PROGRAMME GUIDE

FOR

MASTER OF COMPUTER APPLICATIONS (MCA)
(2 -Years Programme)
(Programme Code: MCA_NEW)

July 2024

SCHOOL OF COMPUTER AND INFORMATION SCIENCES
INDIRA GANDHI NATIONAL OPEN UNIVERSITY MAIDAN GARHI,
NEW DELHI - 110 068

www.ignou.ac.in

eProgramme Guide:

July, 2024.This is a Programme Guide for new MCA (2 Years) Programme offered by IGNOU from July, 2024 admission cycle.

CONTENTS

MESSAGE FROM THE PROGRAMME CO-ORDINATOR

Dear student,

Welcome to the family of distance learners and IGNOU's Master of Computer Applications Programme. It is a 2-years(4 semesters) programme during which you will study a wide range of topics in Computer Science and Applications. You will receive support from IGNOU through your Regional Centre (RC), Learner's Support Centre (LSC) (was called Study Centre) and IGNOU's website. We expect you to be directly in contact with yours RC, LSC, and your peers through the Internet. You may also write to us at the email address given below.

This Programme Guide contains instructional system, syllabus of MCA (2 Years) programme, details of evaluation scheme, links to assignments, important forms and other important information. The self-instructional course material is available on eGyankosh Website(www.egyankosh.ac.in) and IGNOU eContent App (available on Google Playstore). You can download the assignments of the semester in which you have enrolled from our website. Each course contains **one assignment** that will be assessed by a counsellor at your LSC. All these assignments are to be submitted at your LSC within the stipulated last date of submission mentioned against each assignment.

At your LSC you will be able to avail yourself of the counselling for all the courses. You need to have a minimum of 75% attendance for practical counselling sessions to be eligible for appearing for the Term-end Practical Examinations. You must also submit the assignments of every course before the due date to be eligible to appear for the related Term-end Examination.

It is to be noted that the payments that are mentioned in various proformas/formats/forms are as on date and is subject to revision from time to time. You are advised to check these proformas/formats/forms from IGNOU website/LSC/RC for any revision/modification. **Some useful forms and formats (or the link to useful forms and formats) are also given at the end of this booklet.** The Programme Guide, forms and formats are also available on the IGNOU website. Please confirm the fees with the RC / LSC / Website before you pay.

As a distance learner, you may have several queries. You will find answers to many of them in this booklet. **This booklet is a very important guide for you. Read it and preserve it until you successfully complete the MCA programme.** However, during your studies, if you have any feedback, suggestions and comments to make, please write to us immediately. In case, you have specific query, you can write to us on iGRAM(**http://igram.ignou.ac.in**)

Due to the COVID-19 related guidelines, as stipulated by various regulatory bodies, some of the processes as specified in this Programme guide may change. Therefore, learners are advised to be in touch with their Regional centre/LSC for advice and day-to-day information. Alternatively, you may visit the IGNOU website at URL **www.ignou. ac.in**.

Some of the links to the videos are given towards the end of the programme guide. Please watch them for better understanding of the respective courses.

I wish you all the success in pursuing the MCA programme.

MCA Programme coordinator
Email: mca@ignou.ac.in

1. BASIC INFORMATION

1.1 MCA Programme Objectives

The broad objective of the MCA programme is to prepare graduate students for productive careers in software industry and academia by providing an outstanding environment for teaching and research in the core and emerging areas of the discipline. The thrust of programme is on giving the students a thorough and sound background in theoretical and application oriented courses relevant to the latest computer software development. The programme emphasizes the application of software technology to solve mathematical, computing, communications / networking and commercial problems.

This Master's Degree Programme has been designed with a semester approach in mind. The first year courses are aimed at theoretical knowledge and practical skills development in core computers science subjects. The second year is more focused on advanced courses providing conceptual framework and the project work.

1.2 Duration of the Programme

(Minimum -2 Years, Maximum - 4 Years)

To fulfil the requirements for acquiring the MCA, a student may successfully complete each course of the programme and bridge courses, if any, in a minimum of 2 years and a maximum of 4 years.

1.3 Medium of Instruction

The medium of instruction is **English.** The course material is in English.

1.4 Credit System

The University follows the 'Credit System' for its programmes. Each credit is worth 30 hours of student learning time comprising all the learning activities. Thus, a four-credit course involves 120 study hours. This helps the student to understand the academic effort one has to put for successful completion of a course. **Successful completion of the programme requires successful completion of both assignments and the Term-End Examination of each course of the programme and bridge courses, if any.**

1.5 MCA Programme Structure

The programme has been divided into two semesters per year (July to December and January to June). Consequently, there will be two examinations every year - one in the month of December for the July to December semester courses and the other in June for the January to June semester courses. The students are at liberty to appear for any of the examinations conducted by the University during the year subject to completing the minimum time framework and other formalities prescribed for the programme.

