**PhD Course Work: Syllabus Revision in 2016-17**.

| S. No | Course Code | Session 2015-16 | Session 2016-17 | Remark Syllabus Change/ new course |
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| 1 | **RCW – I** | **Research**<br>• Objective, Types of research, process and steps in it. Research proposal and concept.<br>• Research Design- meaning, need, concept and different research designs. Literature survey and review, research design process an error in research.<br>• Research Modeling- Types of Models, Model building and stages, Data consideration and testing(Sampling, Collection and Analysis), Heuristic and Simulation.<br>**Design of Experiments**<br>• Objectives, strategies, Factorial experimental design, Designing engineering | **Research**<br>• Objective, Types of research, process and steps in it. Research proposal and concept.<br>• Research Design- meaning, need, concept and different research designs. Literature survey and review, research design process an error in research.<br>• Research Modeling- Types of Models, Model building and stages, Data consideration and testing (Sampling, Collection and Analysis), Heuristic and Simulation.<br>**Design of Experiments**<br>• Objectives, strategies, Factorial experimental design, Designing engineering experiments, basic principles- replication, randomization, blocking, guidelines for design of experiment.<br>• Analysis of variance- ANOVA- Basic principle, One way and Two way technique.<br>• Analysis of Co-variance- ANOCOVA | **Syllabus rivision** |

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| | | experiments, basic principles- replication, randomization, blocking, guidelines for design of experiment.<br>• Analysis of variance- ANOVA- Basic principle, One way and Two way technique.<br>• Analysis of Co-variance- ANOCOVA technique.<br>**Report writing and Interpretation**<br>• Pre- writing considerations. Meaning and technique of interpretation.<br>• Different steps in report writing, Formats of report writing, Thesis writing, Formats of publication in Research journals. | technique.<br>**Report writing and Interpretation**<br>• Pre- writing considerations. Meaning and technique of interpretation.<br>• Different steps in report writing, Formats of report writing, Thesis writing, Formats of publication in Research journals.<br>**Spreadsheet Tool**<br>• Introduction to spreadsheet application, features and function<br>• Using formulas and functions, Data storing<br>• Features for statistical data analysis, Generating charts/ graph and other features.<br>• Tools used may be Microsoft Excel, Open office or similar tool.<br>**Presentation Tool**<br>• Introduction to presentation tool, features and function.<br>• Creating presentation, Customizing presentation, showing presentation.<br>• Tools used may be Microsoft power Point, Open office or similar tool. | |

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| | | | **Writing Tool**<br>• M.S.Word<br>• PDF format<br>• LaTeX<br>**Web Search**<br>• Introduction to Internet, Use of internet and WWW, Using search engine like Google, Yahoo etc.<br>• Using advanced search techniques. | |
| **2** | **RCW – III** | **Digital Logic:** Logic functions, Minimization, Design and synthesis of combinational and sequential circuits; Number representation and computer arithmetic (fixed and floating point).<br><br>**Computer Organization and Architecture:** Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Instruction pipelining, Cache and main memory, Secondary storage.<br><br>**Programming and Data Structures:** Programming in C; Functions, Recursion, Parameter passing, Scope, Binding; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps.<br><br>**Algorithms:** Analysis, Asymptotic notation, Notions of space and time | **CS-I**<br>Introduction to Data Mining, Major Issues in Data Mining, Applications of Data Mining, Social impacts of data mining. Data Preprocessing, Data warehousing**,** Data Mining primitives, Association Rule Mining. Classification and Predication, Cluster Analysis, Mining complex Types of data.<br><br>Web Scale AI and Big Data, Web Intelligence, Big Data, Indexing, Ranking, Page Rank Searching, Searching structured data. Databases and their Evolution, Big data Technology and Trends. Classification, Clustering, and Mining, Information Extraction in Big Data. Forecasting, Neural Models, Deep Learning, and Research Topics. Data Analysis: Regression and Feature Selection.<br>**CS-II**<br>Introduction to distributed | **New Course** |

