

**TEACHING AND EXAMINATION SCHEME**  
**Master of Computer Applications**  
**W.E.F. 2019-2020**  
**Semester I**

Paper Name (Theory)	Lec	Tut	Exam Hours	MAX MARKS	
				Sess- ional	Sem Exam
mca-101 Computer Organization	5	1	3	20	80
mca-102 Programming C Language	5	1	3	20	80
mca-103 Open Source Technology	5	1	3	20	80
mca-104 Computer Networks	5	1	3	20	80
mca-105 Database Management Systems	5	1	3	20	80
<b>Total of Theory (Sessional &amp; Semester Exam Marks)</b>					<b>500</b>

Paper Name (Practical)	Pract Hours	Exam Hours	Max Marks
mca-106 Lab-C Programming	4	3	50
mca-107 Lab- Networking	4	3	50
mca-108 Lab-Microprocessor, DBMS	4	3	50
mca-109 Lab-Open Source (Linux, PHP)	4	3	50
<b>Total of Practical Marks</b>			<b>200</b>

**Total of Theory & Practical Marks      700**

# TEACHING AND EXAMINATION SCHEME

## Master of Computer Applications

### Semester II

Paper Name (Theory)	Lec	Tut	Exam Hours	MAX MARKS	
				Sess- ional	Sem Exam
mca-201 Data Warehouse & Data Mining	5	1	3	20	80
mca-202 Data Structures, Algorithm & Analysis	5	1	3	20	80
mca-203 Object Oriented Programming	5	1	3	20	80
mca-204 Visual Programming	5	1	3	20	80
mca-205 Web Programming	5	1	3	20	80
<b>Total of Theory (Sessional &amp; Semester Exam Marks)</b>					<b>500</b>

Paper Name (Practical)	Pract Hours	Exam Hours	Max Marks
mca-206 Lab-C++ Programming & Data Structures	4	3	50
mca-207 Lab-Data Mining	4	3	50
mca-208 Lab-Visual Programming	4	3	50
mca-209 Lab-Web Programming	4	3	50
<b>Total of Practical Marks</b>			<b>200</b>

**Total of Theory & Practical Marks      700**

# TEACHING AND EXAMINATION SCHEME

## Master of Computer Applications

### Semester III

Paper Name (Theory)		Lec	Tut	Exam Hours	MAX MARKS	
					Sess- ional	Sem Exam
mca-301	Data science with R	5	1	3	20	80
mca-302	Advance Java Programming	5	1	3	20	80
mca-303	Computer Graphics	5	1	3	20	80
mca-304	Advance Database Management Systems	5	1	3	20	80
<b>Elective I</b>						
mca-305a	Bluetooth Technology	5	1	3	20	80
mca-305b	Wireless Protocols					
<b>Total of Theory (Sessional &amp; Semester Exam Marks)</b>						<b>500</b>

Paper Name (Practical)		Pract Hours	Exam Hours	Max Marks
mca-306	Lab-Advance Java Programming	4	3	50
mca-307	Lab-Computer Graphics	4	3	50
mca-308	Lab-ADBMS&Data Science	4	3	50
mca-309	Lab- Wireless Networking	4	3	50
<b>Total of Practical Marks</b>				<b>200</b>
<b>Total of Theory &amp; Practical Marks</b>				<b>700</b>

## Master of Computer Applications Semester IV

Paper Name (Theory)		Lec	Tut	Exam Hours	MAX MARKS	
					Sess- ional	Sem Exam
mca-401	Programming in Python	5	1	3	20	80
mca-402	Machine Learning	5	1	3	20	80
mca-403	Object Oriented Software Engineering	5	1	3	20	80
mca-404	Deep Learning	5	1	3	20	80
<b>Elective I</b>						
mca-405a	Cyber security	5	1	3	20	80
mca-405b	Image Processing					
<b>Total of Theory (Sessional &amp; Semester Exam Marks)</b>						<b>500</b>
Paper Name (Practical)				Pract Hours	Exam Hours	Max Marks
mca-406	Lab-Deep Learning			4	3	50
mca-407	Lab-Image processing			4	3	50
mca-408	Lab-Machine Learning			4	3	50
mca-409	Lab- Python& OOSE			4	3	50
<b>Total of Practical Marks</b>						<b>200</b>
<b>Total of Theory &amp; Practical Marks</b>						<b>700</b>

# TEACHING AND EXAMINATION SCHEME

## Master of Computer Applications

### Semester V

Paper Name (Theory)		Lec	Tut	Exam Hours	MAX MARKS	
					Sess- ional	Sem Exam
mca-501	Cloud Computing	5	1	3	20	80
mca-502	BIG Data	5	1	3	20	80
mca-503	Advance Windows Programming	5	1	3	20	80
<b>Elective I</b>						
mca-504a	Information Security	5	1	3	20	80
mca-504b	Web Development					
<b>Elective II</b>						
mca-505a	Spatial Database Management System	5	1	3	20	80
mca-505b	Grid Computing					
<b>Total of Theory (Sessional &amp; Semester Exam Marks)</b>						<b>500</b>

Paper Name (Practical)		Pract Hours	Exam Hours	Max Marks
mca-506	Lab-Minor Project	4	3	50
mca-507	Lab-Elective I& Cloud Computing	4	3	50
mca-508	Lab-Elective II&BIG Data	4	3	50
mca-509	Lab-Windows Programming	4	3	50
<b>Total of Practical Marks</b>				<b>200</b>
<b>Total of Theory &amp; Practical Marks</b>				<b>700</b>

**TEACHING AND EXAMINATION SCHEME**  
**Master of Computer Applications**  
**Semester VI**

Paper Name (Theory)		Lec	Tut	Exam Hours	MAX MARKS	
					Sess- ional	Sem Exam
mca-601	Information Retrieval	5	1	3	20	80
mca-602	Service Oriented Architecture	5	1	3	20	80
mca-603	Mobile Application Development	5	1	3	20	80
mca-604	Dissertation	5	1	3	50	200
<b>Total of Theory (Sessional &amp; Semester Exam Marks)</b>						<b>550</b>
Paper Name (Practical)				Pract Hours	Exam Hours	Max Marks
mca-605	Mobile Application Development			4	3	50
mca-606	Seminar			4	3	100
<b>Total of Practical Marks</b>						<b>150</b>
<b>Total of Theory &amp; Practical Marks</b>						<b>700</b>

## **Scheme of Examination (For M. C. A.)**

### **Theory:**

#### **Part A:**

1. 10 Question of 1 mark each – 10 marks
2. Answer should not exceed more than 20 words
3. All questions are compulsory

#### **Part B:**

1. 5 Questions of 2 marks each – 10 marks
2. Answer should not exceed more than 50 words
3. All questions are compulsory

#### **Part C:**

1. 3 Questions of 20 marks each – 60 marks. There will be an internal choice in each question.
2. Answer should not exceed 400 words
3. All questions are compulsory.