Master of Computer Applications Programme Structure

Course Code	Course Title	Theory/ Practical	Credits
	Semester I		
MCS-211	Design and Analysis of Algorithms	Theory	4
MCS-212	Discrete Mathematics	Theory	4
MCS-213	Software Engineering	Theory	4
MCS-214	Professional Skills and Ethics	Theory	2
MCS-215	Security and Cyber Laws	Theory	2
MCSL-216	DAA and Web Design Lab	Practical	2
MCSL-217	Software Engineering Lab	Practical	2
	Semester II		
MCS-218	Data Communication and Computer Networks	Theory	4
MCS-219	Object Oriented Analysis and Design	Theory	4
MCS-220	Web Technologies	Theory	4
MCS-221	Data Warehousing and Data Mining	Theory	4
MCSL-222	OOAD and Web Technologies Lab	Practical	2
MCSL-223	Computer Networks and Data Mining Lab	Practical	2
	Semester III		
MCS-224	Artificial Intelligence and Machine Learning	Theory	4
MCS-225	Accountancy and Financial Management	Theory	4
MCS-226	Data Science and Big Data	Theory	4
MCS-227	Cloud Computing and IoT	Theory	4
MCSL-228	AI and Machine Learning Lab	Practical	2
MCSL-229	Cloud and Data Science Lab	Practical	2
	Semester IV		
MCS-230	Digital Image Processing and Computer Vision	Theory	4
MCS-231	Mobile Computing	Theory	4
MCSP-232	Project	Project	12

Total Credits: 80　　　　**Total No. of Courses: 22**
No. of Theory Courses:15　　**No. of Practical Courses: 6**　　**Project: 1**

Bridge Courses

Passed BCA/ Bachelor Degree in Computer Science Engineering or equivalent Degree.

OR

Passed B.Sc./ B.Com./ B.A. with Mathematics at 10+2 Level or at Graduation Level (with additional *Bridge Courses* whose details are given below):

Bridge Courses:

Course Code	Course Title	Theory/ Practical	Credits
MCS-201	Programming in C and Python	Theory	4
MCS-208	Data Structures and Algorithms	Theory	4

Students who have already successfully completed any of these Bridge courses, viz., MCS-201, MCS-208 of IGNOU, are required to register and successfully complete the remaining bridge courses only.

The fee for bridge courses is as per the Coursewise Registration and Certification Scheme (CRCS) of IGNOU.

Note: *Students WITHOUT Mathematics at 10+2 level or at Graduation level are not eligible for ODL/Online MCA programme.*

Therefore, the students, who have taken admission as per eligibility clause (b) given above, are required to register and successfully complete the following bridge courses along with Master of Computer Applications programme.

1.6 Recognition

IGNOU is a Central University established by an Act of Parliament in 1985 (Act No.50 of 1985) IGNOU Degrees/Diplomas/Certificates are recognized by all member Universities of Association of Indian Universities (AIU) and are at par with Degrees/Diplomas/Certificates of all Indian Universities/Deemed Universities/Institutions vide UGC Circular No. F1-52/2000 (CPP-II) dated 5 May, 2004 and AIU Circular No. EV/B (449)/94/177115 dated January 14, 1994, and UGC's letter no. UGC/DEB/2013 dated 14.10.2013, and UGC notification on UGC website F.No. 1-18/2018 (DEB-I) dated 21-02-2019, list Master of Computer Application of IGNOU as one the programme recognised from 2018-19 to2022-23. You may download all the recognition related information from the following web links.

http://www.ignou.ac.in/ignou/aboutignou/division/srd/new
http://ignou.ac.in/ignou/aboutignou/division/srd/Recognition

1.7 Student Support Services

To provide individualised support to its learners, the University has created a number of Learner Support Centres (LSCs) throughout the country for this Programme. These are

administratively coordinated by the Regional Centres (RCs). The LSCs are the contact points for the students on all major aspects of the Programme. These include counselling sessions, practical sessions, reference library facilities, disseminating information and advice, facilities for audio-visual training aids and teleconferencing.

The University may not always be able to communicate to all the students individually. All the important communications are sent to the Regional Directors who in turn will intimate them to the LSC Coordinators. The Coordinators display such Circulars / Notifications on their notice boards for the benefit of the students. You are, therefore, advised to be in touch with your LSC Coordinator on a more regular basis so as to get the latest information about assignments, submission schedules (assignments and examination forms), declaration of results, etc.