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| | | complexity, Worst and average case analysis; Design: Greedy approach, Dynamic programming, Divide-and-conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Hashing, Sorting, Searching. Asymptotic analysis (best, worst, average cases) of time and space, upper and lower bounds, Basic concepts of complexity classes – P, NP, NP-hard, NP-complete.<br><br>**Theory of Computation:** Regular languages and finite automata, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines, Undecidability.<br><br>**Compiler Design:** Lexical analysis, Parsing, Syntax directed translation, Runtime environments, Intermediate and target code generation, Basics of code optimization.<br><br>**Operating System:** Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems, I/O systems, Protection and security.<br><br>**Databases:** ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query | technologies like Grid Computing, Cloud Computing etc.Architectural models for distributed and mobile computing systems. Basic Concepts in Distributed Computing such as clocks, Message ordering, Consistent global states, and consensus. Basic Algorithms in Distributed Environment. Synchronous and Asynchronous distributed computing. Memory Management in Distributed Environment.<br>Evolution of computing paradigms, Introduction to virtualization and virtual machine. CloudComputing: History, Cloud Service Models.<br>Internet History, Technology, and Security, Information System Security, Introduction to the Concepts of Security, Security Mechanism. Concepts of Grid Computing, Grid Architecture, Grid Security Demands and Solutions.<br>Cybersecurity and the Internet of Thing, IoT and the Industrial Sector, IoT and the Connected Home, IoT and Consumer Wearables.<br>**CS-III**<br>Artificial Intelligence: problem solving, planning, knowledge representation; pattern recognition; natural language understanding, computer vision, automatic programming, machine learning. | |

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| | | languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions and concurrency control.<br><br>**Information Systems and Software Engineering**: information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project, design, coding, testing, implementation, maintenance.<br><br>**Computer Networks:** ISO/OSI stack, LAN technologies (Ethernet, Token ring), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (icmp, dns, smtp, pop, ftp, http); Basic concepts of hubs, switches, gateways, and routers. Network security – basic concepts of public key and private key cryptography, digital signature, firewalls.<br><br>**Web technologies**: HTML, XML, basic concepts of client-server computing. | Neural Networks, Fuzzy Logic, Fuzzy Arithmetic, Introduction of Neuro-Fuzzy Systems,<br><br>Probabilistic Algorithm: Genetic Algorithm, Artificial Bee Colony Algorithm, Ant Colony Algorithm etc. Applications and implementations of probabilistic algorithm. | |
| **3** | **RCW – III** | **Applied Mechanics And Design**<br><br>**Engineering Mechanics:** Free body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion, including | **Metal Machining** - Modelling and control of Chip Formation, Machining of hardmaterials and metal matrix reinforced composites, Characterization and surface integrity in hard machining, Modern concepts of machining | **New Course** |

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| | | impulse and momentum (linear and angular) and energy formulations; impact.<br><br>**Strength of Materials:** Stress and strain, stress-strain relationship and elastic constants, Mohr's circle for plane stress and plane strain, thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; strain energy methods; thermal stresses.<br><br>**Theory of Machines:** Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels.<br><br>**Vibrations:** Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance, critical speeds of shafts.<br><br>**Design:** Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; *principles* of the design of machine elements such as bolted, riveted and welded joints, shafts, spur gears, rolling and sliding contact bearings, brakes and clutches.<br><br>**Fluid Mechanics and Thermal Sciences**<br><br>**Fluid Mechanics:** Fluid properties; | **Metal Forming:**<br><br>Yield criteria, Slip line field theory, Temperature Field in Material.- Plastic and viscoplastic behaviour of material, Surfaces of Discontinuity, Numerical Models of Plasticity.<br><br>**Advanced Machining Processes:**<br><br>Hybrid electro-chemical processes, Hybrid thermal processes, Solid, liquid and powder based material addition processes (Analytical Study)<br><br>**Reverse Engineering :**<br><br>Reverse engineering – Methodologies and Techniques, Hardware and software, Rapid prototyping – Relationship with reverse engineering<br><br>**Group Technology**: Role of group technology in CAD/CAM integration, Methods for developing part families, Classification and coding, Examples of coding systems, Facility design using group technology, Benefits of G.T.<br><br>**Computer Aided Process Planning**: Role of Process Planning, Approaches to process planning- Manual, Variant, Generative approach; Examples of Process planning systems - CAPP, DCLASS, CMPP; Criteria for selecting a CAPP system, Benefits of CAPP.<br><br>**Computer Integrated Manufacturing Systems**: Types of manufacturing systems, Machine tools and related equipment, Material handling systems, Computer control systems, CIMS Benefits.<br><br>**Quality Engineering in Manufacturing:** Introduction – quality and improvement-objectives-quality | |