### **Sessional:**

There will be sessional (internal assessment) of 20 marks conducted by the department.

### **Practical:**

Practical exams shall be conducted by one internal and one external examiner of a batch of 20 students in a day.

Duration of Practical exam is 3 hours.

A Laboratory Exercise File should be prepared by each student for each practical paper and should be submitted during practical examinations.

Practical of 50 marks distribution is as under:

- a. 30 marks for practical examination exercise for 3 questions
- b. 10 marks for Viva-voce
- c. 10 marks for Laboratory Exercise File

### **Eligibility:**

BSC/BA/BCOM/BCA /BSC (CS / IT) / Vocational /Graduate from any discipline with at least 50% marks in aggregate. Admission is strictly on the basis of merit.

## **Scheme of Examination (For M. C. A.)**

Reg. 17 (b)

The examination for the Master of Computer Applications will consist of 6 semesters. The examination shall consist of (a) Theory papers (b) Laboratory / Practical work (c) seminar (d) minor project and (e) industrial dissertation work. Candidates will be required to pursue a regular, full time course of study at the University department for a period of three academic years in order to be eligible for appearing in the examination.

1. Eligibility for M. C. A.: BSC/BA/BCOM/BCA /BSC (CS / IT) / Vocational /Graduate from any discipline with at least 50% marks in aggregate.
2. Examination:
  - i. There shall be 51 papers (5 theory and 4 practical in semesters I to V, 4 theory and 2 practical in semester VI and 1 minor project in Semester V and 1 industrial dissertation and 1 seminar in Semester VI) of 5100 marks (I to VI Semester). There will be 1 Elective in III, IV Semester and 2 Electives in V Semester. Theory paper shall be of 3 hours duration having 100 marks. Out of 100 marks 20 marks shall be considered as internal assessment based on internal test and seminars and 80 marks will be of examination at the end of each semester as determined by the University. The practical shall be of 50 marks assessed by external examiner. The Minor Project work shall be of 50 marks based on project presentation and viva-voce, assessed by external examiner. The Seminar in VI Semester will be 100 marks which will be based on presentation and viva-voce assessed by external examiner. The Industrial Dissertation shall be 250 marks out of which 200 will be based on project presentation and viva-voce, assessed by external examiner and 50 marks will be assessed by internal examiner.
  - ii. To pass a semester a candidate shall have to score 36% marks in each subject (theory and practical) separately and also 40% marks in aggregate of all the papers prescribed for the examination.
  - iii. Due paper(s) will be applicable if a candidate obtains 40% marks in aggregate and fails in not more than two (2) papers (theory). Due paper(s) of I semester will be held along with the III semester, the due of III semester will be held along with V semester, the due paper(s) of II semester will be held along with the IV semester and due papers of the IV semester will be held along with the VI semester. The V and VI semester due paper(s) will be held in the I and II semester respectively of the next year. The chance of due paper(s) will be given thrice in each semester.
  - iv. Wherever a candidate appears at for a due paper examination he/she will do so according to the syllabus in force.
  - v. A candidate not appearing at any examination/absent in any paper of term end examination shall be deemed as fail.
3. A candidate for a pass in the examination shall be required to obtain:
  - i. At least 40% marks in the aggregate of all the papers prescribed for the examination and



- ii. At least 40% marks in the practical(s) wherever prescribed at the examination, provided that if a candidate fails to secure at least 36% marks in each individual paper at the examination notwithstanding his/her having obtained the minimum percentage of marks required in the aggregate for that examination.

No Division will be awarded in the first, to fifth semester examinations. Division shall be awarded at the end of the sixth semester Examination on the combined marks obtained at the first to fifth semester taken together as noted below:

Passed with First Division          60% of the aggregate marks taken together of all the  
Six semester examinations

Passed with second division      48%

All the rest will be declared to have passed the examination.

Provided that if a candidate clears any paper after a continuous period of three years since he/she was admitted to the M. C. A. then for the passing marks, i.e. 36% marks, shall be taken into account in the case of such course(s).

Provided further that in case where a candidate requires more than 36% marks in order to reach the requisite minimum aggregate i.e. 40% marks, as many marks, out of those actually secured by him/her will be taken into account as would enable him/her to make up the deficiency in the requisite minimum aggregate marks.

4. The grace marks shall be given up to 1% of the total aggregate marks of theory and practical of that semester in maximum one paper.
5. Candidates reappearing at an examination in a subsequent year shall be examined in accordance with the scheme and syllabi in force and shall be entitled to the award of the degree of year in which they clear the last failing/unclear paper.

<b>Duration: 3 hours</b>	<b>Max Marks: 80</b>
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### **mca-101Computer Organization**

Number system, Logic Gates, Boolean Algebra, K-Map, combinational circuit, flip-flop, sequential circuit, encoder, decoder, multiplexer, shift register, fixed-point representation, floating-point representation.

Register transfer language, inter-register transfer, arithmetic micro operation, logic and shift micro operation, instruction codes, timing and control, input/output and interrupts.

Processor bus organization, arithmetic logic unit, stack organization, instruction format, addressing mode, data transfer and manipulation, program control, control memory, addressing sequence, micro program sequencer, micro instruction formats.

Block diagram of 8085 and pin configuration, memory hierarchy, associative memory, memory addressing, virtual memory, cache memory, cache coherence.

### **mca-102 Programming C Language**

Overview of C Language: History of C, Character set, C tokens, Identifiers, Keywords, Data types, Variables, Constants, Symbolic Constants, Operators in C, Hierarchy of Operators, Expressions, Type Conversions and Library Functions.

Managing Input and Output Operation: Formatted and Unformatted I/O Functions, Decision making, branching and looping: Decision Making Statements - if Statement, if-else statement, nesting of if-else statements, else-if ladder, switch statement, ?: operator

Looping - while, do-while, for loop, Nested loop, break, continue, and goto statements. Functions: Function Definition, prototyping, types of functions, passing arguments to functions, Nested Functions, Recursive functions.

Arrays: Declaring and Initializing, One Dimensional Arrays, Two Dimensional Arrays, Multi-Dimensional Arrays - Passing arrays to functions. Strings: Declaring and Initializing strings, Operations on strings, Arrays of strings, passing strings to functions. Storage Classes - Automatic, External, Static and Register Variables.