1.8 How to contact the MCA Programme Coordinator?

Students may contact the MCA Programme Coordinator by sending a communication through post to The MCA Programme Coordinator, SOCIS, Vishveswaraiah Bhavan, C-Block, IGNOU Academic Complex, IGNOU, Maidan Garhi, New Delhi – 110068, or can send an Email to mca@ignou.ac.in

2.   INSTRUCTIONAL SYSTEM

The methodology of instruction in this University is different from that of the conventional universities. The Open and Distance Learning (ODL) University system is more learneroriented, and the student has to be an active participant in the teaching-learning process. Most of the instruction is imparted through distance mode with only a small component of face-toface communication. The University follows a multi-channel approach for instruction. It comprises a suitable mix of:

☞ self-instructional material in pdf or printed form

☞ audio-video programmes transmitted through GYAN DARSHAN channel

☞ face-to-face counselling at LSC by academic counselors

☞ compulsory practical sessions at the LSCs

☞ reference library eGyankosh

☞ web based academic support

☞ assignments

☞ Gyan Darshan Channel, including teleconferencing, ☞ Gyan Vani.

☞ SWAYAMPRABHA-DTH (channel-19)

2.1 Self-instructional Material

Self-instructional materials are the primary form of instructional materials. These are supplied to the learners in the form of several booklets called blocks. Each block consists of several units. The size of a unit is such that the material given therein may be expected to be studied by a student in a session of about 4 to 6 hours of study. This self-instructional material is made in electronic form through IGNOU eContent App and eGyankosh website. However, the fast pace of computer industry necessitates that students must do some additional readings. Students are advised to study reference books without fail. Studying the self-

instructional material alone may not be sufficient to write assignments and prepare for the Term-end Examinations. Some reference books are available at your RC/LSC.

2.2 eGyankosh, SWAYAMPRABHA-DTH (Channel-19) and IGNOU eContent App

eGyankosh **(www.egyankosh.ac.in)** is a digital repository consists of the reference links Self instructional materials, recorded videos, YouTube-video archives etc. Various links for the eGyankosh related to SOCIS are:

eGyankosh Homepage: http://www.egyankosh.ac.in/

Self-Learning Material: http://www.egyankosh.ac.in/handle/123456789/380

YouTube-Video Archives: http://www.egyankosh.ac.in/handle/123456789/35748
EMPC YouTube Live/Playlists: https://www.youtube.com/@EMPCIGNOU/streams

The **SWAYAM PRABHA-DTH Channel-13** (Professional Education) is funded by MoE, Govt. of India and Coordinated by IGNOU, New Delhi. This is an exclusive channel covering IGNOUs' Professional and Vocational Education Programmes. This channel broadcasts visually high-quality and graphically enriched video content of IGNOUs' Certificate/Diploma/PG Diploma/PG Certificate/Undergraduate/Postgraduate courses pertaining to Computer Science/Application, Management Studies, Vocational Education, Engineering and Technology, Law Extension and Development Studies, Social Work, Journalism and New Media Studies, Performing Arts and Health Sciences. The scope is very wide and covers courses from 10 Schools of IGNOU through this channel. These video lectures are delivered by Faculty of IGNOU and also from renowned institutional in India, covering basics to advanced courses. Gradually, IGNOU is recording and pooling the videos on Channel19

SWAYAM PRABHA homepage: https://www.swayamprabha.gov.in/

LIVE sessions of SWAYAMPRABHA: https://splive.ignouonline.ac.in/live/ch/13

Professional Education (Channel-13):
https://swayamprabha.gov.in/program/current_he/13

Archive Videos: https://swayamprabha.gov.in/program/archive_he/13

IGNOU eContent App

The self-instructional course material of various programmes of IGNOU are made available through **IGNOU eContent APP**

https://play.google.com/store/apps/details?id=ac.in.ignou.Viewer&hl=en

2.3 Counselling Sessions

The details of the theory and practical counselling sessions are given in the following

sections. **Theory Sessions**

In distance education, face-to-face contact between the learners and their tutors/counsellors is relatively less. The purpose of such a contact is to answer some of your questions and clarify your doubts that may not be possible through any other means of communication. It also provides you with an opportunity to meet your fellow students.

There are academic counsellors at the LSC to provide counselling and guidance to you in the courses that you have chosen for study. Normally, these sessions will be held at the LSC on Saturdays and Sundays.

You should note that the counselling sessions would be very different from the classroom teaching or lectures. Counsellors will not be delivering lectures as in conventional teaching. They will try to help you to overcome difficulties that you face while studying for the MCA programme. In these sessions, you must try to resolve your subject-based difficulties and any other related problems.