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| | | fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc.<br><br>**Heat-Transfer:** Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of turbulence; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.<br><br>**Thermodynamics:** Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle. irreversibility and availability; behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to | assurance-quality systems-Economics – Statistical Tolerances – Quality loss function, Process variability- Charts for attributes, variables, moving average control charts | |

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| | | energy conversion.<br><br>**Applications:** *Power Engineering*: Steam Tables, Rankine, Brayton cycles with regeneration and reheat. *I.C. Engines*: air-standard Otto, Diesel cycles. *Refrigeration and air-conditioning*: Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air: psychrometric chart, basic psychrometric processes. *Turbomachinery:* Pelton-wheel, Francis and Kaplan turbines — impulse and reaction principles, velocity diagrams.<br><br>**Manufacturing and Industrial Engineering**<br><br>**Engineering Materials**: Structure and properties of engineering materials, heat treatment, stress-strain diagrams for engineering materials.<br><br>**Metal Casting:** Design of patterns, moulds and cores; solidification and cooling; riser and gating design, design considerations.<br><br>**Forming:** Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. | | |

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| | | **Joining:** Physics of welding, brazing and soldering; adhesive bonding; design considerations in welding.<br><br>**Machining and Machine Tool Operations:** Mechanics of machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, principles of design of jigs and fixtures<br><br>**Metrology and Inspection:** Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.<br><br>**Computer Integrated Manufacturing:** Basic concepts of CAD/CAM and their integration tools.<br><br>**Production Planning and Control:** Forecasting models, aggregate production planning, scheduling, materials requirement planning.<br><br>**Inventory Control:** Deterministic and probabilistic models; safety stock inventory control systems.<br><br>**Operations Research:** Linear programming, simplex and duplex method, transportation, assignment, network flow models, simple queuing | | |

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| | | models, PERT and CPM. | | |
| 4 | RCW – III | **Constitutional Law India**<br>Essential features of Indian Constitution<br>Premable<br>Fundamental Rights and Duties<br>Fundamental principles of State policy<br>Judiciary<br>Executive<br>Union State Legislative Relations<br>Emergency Provisions<br>Amendment of Constitution<br>Writ Jurisdiction<br>**Legal Theory**<br>Nature and Sources of Law<br>Positivism, Natural Law Theory, Sociological Jurisprudence<br>Rights and Duties<br>Concepts of Possession and Ownership<br>Law and Morality<br>**Public International Law**<br>Nature of International Law and its relationship with Municipal Law<br>Sources of International Law<br>Recognition of States and Governments<br>United Nations and its organs<br>Human Rights: Nature and | Essential Features of Indian Constitution<br>Distribution of Legislative and Executive Powers between Union and States<br>Fundamental Rights, Fundamental Duties and Directive Principles<br>Principles of Natural Justice<br>Judicial Review of Administrative Action- Writ Jurisdiction<br>Judicial Contribution in Bringing Social Changes<br><br>Nature and Definition of Offence<br>Common Intention and Common Object<br>Offences against Human body<br>Offences against Property<br>Offences against women<br><br>Nature of International Law and its relationship with Municipal Law<br>Recognition of States and Governments<br>Human Rights: Nature and scopes, Evolution and growth<br>Environmental Pollution- Meaning of Environment and Environmental Pollution,<br>Remedies for Environmental Protection- Civil, Criminal and Constitutional<br>International Development for protection of Environmental Pollution<br><br>Law relating to Right to Information<br>Law relating to Disadvantage Sections<br>Emerging Trends in Cyber Crimes<br>Laws relating to Women Empowerment | **Syllabus rivision** |

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| | | scopes, Evolution and growth<br>**Administrative Law**<br>Nature, Scope and Importance of Administrative Law<br>Principles of Natural Justice<br>Administrative Discretion and its control<br>Delegated Legislation<br>Lokpal and Lokayukta<br>**Law of Torts**<br>Foundation of Tortuous Liability<br>General Defences to an action of Torts<br>Vicarious Liability<br>Strict and AbsoluteLiability: Emerging trends in India<br>**Law of Crimes – General Principles**<br>Nature and Definition of Offence<br>Private defences<br>Common Intention and Common Object<br>Offences against Human body<br>Offences against Property<br>Offences against women<br>**Law of Contracts-General Principles**<br>Essentials of a valid contract<br>Offer, acceptance and consideration<br>Capacity to Contract- | Law relating to Scientific Investigation in Criminal matters | |