Structures-Declaring and Initializing, Nested structure, Array of Structure, Passing Structures to functions, Unions, typedef, enum, Bit fields. Pointers – Declarations, Pointer arithmetic, Pointers and functions, Call by value, Call by reference, Pointers and Arrays, Arrays of Pointers, Pointers and Structures. Meaning of static and dynamic memory allocation, Memory allocation functions, stack, single linked list, prefix, postfix, infix, queue

<b>Duration: 3 hours</b>	<b>Max Marks: 80</b>
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### **mca-103Open Source Technology**

Introduction to Operating Systems, goals of OS, operation of OS, resource allocator and related functions, classes of OS, batch processing, multi-processing, time sharing, distributed, real time systems, system calls, system programs, structure of OS, layer design of DOS, Unix, virtual machine OS, kernel based OS.

Process concept, interacting process, threads, fundamental of scheduling, scheduling criteria, long medium short term scheduling, scheduling algorithms , structure of concurrent system, critical section, critical region, inter-process communication, monitor and semaphores, implementation and uses.

Logical versus physical address, swapping, contiguous allocation, segmentation, paging, segmentation with paging, kernel memory allocation, page replacement algorithm, virtual memory, virtual memory with paging, demand paging, dead lock, characterization, methods for handling dead locks, prevention, avoidance, thrashing, allocation of frame, virtual memory using segmentation,

Architecture of Distributed system, inter-process communication protocol, network OS, issues in distributed design, issues of distributed file system, network structure, distributed system structure, file system, coordination.

History of Linux, Linux architecture, Linux file System, file naming, types of files, directory command, file command, vi editor, locating files in Linux, filter pipe, shell variables, local and global variables, command substitution, if, while, for, shift, tar, basic networking commands in Linux.

### **mca-104Computer Networks**

Introduction to Data communications and networking, protocols, standards and architecture, topology, transmission mode, OSI model, analog and digital signals, periodic and aperiodic signals, time and frequency domain, Fourier analysis concept.

Encoding digital to digital conversion, analog to digital conversion, digital to analog conversion, analog to analog conversion, transmission of digital data, DTE-DCE interface, EIA-232, EIA-449, X.21, modem, cable modem, guided and unguided, transmission media

Multiplexing, TDM, FDM, WDM, DSL, HDLC, error classification, types of errors, error detection, error correction, virtual redundancy check, longitudinal redundancy check, cyclic redundancy check.

Asynchronous transfer mode, protocol architecture, ATM cells, ATM layers, switches, circuit switching network and concepts, routing, packet switching, X.25, virtual circuit approach, point-to-point layers, link control protocol, network control protocol.

### **mca-105 Database Management Systems**

Conventional file system, object of database systems, data abstraction, data definition language, data manipulation language, database administrator. Database design stages, database model, database system architecture.

Centralized and client/server architecture in DBMS, entity relationship model, entities and entity sets their relationship, mapping constraints, generalization, aggregation, use of ER model for the design of databases, sequential, random, index sequential file organization, introduction and history of relational database, system relational algebra, normalization up to DKNF.

Create a Table in MS Access -Data Types, Field Properties, Fieldsnames, types, properties, default values, format, caption, validationrules Data Entry Add record delete recode and edit text Sort, find/replace,filter/select, re-arrange columns, freeze columns. Edit a Tables- copy, delete, import, modify table structure find replace.

Setting up Relationships- Define relationships, add a relationship, set a rule for Referential Integrity, change the join type, delete a relationship, save relationship Queries & Filter –difference between queries and filter,filter using multiple fields AND,OR,advance filter Queries create Query with one table,fiend record with select query, find duplicate record with query,find unmatched record with query, run query,save and change query.

Introduction to Forms Types of Basic Forms: Columnar, Tabular, Datasheet, Main/Subforms, add headers and footers, add fields to form, add text to form use label option button, check box,combo box, list box Forms Wizard, Create Template.

Introduction to Reports,Types of Basic Reports: Single Column, Tabular Report Groups/Total, single table report multi table report preview report print report, Creating Reports and Labels, Wizard

### **mca-201Data Warehouse & Data Mining**

Introduction of data warehousing, basic concepts, data warehousing architecture , data characteristics, Reconciled data layers. Data transformation function, tools to support data reconciliation.

Data Modeling Techniques and Options: Dimensions and Query Hierarchies, Star Schema and Variants, Spatial Data: A Very Special Dimension, Storage Concerns and Planning Physical Database Design, Exploiting Parallel Technology, Indexes

Introduction to data mining, DM techniques, issues and challenges in Dm, Applications, association rules, Prior, Partition, Pincer-Search, Dynamic Itemset counting, FP-tree growth, Incremental, Boder Algorithm

Clustering Techniques, portioning, k-Medoid algorithm, Hierarchical, categorical clustering algorithm, Decision tree, best split, splitting indices and criteria, decision tree construction algorithm, CART, ID3, C4.5, CHAID, Decision tree construction with presorting, rain Forest, approximate methods, Boat, Pruning Technique

Data mining using NN, web mining, temporal and spatial data mining.

<b>Duration: 3 hours</b>	<b>Max Marks: 80</b>
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### **mca-202Data Structures & Algorithm Analysis**

Definitions of Data Structure and Algorithm – Time and Space complexity- Algorithm notations.

Brute force and greedy algorithms, Divide and Conquer Strategy: Merge sort, quick sort, dynamic programming

Control structures- Variables – Data types- Arrays- String processing – Sorting and Searching- Insertion-Selection-Merge- Radix-Binary Search- Linear Search

Binary tree- Representation – Traversing – Threaded Binary tree- Binary Search tree- Insertion deletion into a binary search tree

Graph- Representation of Graph- Shortest path – Operation on Graphs- Traversing a Graph



### **mca-203Object Oriented Programming**

Object Oriented Concepts, Tokens, Expressions and Control Structures Introduction: Basic Elements of Programming, Console I/O Operations.

Control Structures: Control and Looping Statements. Function: Function Prototyping, Call and Return by Reference, Inline Function, Default and Const Arguments, Function Overloading, Arrays, Manipulators and Enumeration.

Classes and Object, Object Oriented Methodology: Basic Concepts/Characteristics of OOP. Advantages and Application of OOP's, Procedural Programming Vs OOP

Classes and Objects: Specifying a Class, Creating Objects, Private & Public Data Members and Member Functions, Defining Inline Member Functions, Static Data Members and Member Functions. Arrays within Class, Arrays of Objects, Objects as Function Arguments, Returning Objects.

Constructors, Destructors, Operators Overloading and Inheritance. Constructors and Destructors: Introduction, Parameterized Constructors, Multiple Constructors in A Class, Constructors With Default Arguments, Dynamic Initialization of Objects, Copy Constructors, Dynamic Constructors, Const Objects, Destructors Operators Overloading: Definition, Unary and Binary Overloading, Rules for Operator Overloading.

Inheritance: Defining Derived Classes, Types of Inheritance, Constructors and Destructors in Derived Classes.