Practical Sessions and Compulsory Attendance

The practical sessions will be held in the computer centres / labs of the LSC. In these computer labs, the participants will have the facility to use the computer and software packages relevant to the syllabus. The following points regarding the practical attendance must be noted:

i) 75% attendance is compulsory for each lab course. This is a pre-requisite for taking the term-end practical examination in the respective lab courses.

ii) A student who fails to fulfil the 75% attendance requirements will be allowed to reregister for that lab course. For fee details and the application form, please contact your Regional Centre.

iii) Students are required to prepare a separate lab record for each lab course. The practical counsellor should duly sign this lab record after each session.

iv) Student attendance will be recorded course wise at the Learner Support Centre.

v) Strictly follow the guidelines given in the Lab manuals for the respective lab courses.

vi) Computer to Student ratio in a practical session would be 1:2. (2 students would be sharing a machine)

> **Before attending the counselling session for each course, please go through your course material as per the session schedule and make a plan of the points to be discussed. Unless you have gone through the Units, there may not be much to discuss and a counselling session may not be fruitful.**

Counselling Schedule

The following is the counselling schedules for 1st to 4th Semesters of MCA. **The respective Learner support centres will communicate you the exact dates of the Schedule. MCA 1st Semester Schedule**

Course	Theory/Practical	Credits	No. of Theory Counselling Sessions*	Hrs	No. of Practical Counselling Sessions**	Hrs
MCS-211	Theory Sessions	4	6	12	-	-
MCS-212	Theory Sessions	4	6	12	-	-
MCS-213	Theory Sessions	4	6	12	-	-

MCS-214	Theory Sessions	2	3	6	-	-
MCS-215	Theory Sessions	2	3	6	-	-
MCSL-216	Practical Sessions	2	-	-	20	60
MCSL-217	Practical Sessions	2	-	-	20	60

Counselling of Bridge Courses (Only for the students who are required to register for these courses based on eligibility conditions for admission to MCA programme)

Course	Theory/Practical	Credits	No. of Theory Counselling Sessions*	Hrs	No. of Practical Counselling Sessions**	Hrs
MCS-201	Theory Sessions	4	6	12	-	-
MCS-208	Theory Sessions	4	6	12	-	-

MCA 2nd Semester Schedule

Course	Theory/Practical	Credits	No. of Theory Counselling Sessions*	Hrs	No. of Practical Counselling Sessions**	Hrs
MCS-218	Theory Sessions	4	6	12	-	-
MCS-219	Theory Sessions	4	6	12	-	-
MCS-220	Theory Sessions	4	6	12	-	-
MCS-221	Theory Sessions	4	6	12	-	-
MCSL-222	Practical Sessions	2	-	-	20	60
MCSL-223	Practical Sessions	2	-	-	20	60

MCA 3rd Semester Schedule

Course	Theory/Practical	Credits	No. of Theory Counselling Sessions*	Hrs	No. of Practical Counselling Sessions**	Hrs
MCS-224	Theory Sessions	4	6	12	-	-
MCS-225	Theory Sessions	4	6	12	-	-
MCS-226	Theory Sessions	4	6	12	-	-
MCS-227	Theory Sessions	4	6	12	-	-
MCSL-228	Practical Sessions	2	-	-	20	60
MCSL-229	Practical Sessions	2	-	-	20	60

MCA 4ᵗʰ Semester Schedule

Course	Theory/Practical	Credits	No. of Theory Counselling Sessions*	Hrs	No. of Practical Counselling Sessions	Hrs
MCS-230	Theory Sessions	4	6	12	-	-
MCS-231	Theory Sessions	4	6	12	-	-
MCSP-232	Project	12	4	8	-	-

*Theory counselling sessions is of 2 Hr duration.
**Practical counsessling sessions is of 3 Hr duration.

Semester	No. of Sessions		No. of Hours	
	Theory	Practical	Theory	Practical
I	24	40	48	120
II	24	40	48	120
III	24	40	48	120
IV	12 + 4 sessions for discussions on Project	-	24 + 8	-
TOTAL	84	120	176	360

Total Computer time per semester = Practical time
= 120 Sessions =360 Hours per semester *Note:*
75% attendance is compulsory in Practical Lab Sessions.

MCA 1st Semester Schedule

MCS-211 : Design and Analysis of Algorithms

Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1,Unit-2 and Unit-3
	2	All topics of Block-1 Unit-4, Block-2 Unit-1
	3	All topics of Block-2 Unit-2 and Unit-3
	4	All topics of Block-3 Unit-1 and Unit-2
	5	All topics of Block-3 Unit-3, Block-4 Unit-1
	6	All topics of Block-4 Unit-2 and Unit-3

MCS-212: Discrete Mathematics

Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1 and Unit-2
	2	All topics of Block-1 Unit-3, Block-2 Unit-1
	3	All topics of Block-2 Unit-2 and Unit-3
	4	All topics of Block-3 Unit-1,Unit-2 and Unit-3
	5	All topics of Block-3 Unit-4, Block-4 Unit-1
	6	All topics of Block-4 Unit-2, Unit-3 and Unit-4

MCS-213: Software Engineering

Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1, Unit-2 and Unit-3
	2	All topics of Block-1 Unit-4 Block-2 Unit-5
	3	All topics of Block-2 Unit-6, Unit-7 and Unit-8
	4	All topics of Block-3 Unit-9,Unit-10, Unit-11
	5	All topics of Block-3 Unit-12, Block-4 Unit-13
	6	All topics of Block-4 Unit-14, Unit-15 and Unit-16

