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF); edited by Andrew D. Eaton, Mary Ann H. Franson.Satyanarayan, U. Biotechnology(2008), Books and

Allied Ltd.Kolkata
17. Singh, B. D. Biotechnology,(2010), Kalyani Publishers, New Delhi

Subject Code: 23 BBT: 409

Subject : Practicals in Molecular Biology and Microbial Biotechnology (2 Credit Course)

Total Practical= 15 P (15x3hrs.)

Sr. No.	Title of Experiment	No. of Practical
	Molecular Biology	
1	Preparation of Reagents	1
2	Isolation of Eukaryotic(Plant) DNA and analysis by Agarose gel electrophoresis	2
3	Isolation of Eukaryotic(Animal) DNA and analysis by Agarose gel electrophoresis	2
4	Estmation of RNA by Orcinol method	**1**
5	Estimation of proteins by Bradford method	**1**
	Microbial Biotechnology	
6	Food and Dairy Microbiology: a. Isolation and identification (Genus level) of spoilage causing microorganisms from spoiled foods b. Grading of raw milk (Dye reduction test, DMC) c. Determination of efficiency of Pasteurization by phosphatase test	**3**
7	Study of Normal flora of humans (Skin and oral cavity)	**1**
8	Assessment of potability of water: a. Presumptive b. Confirmed and c. Completed test. d. Eijkman's teste. e. IMViC tests	**3**
9	Visit to Dairy/ Effluent treatment plant / Sewage Treatment /Biofertilizer plant/ any other relevant industry and report writing.	**1**

Reference books :

1 Lab manual on molecular biology January 2016 Edition: First Edition, Media AssociatesDelhi-53Editor: Ruhi Dixit, KartikayBisen, Ashwani Kumar, Ashim Borah, Chetan KeswaniISBN: 978-81-909182-7-5

2 Modern Food Microbiology, James Jay, 7th edition, Springer Publications
3 Madigan M.T, Martinko J.M. (2006) Brock's Biology of Microorganisms. 11th Edition.Pearson Education Inc
4 Ananthnarayana, R. and C.E, Jayaram Panikar, 1996 Text book of microbiology, 5th edition, Orient Longman. .Park and Park, Preventive and Social medicine. 2013, Publisher: Banarsidas Bhanot, Jabalpur

Subject Code: 23 BBT -410

Subject : Practicals in Animal & Plant Development (2 Credit Course)

(Total Practical= 15 P (15x3hrs.)

Sr. no.	Topic of practical	Practical No
	Animal development	
1	Study of frog development, observation of different development stages (Permanent slides or fixed embryos)	1
2	Study of amphioxus development, observation different development stages (Permanent slides)	1
3	Study of staging & staining of Chick embryos (24 h, 48h, 72 h)	2
4	Effect of teratogen on development of chick embryo by window technique	2
5	Demonstration of any one technique of chick embryo culturing	1
6	Demonstration of regeneration in *Hydra*	1
	Plant Development	
1	Methods of studying plant development (any suitable plant material) a) Dissection b) Sectioning c) Staining d) Mounting	1
2	Study of apices and meristem- RAM, SAM, florally induced meristem	2
3	Microsporogenesis- anther squash technique	1
4	Development of male and female gametophytes	1
5	Developmental stages during plant embryogenesis in dicots and monocots	1
6	Dissection of seed and excision of young embryo and endosperm (Two dicotyledon and Two monocotyledon example)	1

Reference Books:

1. Burgess J. (1985) An Introduction to Plant Cell Development (Cambridge Univ Press, UK)
2. Taiz L, Zeiger E (2010) – Plant physiology (Sinauer Associates, USA).
3. Sharma HP (2009) – Plant embryology: Classical and experimental (alpha sci)
4. Development Biology, 9thedition, (2010), Gilbert S.F.(Sinauer Associates, USA)
5. Principles of Development, 5thedition (2018), Wolpert L and Tickle C,

Publisher: OxfordUniversity Press, USA.

6. An introduction to embryology, 5th edition, B. I. Balinsky, B.C. Fabian (2012) CengageLearning India

Subject Code: 23 BBT -411

Subject :Practical in Cell Biology and Immunology(2 Credit Course)

Total Practical= 15 P (15x3hrs.)

Unit	Topic	Practical
Section I : Cell Biology		
1	Study of different stages of Mitosis	2
2.	Effect of colchicine on mitosis	1
3	Study of different stages of Meiosis in *Tradescantia*	2
4	Study of polytene chromosomes (*Drosophila/Chironomus* larva)	2
Section II – Immunology		
5.	Determination of blood group using slide agglutination Reaction	1
6	To determine total leukocyte of given blood sample	1
7	Determine Differential count of given blood sample	1
8	Immunodiffusuion: a) Single Radial immunodiffusion b) Ouchterlony double diffusion technique (pattern of identity)	2
9	Determination of antibody titer by tube agglutination test (Widal Test)	2
10	Detection of presence of antigen by qualitative ELISA(Dot ELISA)	1

Reference Books :

1 Cell biology and genetics lab manual Boğaziçi University Department of MolecularBiology and Genetics 2007-2008

2 Cell Biology Laboratory The University of Toledo Department of BiologicalSciences/Natural Sciences and Mathematics

3 Ananthanarayan R and Paniker CKJ. Textbook of Microbiology. University PressPublication.

4 Roitt I. Essential Immunology. 10th Ed. Blackwell Science.

5 Kuby. Immunology. 4th edition. W. H. Freeman & company.