Pointers Virtual & Friend functions and file handling Pointers: Pointer to Objects, this Pointer, New and Delete Operators, Virtual Function, Friend Functions. Opening, Closing a File, File Modes, File Pointers and their Manipulation, Sequential Input and Output Operations: Updating a File, Random Access, and Error Handling During File Operations, Command Line Arguments.

Single linked lists, stack, queue, sorting, insertion, selection, bubble

### **mca-204Visual Programming**

Introduction to .NET, .NET Framework features & architecture, CLR, Common Type System, MSIL, Assemblies and class libraries. Introduction to visual studio, Project basics, types of project in .Net, IDE of VB.NET- Menu bar, Toolbar, Solution Explorer, Toolbox, Properties Window, Form Designer, Output Window, Object Browser. The environment: Editor tab, format tab, general tab, docking tab. visual development.

Variables -Declaring variables, Data Types, Forcing variables declarations, Scope & lifetime of a variable, Control flow statements: conditional statement, loop statement. Constants, Arrays, types of arrays, Collections.

Subroutines, Functions, Passing variable number of arguments, Optional Arguments, Returning value from function, MsgBox & Inputbox, Class, overloading, constructor, inheritance, overriding, interfaces.

Working with Forms : Loading, showing and hiding forms, controlling one form within another. Textbox, Label, Button, Listbox, Combobox, Checkbox, PictureBox, RadioButton, Panel, scrollbar, Timer, ListView, TreeView, toolbar, StatusBar, OpenFileDialog, SaveFileDialog, FontDialog, ColorDialog, PrintDialog, LinkLabel. Designing menus : ContextMenu, access & shortcut keys.

Database programming with ADO.NET – Overview of ADO, from ADO to ADO.NET, Accessing Data using Server Explorer. Creating Connection, Command, Data Adapter and Data Set with OLEDB and SQLDB. Display Data on data bound controls, display data on data grid. Generating reports using CrystalReportViewer

### **mca-205Web Programming**

Cascading Style Sheets, introduction, levels of style sheets, style specification formats, selector forms, property value forms, font properties, list properties, color, alignment of text, the box model, background images, the <span> and <div> tags, conflict resolution.

Overview of JavaScript, object orientation and JavaScript, syntactic characteristics, primitives, operations, and expressions, screen output and keyboard input, control statements, object creation and modification, arrays, functions, constructors, pattern matching using regular expressions, errors in scripts.

JavaScript execution environment, the Document Object Model, elements access in JavaScript, events and event handling, handling events from body elements, handling events from text box and password elements, the DOM2 event model, the navigator object, DOM tree traversal and modification, positioning elements, moving elements, element visibility, changing colors and fonts, dynamic content, stacking elements, locating the mouse cursor, reacting to a mouse click, slow movement of elements, dragging and dropping elements.

Browser Management and Media Management, classes, constructors, object-oriented techniques in JavaScript

### **mca-301Data Science with R**

Introduction- Basic elements of R, data input and output, objects, attributes, number , vectors , array, matrix, lists,

Reading data from files , controls statements, loops , functions, R scripts, data science overviews, data visualisation using graphics in R, GGplot 2, File format of graphics output, introduction to hypotheses, types of hypothesis, data sampling, confidence and significance level, hypothesis tests, parametric test, non-parametric test,

Introduction to Regression Analysis, types of regression analysis, nonlinear regression, cross validation, principal component analysis, factor analysis, classification its types, linear, logistics , regression, support vector machine, k-nearest neighbour, Naïve Bayes classification, decision tree classification, random forest classification, evaluating classifier model, introduction clustering, clustering methods, association rules, Apriori algorithm

### **mca-302 Advance Java Programming**

Introduction to Java, characteristics, Object oriented programming, data types, variables, arrays  
Control statements: selection, iteration, jump statements, operators, Introduction to classes, class fundamentals, constructor, methods, stack class, inheritance, creating multilevel hierarchy, method overriding, Packages and interfaces, exception handling, multi-threaded programming, I/O applets  
Java Library, string handling, string comparison, string buffer

Servlet Structure, Servlet packaging, HTML building utilities, Lifecycle, Single Thread model interface, Handling Client Request: Form Data, Handling Client Request: HTTP Request Headers. Generating server Response: HTTP Status codes, Generating server Response: HTTP Response Headers, Handling Cookies, Session Tracking.

Overview of JSP Technology, Need of JSP, Benefits of JSP, Advantages of JSP, Basic syntax, invoking Java code with JSP scripting elements, creating Template Text, Invoking java code from JSP, Limiting java code in JSP, using JSP expressions, comparing servlets and JSP, writing scriptlets. Using Scriptlets to make parts of JSP conditional, using declarations, declaration example. Controlling the Structure of generated servlets: the JSP page directive, import attribute, session attribute, isEignore attribute, buffer and auto flush attributes, info attribute, errorPage and isErrorPage attributes, is Thread safe Attribute, extends attribute, language attribute, Including files and applets in JSP Pages, using java beans components in JSP documents

### **mca-303Computer Graphics**

Interactive graphics, passive graphics, advantage of interactive graphics, classification of application, hardware and software requirement of computer graphics

Point, line, DDA algorithm, Bresenham's line algorithm, circle generating algorithm, polynomial and spline curves, parallel curve algorithms, curve function, clipping operation, point, line, Cohen-Sutherland line clipping

2D transformation, matrix representation of 2D, composite transformation, translation, rotation, scaling, general pivot-point rotation, general fix scaling, reflection, shear, affine transformations and transformation functions

Parallel projection, perspective projection, visible line identification, depth cueing, surface rendering, meshes, splines, cubic spline interpolation, Bezeir Curves and surfaces, B-spline and surfaces, Beta-spline, 3D transformation, rotation, scaling, composite transformation, 3D transformation function.

### **mca-304 Advance Database Management Systems**

Object Oriented modeling, class, different types of attributes, generalization, inheritance, aggregation, encapsulation, complex objects, object definition language, object query language, object technology in RDBMS, dynamic multi-level index using B & B+ tree

Distributed database design, architecture of distributed processing system, data communication concept, data placement, placement of DDBMS, and other components, concurrency control techniques, recovery, transaction management, need of recovery, recovery techniques, serializability, two-phase locking.

Query optimization and processing, algorithm for external sorting, select and join, object and set operations, heuristics in query optimization, temporal database concept, multi-media database, Security and integrity of databases, security specifications in SQL, access control, flow control.

SQL\*PLUS Data types, Constraints, Operators, DDL, DML, PL/SQL syntax, Data types, PL/SQL functions, Error handling in PL/SQL, package functions, package procedures, Oracle transactions. Stored procedures & functions, creation and execution of procedures

Database Triggers: Introduction, Use & type of database Triggers, Triggers Vs. Declarative Integrity Constraints, BEFORE Vs. AFTER Trigger Combinations, Creating a Trigger, Dropping a Trigger.