MCS-214: Professional Skills and Ethics

Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1,Unit-2, Unit-3, Unit-4
	2	All topics of Block-1 Unit-5 , Block-2 Unit-6, Unit-7 and Unit-8
	3	All topics of Block-2 Unit-9, Unit-10, Unit-11

MCS-215: Security and Cyber Laws

Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1 and Unit-2
	2	All topics of Block-1 Unit-3, Block-2 Unit-1
	3	All topics of Block-2 Unit-2 and Unit-3

MCSL-216: DAA and Web Design Lab

Counselling Sessions

Sessions	Session Number	Topics to be Covered
Practical Counselling	1-10	All topics of DAA
	11-20	All topics of Web Design Lab

MCSL-217: Software Engineering Lab

Counselling Sessions

Sessions	Session Number	Topics to be Covered
Practical Counselling	1-20	All topics of Software Engineering Lab

Counselling Schedule of Bridge Courses (Only for the students who are required to register for these courses based on eligibility conditions for admission to MCA programme)

MCS-201: Programming in C and Python

Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1, Unit-2 and Unit-3
	2	All topics of Block-1 Unit-4 Block-2 Unit-5
	3	All topics of Block-2 Unit-6, Unit-7 and Unit-8
	4	All topics of Block-3 Unit-9,Unit-10, Unit-11
	5	All topics of Block-3 Unit-12, Block-4 Unit-13
	6	All topics of Block-4 Unit-14, Unit-15 and Unit-16

MCS-208: Data Structures and Algorithms

Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1, and Unit-2
	2	All topics of Block-1 Unit-3 Block-2 Unit-4
	3	All topics of Block-2 Unit-5 and Unit-6
	4	All topics of Block-3 Unit-7 and Unit-8
	5	All topics of Block-3 Unit-9, Block-4 Unit-10
	6	All topics of Block-4 Unit-11 and Unit-12

MCA 2nd Semester Schedule

MCS-218: Data Communication and Computer Networks

Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1 and Unit-2
	2	All topics of Block-1 Unit-3 Block-2 Unit-1
	3	All topics of Block-2 Unit-2, Unit-3 and Unit-4
	4	All topics of Block-3 Unit-1, Unit-2 and Unit-3
	5	All topics of Block-3 Unit-4 Block-4 Unit-1
	6	All topics of Block-4 Unit-2, Unit-3 and Unit-4

MCS-219: Object Oriented Analysis and Design
Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1, Unit-2, Unit-3 and Unit-4
	2	All topics of Block-1 Unit-5 Block-2 Unit-1
	3	All topics of Block-2 Unit-2 and Unit-3
	4	All topics of Block-3 Unit-1 and Unit-2
	5	All topics of Block-3 Unit-3 Block-4 Unit-1
	6	All topics of Block-4 Unit-2 and Unit-3

MCS-220: Web Technologies
Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1, Unit-2, Unit-3
	2	All topics of Block-1 Unit-4 Block-2 Unit-5
	3	All topics of Block-2 Unit-6, Unit-7 and Unit-8
	4	All topics of Block-3 Unit-9 and Unit-10
	5	All topics of Block-3 Unit-11 Block-4 Unit-12
	6	All topics of Block-4 Unit-13 and Unit-14

MCS-221: Data Warehousing and Data Mining Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1 and Unit-2
	2	All topics of Block-1 Unit-3 Block-2 Unit-4

	3	All topics of Block-2 Unit-5 and Unit-6
	4	All topics of Block-3 Unit-7 and Unit-8
	5	All topics of Block-3 Unit-9 Block-4 Unit-10
	6	All topics of Block-4 Unit-11 and Unit-12

MCSL-222: OOAD and Web Technologies Lab
Counselling Sessions

Sessions	Session Number	Topics to be Covered
Practical Counselling	1-10	All topics of OOAD
	11-20	All topics of Web Technologies Lab

MCSL-223: Computer Networks and Data Mining Lab
Counselling Sessions

Sessions	Session Number	Topics to be Covered
Practical Counselling	1-10	All topics of Computer Networks Lab
	11-20	All topics of Data Mining Lab

MCA 3rd Semester Schedule

MCS-224: Artificial Intelligence and Machine Learning
Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1, Unit-2 and Unit-3
	2	All topics of Block-1 Unit-4 Block-2 Unit-5
	3	All topics of Block-2 Unit-6, Unit-7 and Unit-8
	4	All topics of Block-3 Unit-9,Unit-10, Unit-11
	5	All topics of Block-3 Unit-12, Block-4 Unit-13
	6	All topics of Block-4 Unit-14, Unit-15 and Unit-16