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| | | Minor's contract<br>Elements vitiating contract-mistake, fraud, misrepresentation, public policy, coercion, undue influence, frustration of contract<br>Remedies for breach of contract-Damages. | | |
| **5** | **RCW – III** | **Managerial Economics**<br>Demand Analysis: Demand forecasting, Law of Demand. Determinants of Demand, Measurement of Elasticity of Demand; Production Function with One Variable Input and with Two variable input; Cost Concepts, Short Run and Long Run Cost Function. Cost Output Relationship.<br>Forms of Market Perfect Competition: Monopoly, Monopolistic Compilation. Price Determination in Different Market<br>Macro Economics – concept, need and significance; National Income concepts and its measurement, Inflation and Unemployment<br>**Organisation Behaviour**<br>Concept and significance of organisational behaviour, , organisational design, types of organisational structure and structural components, understanding and managing Individual behaviour – Personality, Perception, Attitudes, Learning Theories and reinforcement, Motivation theories<br>Understanding and managing Group Behaviour – Process, interpersonal and group dynamics, communication – verbal, non-verbal, Leadership – | **MG-I**<br>**Fundamentals of Financial Management**<br>Meaning, Scope, Function & Objective of Financial Management, Decision Making, Role of Financial Manager in a company. Financial statements and their analysis through Ratio analysis and cash flow analysis.<br>**Statistical Methods**<br>Meaning, scope and limitations of statistics. Measurement of Central tendency- Mean, Mode and Median. Measures of Dispersion- Mean Deviation and Standard Deviation. Meaning Significance and limitations of Correlation and Regression.<br>**Financial System**<br>Meaning and functions of financial system, financial concepts, financial assets, financial intermediaries, financial markets, financial rates of return and financial instruments.<br>**Financial Decision Making**<br>Capital Structure- Meaning, significance & factors affecting | **Syllabus rivision** |

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| | | types, , Managing conflicts, Change Management and organisation development<br><br>**Human Resource Management**<br><br>Concepts and perspectives in HRM; HR Planning – objectives, process and techniques; Job Analysis- job description and specification; Recruitment and selection process; Induction, Training and Development – types and process;<br><br>Performance appraisal methods and evaluation; Job evaluation and wage & salary administration, Industrial Relations and Trade Unioins; Industrial Disputes – dispute settelement bodies and process, greivance handling; Labour Welfare & Social Security measures<br><br>**Financial Management**<br><br>Financial Management – nature, scope, objective and importance. Assumptions, importance and limitations of Cost volume profit analysis; Capital Budgeting decisions- Traditional methods and Discounted Cash Flow methods.<br><br>Factors affecting Capital Structure and calculation Cost of Capital; Determinants of Dividend Policy; Long term and short term sources of finance, Preparation of cash flow statements and its advantages. Meaning, objectives and limitations of Ratio Analysis. Calculation of various Ratios.<br><br>**Marketing Management**<br><br>Consumer and Industrial markets, Market Segmentation – Targeting | capital structure. Calculation of specific and weighted average cost of capital. Capital budgeting- decisions on the basis of traditional and discounted cash flow methods.<br><br>**International Financial Management**<br><br>International Accounting & International taxation including DTAA. Foreign Direct Investment- Advantages and Disadvantages. Risk Management through Future contracts, forward contracts and options.<br><br>MG:II<br><br>An overview of Human Resource Management: Importance and Functions, development of HRM, Personnel ManagementVs.HRM,changingroleofHRM,roleandqualitiesofHRmanager,challengestoHRM; Strategic HRM<br><br>HumanResourcePlanning Objectivs andSignificance,Process,JobAnalysis,Recruitment&Selection,Placementandinduction,Traininganddevelopment,Needassessment,Methodsoftraining; Evaluation of training program<br><br>Organizational Change & Development: Motivation, Leadership Styles, Job Satisfaction, Organization Culture, Organizational Effectiveness;Organizational Development, Stress & Burn out; Quality of Work Life, Work Life Balance, Employee Engagement | |