### **mca-305aBluetooth Technology**

Introduction to wireless technologies: WAP services, Serial and Parallel Communication, Asynchronous and synchronous Communication, FDM,TDM, TFM, Spread spectrum technology  
Introduction to Bluetooth: Specification, Core protocols, Cable replacement protocol

Bluetooth Radio: Type of Antenna, Antenna Parameters, Frequency hoppingBluetooth Networking: Wireless networking, wireless network types, devices roles and states, adhoc network, scatternet  
Connection establishment procedure, notable aspects of connection establishment, Mode of connection, Bluetooth security, Security architecture, Security level of services, Profile and usage model: Generic access profile (GAP), SDA, Serial port profile, Secondary Bluetooth profile

Hardware: Bluetooth Implementation, Baseband overview, packet format, Transmission buffers,  
Protocol Implementation: Link Manager Protocol, Logical Link Control Adaptation Protocol, Host control Interface, Protocol Interaction with layers



### **mca-305bWireless Protocols**

Overview of Third Generation (3G) in wireless

Universal Mobile Telecommunication Service (UMTS), UMTS Service and Air interface, 3GPP network architecture, CDMA2000, TD-CDMA and TDSCDMA Technologies.

Evolution of 2.5G

Enhancement over 2G, GPRS and EDGE network services and architectures, traffic dimensioning, CDMA2000 (1XRTT), WAP and SMS, migration path from 2G to 2.5G to 3G

UMTS

UMTS basics, WCDMA interface, UTRAN architecture, establishment of UMTS speech cells, UMTS packet data (R99), high speed packet data handover and UMTS core network evolution

CDMA2000

Radio components, network structure packet data transport flow, radio network (IS-2000, 1XRTT), EVDO

TD-SCDMA

Architecture and code network, radio network, interface migration technique RAN Traffic planning.

TD-CDMA

Generic TD-CDMA architecture, code networks, radio network, interface migration technique RAN traffic planning

VoIP Technology

Basis of IP transport, VoIP challenge, H-323, session invitation protocol, distributed architecture and media gateway control, VoIP and SS7 VoIP quality of service.

<b>Duration: 3 hours</b>	<b>Max Marks: 80</b>
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### **mca-401 Programming in Python**

Programming basics and strings, numbers and operators, variables, making decisions

Functions, classes and objects, organizing programs, files and directories

Building modules, text processing,

Writing a GUI with Python, Accessing Databases

Python with XML, Network Programming, Programming with C, Numerical Programming,

Web Application and Web Services, Integrating Java with Python

### **mca-402Machine Learning**

Introduction: Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning.

Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias.

Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search

Artificial Neural Networks: Introduction, Neural Network representation, Appropriate problems, Perceptions, Backpropagation algorithm.

Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, , Naive Bayes classifier, Bayesian belief networks

Evaluating Hypothesis: Motivation, Estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms.

Instance Based Learning: Introduction, k-nearest neighbor learning, locally weighted regression, radial basis function, cased-based reasoning

### **mca-403 Object Oriented Software Engineering**

Concepts of Software Engineering, Software Characteristics, components applications, software Metrics and Models; Process and Product Metrics, Size metric, Complexity metric, McCabe's Cyclometric Complexity, Halsted Theory, Function Point Analysis.

System Development Life Cycle (SDLC) Steps, Water fall model, Prototypes, Spiral model. Planning and Software Project: Cost Estimation, Project Scheduling, Quality Assurance Plans, Project Monitoring Plans.

Software Development & Software Design : System design, detailed design, function oriented design, object oriented design user Interface design, Design level metrics: Phases, Process Models, Role of Management, Role of Metrics and Measurement, Software Quality factors

Coding and Testing: Programming Practices, verification, Monitoring and Control. Testing level metrics Software quality and reliability Clean room approach, software reengineering.

Testing & Reliability: Testing Fundamentals, Test case design, Functional Testing, Structural Testing, Test Plan activities during testing, Unit System , Integration Testing. Concept of Software Reliability, Software Repair and Availability, Reliability Models (JM, GO, MUSA Markov) Limitations of Reliability Models

<b>Duration: 3 hours</b>	<b>Max Marks: 80</b>
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### **mca-404Deep Learning**

Definition of AI, Application of AI, knowledge-based systems, representation of knowledge organization and acquisition of knowledge

Syntax, semantics of propositional logic, syntax and semantics of FOPL, conversion to clausal form, inference rule, resolution principles, non-deductive inference methods, representation using rules, truth maintenance system, predicate completion and circumscription, modal and temporal logics

Bayesian probabilistic inference, possible word representation, Dempster-Shafer Theory, Ad-Hoc methods, Expert system, natural language processing

Introduction to Deep learning, Backpropagations algorithm, initialization, deep neural network, introduction of generative adversarial network, Markov decision process

RNN Basics, Advance RNN, LSTN, GRU, Bi directional neural network, shallow neural network

### **mca-405aCyber Security**

Basic security concepts: hardware and software vulnerabilities, Malware : Types of Malware, Virus, Trojan, key logger, file blinder, testing FUD and Countermeasure.

Password cracking and prevention, introduction , password cracking techniques, dictionary based attack, brute force attack, cracking common files password, cracking web based password, password reset flaws , password change flaws , cracking Wi-Fi, password, countermeasures for users , countermeasures for system administrators.

Authentication and authorization vulnerabilities, authentication concepts, scenarios, user enumeration , direct page requests parameter modification , lack of SSL at login pages, Bypassing weak CAPTCHA mechanisms, login without SSPL , authorization, RBAC, authorization bypassing , parameter tampering, forceful browsing, rendering based authorization client side validation attacks, insecure direct object reference,

Input vulnerabilities: SQL injection , common implementation mistakes, - authentication bypassing using SQL injection, Cross site scripting, Reflected Vs Stored XSS Command injection.

Session and browser manipulation: Session and browser manipulation attacks, session management techniques, cookie based session management , cookie properties, cookies secrets in cookies, tampering , exposed session variables, missing attributes – http only, secure session validity after logoff, long session timeout, session keep alive enable /disable, session id rotation, cross site request forgery (CSRF), open redirect

### **mca-405bImage Processing**

Elements of Visual Perception, A Simple Image Formation Model, Basic Concepts in Sampling and Quantization, Representing Digital Images, Spatial and Gray-level Resolution, Zooming and Shrinking Digital Images, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.

Image Enhancement in the Spatial Domain: Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters

Image Enhancement in the Frequency Domain: Introduction to the Fourier Transform and the Frequency Domain, Smoothing Frequency-Domain Filters, Sharpening Frequency Domain, Filters, Homomorphic Filtering.