MCS-225: Accountancy and Financial Management
Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1 and Unit-2
	2	All topics of Block-1 Unit-3 Block-2 Unit-1
	3	All topics of Block-2 Unit-2, Unit-3 and Unit-4
	4	All topics of Block-3 Unit-1,Unit-2, Unit-3 & Unit-4
	5	All topics of Block-3 Unit-5 Block-4 Unit-1
	6	All topics of Block-4 Unit-2 and Unit-3

MCS-226: Data Science and Big Data
Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1, Unit-2 and Unit-3
	2	All topics of Block-1 Unit-4 Block-2 Unit-5
	3	All topics of Block-2 Unit-6, Unit-7 and Unit-8
	4	All topics of Block-3 Unit-9,Unit-10, Unit-11
	5	All topics of Block-3 Unit-12, Block-4 Unit-13
	6	All topics of Block-4 Unit-14, Unit-15 and Unit-16

MCS-227: Cloud Computing and IoT
Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1 and Unit-2
	2	All topics of Block-1 Unit-3 Block-2 Unit-4
	3	All topics of Block-2 Unit-5, Unit-6 and Unit-7
	4	All topics of Block-3 Unit-8
	5	All topics of Block-3 Unit-9, Block-4 Unit-10
	6	All topics of Block-4 Unit-11 and Unit-12

MCSL-228: AI and Machine Learning Lab
Counselling Sessions

Sessions	Session Number	Topics to be Covered
Practical Counselling	1-10	All topics of AI
	11-20	All topics of Machine Learning Lab

MCSL-229: Cloud and Data Science Lab
Counselling Sessions

Sessions	Session Number	Topics to be Covered
Practical Counselling	1-10	All topics of Cloud
	11-20	All topics of Data Science Lab

MCA 4th Semester Schedule

MCS-230: Digital Image Processing and Computer Vision
Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1, Unit-2 and Unit-3
	2	All topics of Block-1 Unit-4 Block-2 Unit-5

	3	All topics of Block-2 Unit-6 and Unit-7
	4	All topics of Block-3 Unit-9 and Unit-10
	5	All topics of Block-3 Unit-11, Block-4 Unit-12
	6	All topics of Block-4 Unit-13 and Unit-14

MCS-231: Mobile Computing
Counselling Sessions

Sessions	Session Number	Topics to be Covered
Theory Counselling	1	All topics of Block-1 Unit-1, Unit-2 and Unit-3
	2	All topics of Block-1 Unit-4 Block-2 Unit-5
	3	All topics of Block-2 Unit-6, Unit-7 and Unit-8
	4	All topics of Block-3 Unit-9,Unit-10, Unit-11
	5	All topics of Block-3 Unit-12, Block-4 Unit-13
	6	All topics of Block-4 Unit-14, Unit-15 and Unit-16

2.4 Web Based Support

The learners can have access to IGNOU's website at the following address (URL): ***http://www.ignou.ac.in.*** You can download assignments, old question papers, circulars, etc. from the website. The Programme Guide is also available at the website. The following section gives you how to browse the IGNOU's website.

3. BROWSING IGNOU'S WEBSITE

The IGNOU's website is a dynamic source of latest information and is subject to continuous updates. Thus, various pages shown here may change in future. IGNOU itself is continuously changing to bring about improvement in quality of its services. You must visit IGNOU website for all the latest information, filling up or downloading various form, downloading of assignments, results etc.