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| | | and positioning; Product decisions, Product Mix, Product life cycle, Branding and Packaging, Pricing methods and strategies;<br><br>Promotion decisions, promotion mix - advertising, personal selling; Channel Management, Vertical marketing system; Evaluation and control of marketing effort; New issues in Marketing – online marketing, customer relationship management<br><br>**Production and Operations Management**<br><br>Role and scope of production management, Facility location, layout planning and analysis; production planning and control – production process analysis, Production scheduling; Work measurement, Time and motion study, Statistical quality control, TQM<br><br>Role and scope of operations research; Linear Programming; Sensitivity analysis; Transportation Model; Inventory control, Queing Theory, PERT/CPM, Probability distributions – Binomial, Poisson, Normal and Exponential, Correlation and regression analysis<br><br>**Business Environment & Strategic Management**<br><br>Nature and Concept, Components (Economic and Non-Economic), Types of Market Economy, Monetary Policy : Concept & Instruments, Fiscal Policy : Concept, Government Budget and its Components; Privatization and Liberalization, Fundamentals and Facets of Globalization, GATT, WTO;<br><br>Components of Strategic Management, BCG Model, Porter's generic strategies, strategies in industry evolution, fragmentation, | CompensationManagement: Jobevaluation - Techniques,Wagesandsalaryadministration.Incentivepayments,fringe benefits;<br><br>Performanceappraisal:Objectivesandtechniques,PerformanceManagementandAppraisal,Stepsinappraisingperformance,TypesofAppraisal,360DegreeFeedback,BalancedScoreCard;CareerPlanninganddDevelopment<br><br>Industrial Relations: Causes of Industrial Unrest and Remedial Measures, Industrial disputes in India, Trade Unionism in India, Social Security, Health & Welfare Measure in India<br><br>Grievance management, collective bargaining – Concept, Process; Pre-requisites; industrial democracy and employee participation, Objectives and forms ofemployee participation.<br><br>International Human Resource Management: Dynamics of HRM in Multinational Corporations, Cross Cultural HRM. Human Relations Challenges of the Future, workforce diversity management, talent management; Ethical Issues in Human Resource Management<br><br>MG:III<br><br>Marketing – Basics, Present day importance of marketing in national and global context;<br><br>Market Segmentation Process, | |

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| | | maturity and decline, Global entry strategies, Joint Ventures and Strategies Alliances<br><br>**Business Ethics & Corporate Governance**<br><br>Entrepreneurship – concept, types, issues in innovation and creativity; Ethical issues in management, Ethical organization and its corporate code, Importance and need for business ethics; concept and importance of corporate governance, Corporate Governance & Ethics, Corporate Social Responsibility – concept, scope of Social Responsibility, Stakeholders (Internal and External), | Identifying and Evaluation Segments, Market Targeting and Positioning for Competitive Advantage. Consumer Behaviour – Decision Making Perspectives, Improving the judgement process, Models of consumer behaviour; Marketing Information System – Marketing Research System and Marketing Decision Support System.<br><br>Research Methods in Marketing – Quantitative and Qualitative Research in Marketing, Attitude Measurement and Scaling Techniques, Product Research, Test Marketing, Advertising Research, Media Research, Motivation Research.<br><br>Strategic Marketing – Customer, Competitor and Environmental Analysis; SWOT Analysis, BCG Framework model, Porter's Model, GE Model, McKinsey Model, Market Leader, Challenger, Follower and Nicher Strategies; Market Entry/Exit Decision; Marketing Mix Strategies; Sustaining Competitive Advantage and Core Competence.<br><br>New Product Development, Product Mix Strategies, Product Differentiation Strategies, Branding and Packaging Strategies and Decisions.<br><br>Logistics and Supply Chain Management; Retail Merchandising – Retailers' Marketing Mix, Product Merchandising and Display, Vendor | |

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| | | | Relations, Pricing and Mark Downs, e-retailing, Customer Relationship Management – Customer Life Time Value Customer Acquisition Development and Retention, Brand and Customer Equity.<br><br>Nature of Marketing of Services, Services Versus Physical Goods, Different types of service Attributes – Search, Experience and Credence, Marketing Mix, ExtendedMarketingMix for Services(Seven Ps of Services), Classification of services, Characteristics of services (4-I's of Services). Service Consumer and Buying Process, Managing Service Product, Promotion, Place and Service Inventory, Managing Service Product, Promotion, Place and Service Inventory, 'People' Element in Marketing Mix and Relationship Marketing. | |