Image Restoration: A Model of the Image degradation/Restoration process, Noise Models, Restoration in the Presence of Noise Only—Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Inverse Filtering, Minimum

### **mca-501Cloud Computing**

Introduction: Business and IT perspective, Cloud and virtualization, Cloud services requirements, cloud and dynamic infrastructure, cloud computing characteristics, cloud adoption.

Cloud models: Cloud characteristics, Measured Service, Cloud models, security in a public cloud, public versus private clouds, cloud infrastructure self-service.

Cloud at a service: Gamut of cloud solutions, principal technologies, cloud strategy, cloud design and implementation using SOA, Conceptual cloud model, cloud service demand.

Cloud solutions: Cloud ecosystem, cloud business process management, cloud service management, cloud stack, computing on demand, cloud sourcing.

Cloud offerings: Cloud analytics, Testing under cloud, information security, virtual desktop infrastructure, Storage cloud.

Cloud management: Resiliency, Provisioning, Asset management, cloud governance, high availability and disaster recovery, charging models, usage reporting, billing and metering.

Cloud virtualization technology: Virtualization defined, virtualization benefits, server virtualization, Hypervisor management software, Logical partitioning, VIO server, Virtual infrastructure requirements. Storage virtualization, storage area networks, network attached storage, cloud server virtualization, virtualized data center.

Cloud and SOA: SOA journey to infrastructure, SOA and cloud, SOA defined, SOA defined, SOA and IAAS, SOA based cloud infrastructure steps, SOA business and IT services.



### **mca-502Managing Big Data**

What is big data, why big data, data, data storage and analysis, comparison with other systems, relational database management system, grid computing, volunteer computing, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies

Introduction to HADOOP – open source technologies, cloud and big data, mobile business intelligence, crowd sourcing analytics, inter and trans-firewall analytics.

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, shading, version, map reduce, partitioning and combining, composing map-reduce calculations.

### **mca-503 Advance Web Programming**

Introduction to .NET Framework: Genesis of .NET – Features of .NET – .NET binaries – Microsoft Intermediate Language – Meta Data – .NET types and .NET name spaces – Common Language Runtime – Common Type System – Common Language Specification – .NET Applications using command line compiler and visual studio .NET IDE.

Basics of ASP.NET: Introducing ASP.NET – Creating and deploying ASP.NET applications – Web forms – web controls – working with events – rich web controls – custom web controls – validation controls – debugging ASP.NET pages.

Advanced ASP.NET: ASP.NET configuration – Business objects – HTTP Handlers – Caching in ASP.NET – ASP.NET security – localizing ASP.NET applications – deployment projects

Building Web Services: Introduction to web services – web services infrastructure – SOAP – building a web service – deploying and publishing web services – finding web services – consuming web services

ADO.NET: Basics of ADO.NET – Changes from ADO – Data Table – Data Views – Data Set – Data Relation Type – ADO.NET Managed Providers – OLEDB and SQL Managed Providers – OLEDB Data Adapter Type.

### **mca-504a Information Security**

Introduction to Cryptography: Introduction To Security: Attacks, Services & Mechanisms, Security, Attacks, Security Services

Conventional Encryption: Classical Techniques, Conventional Encryption Model, and Steganography, Classical Encryption Techniques.

Modern Techniques: Simplified DES, Block Cipher Principles, DES Standard, DES Strength, Differential & Linear Cryptanalysis, Block Cipher Design Principles, Block Cipher Modes of Operation.

Conventional Encryption Algorithms: Triples DES, Blowfish, International Data Encryption Algorithm, Key Distribution, Random Number Generation, Placement of Encryption Function.

Public Key Encryption: Public-Key Cryptography: Principles of Public-Key Cryptosystems, RSA Algorithm, Key Management, Primality, The Chinese Remainder Theorem.

Hash Functions: Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Birthday Attacks, Security of Hash Function & MACS, MD5 Message Digest Algorithm, Secure Hash Algorithm, (SHA)

Digital Signatures: Digital Signatures, Authentication Protocol

Network & System Security: Authentication Applications: Kerberos X.509, Directory Authentication Service, Electronic Mail Security, System Security: Intruders, Viruses, Firewall Design Principles, Trusted Systems.

### **mca-504bWeb Development**

Basics of PHP: Introduction to PHP, what does PHP do? ,history of PHP , language basics ,data types , variables , expressions and operators , flow control statements , including code , embedding PHP in web pages.

Functions & Strings: Calling a function, defining a function, variable scope, function parameters, return values, variable functions, anonymous functions. Strings: Accessing individual characters, cleaning strings, encoding and escaping, comparing strings, manipulating and searching strings, regular expressions.

Arrays & Objects: Indexed vs. associative arrays, identifying elements of an array, storing data in arrays, multidimensional arrays, extracting multiple values, converting between arrays and variables, traversing arrays, sorting. Objects: Creating an object, accessing properties and methods, declaring a class, introspection.

MySQL Overview: Introduction, connecting to and disconnecting from the server , Entering queries , Creating and using a database , Creating and selecting a database , creating a table , loading data into a table , Retrieving information from a table , selecting all data , selecting particular rows , selecting particular columns , sorting rows , date calculations , working with NULL values , pattern matching , counting rows , using more than one tables. MySQL databases in PHP: Introduction, connecting to a MySQL database, querying the database, Retrieving and displaying the results, modifying data, deleting data.

### **mca-505a Spatial Database Management System**

Basic of neural Networks, inference and learning, classification of models, association of models, optimization and self-organization models, definition of learning, supervised and unsupervised learning. AI learning, neural network learning, knowledge based neural network, rule based, decision tree based, constraint based neural network.

Incremental learning, symbolic methods, neural network approaches, applications of neural networks, neural networks as mathematical models, expert system heuristic, hierarchical models, hybrid, parallel, control network discovery, symbolic methods, neural network methods.

Genetic Algorithm, evolutionary programming, classifier system, genetic programming parse tree, mathematical foundation of GA variant of GA (Hybrid and fuzzy GA enhancement of genetic programming application)

Introduction to GIS, history, definition, hardware and software, raster based GIS, data acquisition, nature of spatial data, geo-referencing.

GIS functionality, data models, raster, vector, object oriented, coordinate system and geo-coding, data structures

Introduction to ArcView, creating maps, adding tabular data, choosing map projection, attribute features, aggregating data, creating and editing spatial data.

Introduction to VBA / .NET, data types, string, numbers, geo-coding, script writing, loops, interacting with views and themes, graphics, creating layout.

Spatial data overview, data mining primitives, generalization and specialization, spatial rules, classification algorithms, classification, clustering algorithms.

### **mca-505bGrid Computing**

Introduction: Grid Computing & Key Issues – Applications – Other Approaches – Grid Computing Standards – Pragmatic Course of Investigation.

Grid Benefits & Status of Technology: Motivations – History of Computing, Communications and Grid Computing – Grid Computing Prime Time – Suppliers and Vendors – Economic Value – Challenges.