Navigation from Home Page

The learners can have access to IGNOU's website at the following address (URL) ***http://www.ignou.ac.in.*** As students get connected to this site, the following page displays the Home Page of IGNOU's web site (Figure 1). Students need to click on various options to get the related information.
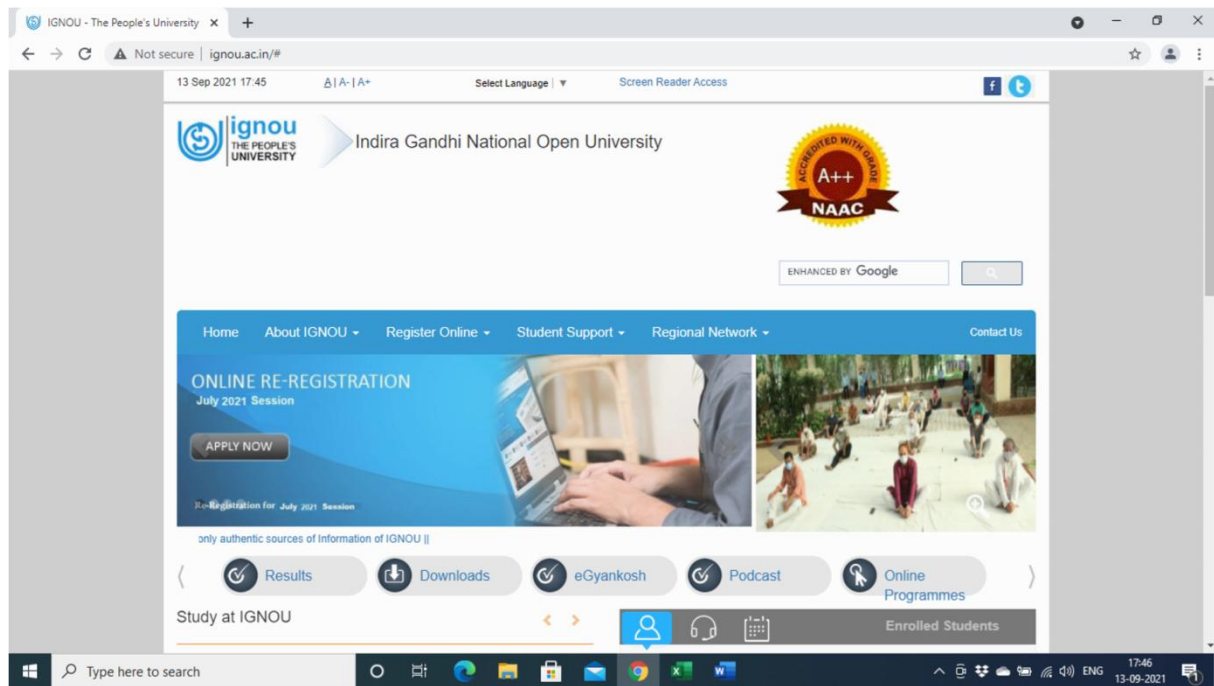
Figure 1: IGNOU Website

From this **Home page** Select **About IGNOU,** which will display an Option List select **School of Studies. It** will show you a page of all the schools of studies of IGNOU, Select **School of Computer and Information Sciences (SOCIS)** to display page of SOCIS (Figure 2). School of Computer and Information Sciences (SOCIS) offers PhD in Computer Science, MCA, BCA and CIT programmes, you can click on **Programmes** link on SOCIS page to get the list of programmes on offer as shown in Figure 2.
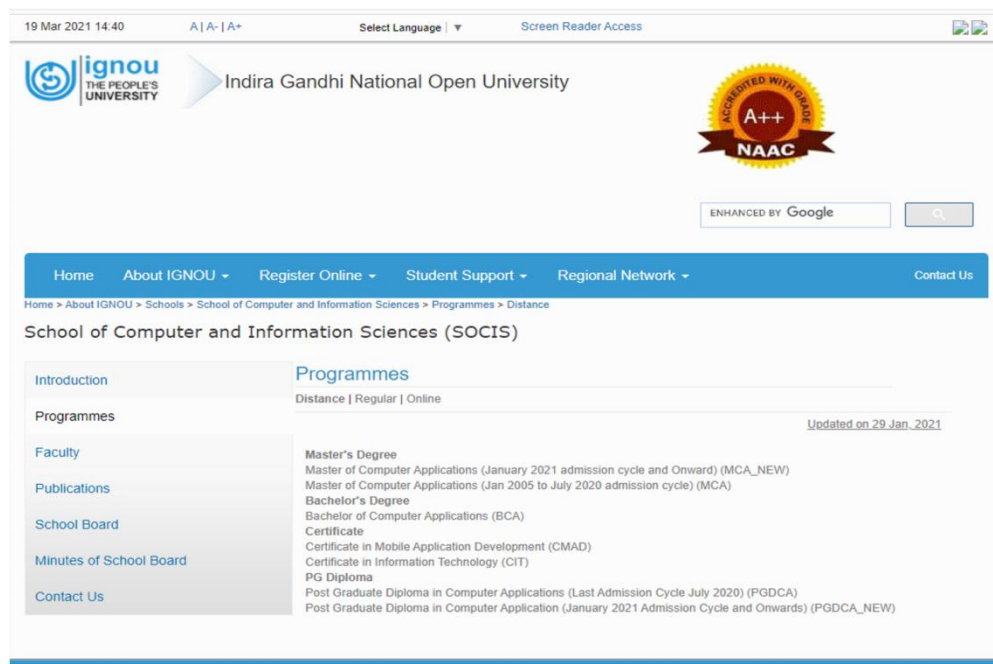
Figure 2: SOCIS Programmes