Components of Grid Computing Systems and Architectures: Basic Constituent Elements-A Functional View – A Physical View – Service View.

Grid Computing Standards-OGSI: Standardization – Architectural Constructs – Practical View – OGSA/OGSI Service Elements and Layered Model – More Detailed View.

Standards Supporting Grid Computing-OGSA: Functionality Requirements – OGSA Service Taxonomy – Service Relationships – OGSA Services – Security Considerations.

### **mca-601 Information Retrieval**

Introduction: Motivation, Basic concepts, past, present, and future, the retrieval process.

Modeling: Introduction, A taxonomy of information retrieval models, retrieval: ad hoc and filtering, a formal characterization of IR models, classic information retrieval, alternative set theoretic models, alternative algebraic models, alternative probabilistic models, structured text retrieval models, models for browsing.

Retrieval Evaluation: Introduction, retrieval performance evaluation, reference collections. query

Languages: Introduction, keyword-based querying, Pattern matching, Structural queries, Query protocols.

Query Operations: Introduction, user relevance feedback, automatic local analysis, automatic global analysis.

Text and multimedia languages and Properties: Introduction, metadata, text, markup languages,

Indexing and searching: Introduction; inverted files; other indices for text; Boolean queries; sequential searching; pattern matching; structural queries; compression.

Searching the Web: Introduction, challenges, characterizing the web, search engines, browsing, meta searchers, finding the needle in the haystack, searching using hyperlinks.

### **mca-602Service Oriented Architecture**

SOA BASICS: Software Architecture, types of IT Architecture SOA, evolution, key components, perspective of SOA, enterprise-wide SOA architecture, enterprise applications, solution architecture for enterprise application, software platforms for enterprise applications, patterns for SOA, SOA programming models.

SOA analysis and design: Service-Oriented Analysis and Design, design of activity, data, client and business process services, technologies of SOA, SOAP, WSDL, JAX, WS, XML WS for .NET, service integration with ESB, scenario, business case for SOA, stakeholder objectives, benefits of SPA, cost savings.

SOA Governance: SOA implementation and governance, strategy, SOA development, SOA governance, trends in SOA, event-driven architecture, software as a service, SOA technologies, proof-of concept, process orchestration , SOA best practices.

SOA Implementation: SOA based integration, integrating existing application, development of web services, integration – SOA using REST, RESTful services, RESTful services with and without JWS, Role of WSDL,SOAP and Java/XML mapping in SOA, JAXB Data binding.

Application Integration: JAX, WS 2.0 client side/server side development packaging and deployment of SOA component, SOA shopper case study, WSDL centric Java WS with SOA-J, related software, integration through service composition (BPEL), case study – current trends.



### **mca-603 Mobile Application Development**

Introduction to mobile communication and computing: Introduction to mobile computing, Novel applications, limitations and GSM architecture, Mobile services, System architecture, Radio interface, protocols, Handover and security. Smart phone operating systems and smart phones applications

Fundamentals of Android Development: Introduction to Android., The Android SDK, Understanding the Android Software Stack, Installing the Android SDK, Creating Android Virtual Devices, Creating the First Android Project, Using the Text View Control, Using the Android Emulator, The Android Debug Bridge (ADB), Basic Widgets Understanding the Role of Android Application Components, Event Handling , Displaying Messages Through Toast, Creating and Starting an Activity, Using the Edit ext Control.

The Android Debug Bridge (ADB), basic widgets understanding the role of Android Application Components, event handling, displaying messages through toast, creating and starting an activity, using the Edit ext Control Building Blocks for Android Application Design, Laying Out Controls in Containers, utilizing resources and media

Using Selection Widgets and Debugging Displaying and Fetching Information Using Dialogs and Fragments Advanced, Android Programming: Internet, Entertainment, and Services, Implementing drawing and animations, displaying web pages and maps, communicating with SMS and emails, creating and using content providers: creating and consuming services, publishing android applications

# MANUAL FOR PREPARATION OF DISSERTATION THESIS

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## 1. GENERAL

The manual is intended to provide broad guidelines to the MCA candidates in the preparation of the thesis. In general, the thesis shall report, in an organized and scholarly fashion, an account of original research work of the candidate leading to the discovery of new facts or techniques or correlation of facts already known (analytical, experimental, hardware oriented, etc.)

## 2. NUMBER OF COPIES TO BE PREPARED

At least four copies are to be prepared, one each for External Examiner, Guide, Departmental Library and self. The copies should be submitted to the Controller of Examination through the Head of the Department before the due date.

## 3. ARRANGEMENT OF CONTENTS OF THESIS

The sequence in which the thesis material should be arranged and bound should be as follows:

1. Title page
2. Bonafide Certificate
3. Abstract
4. Acknowledgement
5. Table of Contents
6. List of Tables
7. List of Figures
8. List of Symbols, Abbreviations or Nomenclature (Optional)
9. Chapters
10. References
11. Appendices

The Tables and Figures shall be introduced in the appropriate places.

## 4. PAGE DIMENSIONS AND MARGIN

The thesis should be prepared on good quality white paper preferably not lower than 80gsm. Standard A4 size paper should be used for preparing the copies. The final thesis should have the following page margins:

Top edge	: 30 to 35 mm
Left side	: 35 to 40 mm
Bottom edge	: 25 to 30 mm
Right side	: 20 to 25 mm

Tables and figures should conform to the margin specifications. Large size figures should be photographically or otherwise reduced to the appropriate size before insertion.

## 5. MANUSCRIPT PREPARATION

The headings of all items 2 to 11 listed in section 3 should be typed in capital letters without punctuation and centered 50mm below the top of the page. The text should commence 4 spaces below this heading.

- 5.1 Title Page – A specimen copy of the title page is given in Appendix 1.
- 5.2 Bonafide Certificate – A specimen copy of the bonafide certificate is given in Appendix 2.

- 5.3 Abstract – Abstract should be an essay type of narrative not exceeding 600 words, outlining the problem, the methodology used for tackling it and a summary of the findings.
- 5.4 Acknowledgement – It should be brief and preferably should not exceed one page when typed double spacing.
- 5.5 Table of Contents – The table of contents should list all material following it as well as any material which precedes it. The title page, bonafide certificate and acknowledgement will not find a place among the items listed in the table of contents. One and a half spacing should be adopted for typing the matter under this head.
- 5.6 List of Tables – The list should use exactly the same captions as they appear above the tables in the text. One and a half spacing should be adopted for typing the matter under this head.
- 5.7 List of Figures – The list should use exactly the same captions as they appear below the figures in the text. One and a half spacing should be adopted for typing the matter under this head.
- 5.8 List of Symbols, Abbreviations and Nomenclature – One and a half spacing should be adopted for typing the matter under this head. Standard symbols and abbreviations should be used.
- 5.9 Chapters – The chapters may be broadly divided into 3 parts:
- i. Introductory chapter,
  - ii. Chapters developing the main theme of the thesis,
  - iii. Results, Discussions and Conclusions.

The main text will be divided into several chapters and each chapter may be further divided into several divisions and sub-divisions.

- Each chapter should be given an appropriate title.
- Tables and figures in a chapter should be placed in the immediate vicinity of the reference where they are cited.
- Footnotes should be used sparingly. They should be typed single space and placed directly underneath in the very same page which refers to the material they annotate.

- 5.10 List of References – When works of other researchers are used either directly or indirectly the origin of the material thus referred to as appropriate places in the thesis should be indicated. A paper, a monograph or a book may be designated by the name of the first author followed by the year of publication, placed inside brackets at the appropriate place of reference. The citation may assume any one of the following forms:

Examples of citation

- i. An improved algorithm has been adopted in literature (Tsychiya 1980)
- ii. Jankins and Walts (1968) have dealt at length with this principle.
- iii. The problem of mechanical manipulators has been studied by Shin et al (1984) and certain limitations of the method used has been pointed out by Shin et al (1984 a)

The listing should be typed 4 spaces below the heading REFERENCES in alphabetical order in single spacing left-justified. The reference material should be listed in the alphabetical order of the first author. The name(s) of the author(s) should be immediately followed by the year and other details. A typical illustrative list is given below.

## REFERENCES

1. Ariponnammal S. and Natarajan S. (1994) 'Transport Phenomena of Sm Sel-x Asx', Pramana Journal of Physics, Vol. 42, No.5, pp.421-425.
2. Barnard R.W. and Kellogg C. (1980) 'Applications of Convolution Operators to Problems in Univalent Function Theory', Michigan Mach. J., Vol 27, pp 81-94.
3. Jankins G.M. and Walts D.G. (1968) 'Spectral Analysis and its Applications', Holder Day, San Francisco.
4. Shin K.G. and McKay N.D. (1984) 'Open Loop Minimum Time Control of Mechanical Manipulations and its Applications', Proc. Amer. Contr. Conf., San Diego, CA, pp.1231-1236.

5.11 Appendices – Appendices are provided to give supplementary information, which if included in the main text may serve as a distraction and cloud the central theme under discussion.

- Appendices should be numbered using Arabic numerals, e.g. appendix 1, Appendix 2, etc.
- Appendices, tables and references appearing in appendices should be numbered and referred to at appropriate places just as in the case of chapters.

5.12 Tables and Figures – The word table means tabulated data in the body of the thesis as well as in the appendices. All other material used in the body of the thesis and appendices such as charts, graphs, maps, photographs and diagrams may be designated as figures.

- A table or figure including caption should be accommodated within the prescribed margin limits and appear on the page following the page where their first reference is made.
- Tables and figures half page or less in length may appear on the same page along with the text. However, they should be separated from the text both above and below by triple spacing.
- All tables and figures should be prepared on the same paper or material used for the preparation of the rest of the thesis.
- Two or more small tables or figures may be grouped if necessary in a single page.
- Photographs, if any, should be included in colourxerox form or as colour printouts of scanned images. More than one figure can be included in a page.

## 6. TYPING INSTRUCTIONS

6.1 General Uniformity of the font (say, Times New Roman) in the entire thesis shall be observed. A sub-heading at the bottom of a page must have at least two full lines below it or else it should be carried over to the next page. The last word of any page

should not be split using a hyphen. Double spacing should be used for typing the bonafide certificate and acknowledgement. One and a half spacing should be used for typing the general text. Single spacing should be used for typing:

- i. Long Tables
- ii. Long quotations
- iii. Foot notes
- iv. Multiline captions
- v. References All quotations exceeding one line should be typed in an indented space - the indentation being 15mm from either margins.

## 6.2 Chapters:

The format for typing chapter headings, division headings and sub division headings are

explained through the following illustrative examples.

Chapter heading:	CHAPTER 1
	INTRODUCTION
Division heading :	1.1 OUTLINE OF THESIS
Sub-division heading:	1.1.2. Literature review

The word CHAPTER without punctuation should be centered 50mm down from the top of the page. Two lines below, the title of the chapter should be typed centrally in capital letters. The text should commence 4 lines below this title. The division and sub-division captions along with their numberings should be left-justified. The typed material directly below division or sub-division heading should commence 2 spaces below it. Within a division or sub-division paragraphs are permitted. Every paragraph should commence 3 spaces below the last line of the preceding paragraph.

## 7. NUMBERING INSTRUCTIONS

### 7.1 Page Numbering

All page numbers (whether Roman or Arabic) should be typed without punctuation on the upper right hand corner 20mm from top with the last digit inline with the right hand margin. The preliminary pages of the thesis (such as title page, acknowledgement, table of contents, etc.) should be numbered in lower case Roman numerals. The title page will be numbered as (i) but this should not be typed. The page immediately following the title page shall be numbered (ii) and it should appear at the top right hand corner as already specified. Pages of main text, starting with Chapter 1 should be consecutively numbered using Arabic numerals.

7.2 Numbering of Chapters, Divisions and Sub-8 Divisions. The numbering of chapters, divisions and sub-divisions should be done using Arabic numerals only and decimal notation should be used for numbering the divisions and sub-divisions within a chapter. For example, sub-division 4 under division 3 belonging to Chapter 2 should be numbered as 2.3.4. The caption for the sub-division should immediately follow the number assigned to it. Every chapter beginning with the first chapter should be serially numbered using Arabic numerals.

7.3 Numbering of Tables and Figures Tables and figures appearing anywhere in the thesis should bear appropriate numbers. The rule for assigning such numbers is illustrated through an example. Thus, if a figure in Chapter 3, happens to be the fourth then assign Fig. 3.4 to that figure. Identical rules apply for tables except that

the word Fig. is replaced by the word Table. If figures (or tables) appear in appendices then figure 3 in Appendix 2 will be designated as Fig. A2.3. A table may be continued into the next page, but no line should be drawn underneath an unfinished table. The top line of the table continued into the next page should, for example, read Table 2.1 (continued) placed centrally and underlined.

- 7.4 Numbering of Equations: Equations appearing in each chapter or appendix should be numbered serially, the numbering commencing afresh for each chapter or appendix. Thus, for example, an equation appearing in Chapter 2, if it happens to be the eighth equation in that chapter should be numbered (2.8) thus: ... (2.8) while referring to this equation in the body of the thesis it should be referred to as Eqn. 2.8.

## **8. BINDING SPECIFICATIONS**

The thesis should be bound using flexible cover of thick white or blue art paper. The cover should be printed in black letters and the text for printing should be identical to what has been prescribed for the title page.

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