One of the most important link for students is Student Zone which can be reached from Home page by selecting Student Zone option on the Student Support Option List (Link address: *http://www.ignou.ac.in/ignou/studentzone*). Figure 3 displays the options of the Student Zone page.
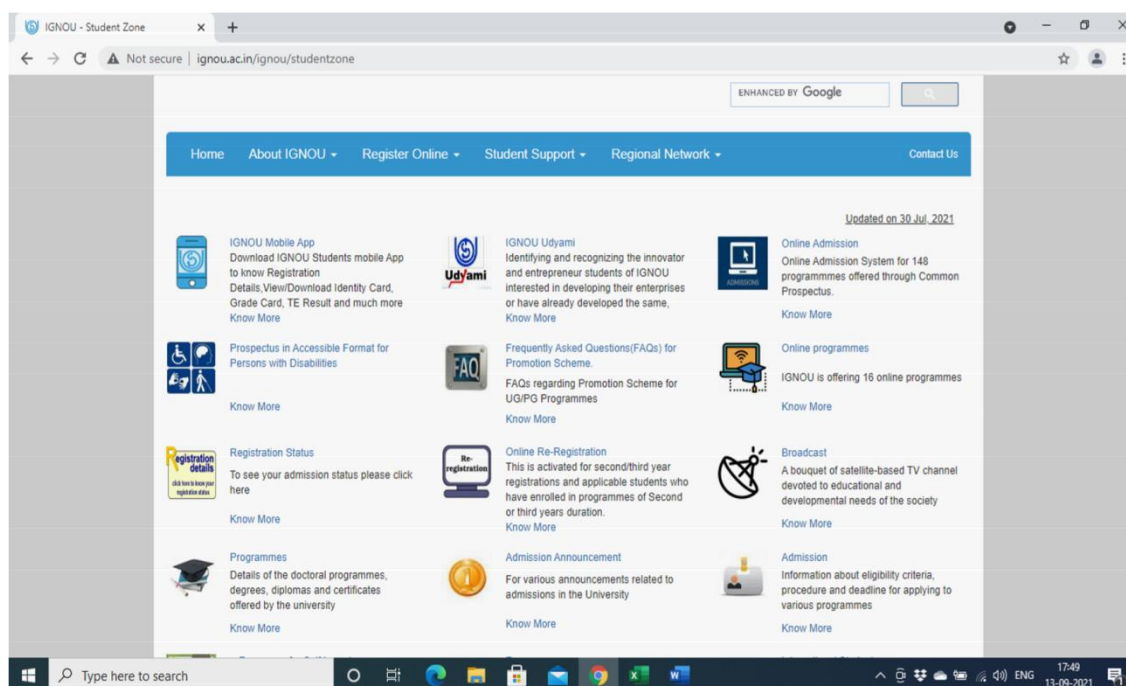

Figure 3: Student Zone page

4. MCA SYLLABUS

SEMESTER - I

MCS-211   Design and Analysis of Algorithms   Credit: 4

Algorithms are the central part of computing and Design and Analysis of algorithms course is the core of the study of Computer Science discipline. The revised course on design and analysis of algorithm introduces many new topics: Deterministic and Stochastic Algorithms , how to solve recurrence relation problems through Substitution method, Recurrence tree and Master methods, An overview of local and global optima ,Fractional Knapsack problem ,Huffman Codes ,a task scheduling algorithm , Topological Sort ,Strongly Connected Components , Maximum Bipartite Matching Problem, Binomial coefficient computation , Floyd Warshall algorithm , **String Matching Techniques :**The naïve String Matching Algorithm, The Rabin Karp Algorithm, Knuth –Morris Pratt Algorithm, **Handling Intractability:** Approximation algorithms for Vertex Cover problem and Minimizing makespan as parallel machines (Graham's algorithm) , Parameterized algorithm for Vertex Cover problem and Meta-
heuristic Algorithms

Course Structure*

Block- 1 Introduction to Algorithms

Unit 1: Basics of an Algorithm and its properties

- Introduction
- Objective
- Example of an Algorithm
- Basics building blocks of Algorithms
  - A survey of common running time
- Analysis & Complexity of Algorithm
- Types of problems
- Problem Solving Techniques
- Deterministic and Stochastic Algorithms
- Summary
- Solutions/Answers
- Further Readings

Unit 2: Some pre-requisites and Asymptotic Bounds
- Introduction
- Objectives
- Some Useful Mathematical Functions & Notations
  - Functions & Notations
  - Modular Arithmetic/Mod Function
- Mathematical Expectation
- Principle of Mathematical Induction
- Concept of Efficiency of an Algorithm
- Well Known Asymptotic Functions & Notations
- Summary
- Solutions/Answers

Unit 3: Analysis of Simple Algorithm

- Introduction
- Objectives
- complexity Analysis of Algorithms
  Euclid Algorithm for GCD
Polynomial Evaluation Algorithm
Exponent Evaluation
Sorting Algorithm
3.3 Analysis of Non-Recursive Control
Structures Sequencing
For Construct
While and Repeat Constructs
Recursive Constructs
Summary
Solutions/Answers

Further Readings

Unit 4: Solving Recurrences
- Introduction

- Objective
- Substitution Methods
- Iteration Methods
- Recursive Tree Methods
- Master Methods
- Summary
- Solution/Answers
- Further Readings

Block- 2 Design Techniques-I

Unit 1: Greedy Technique
- Some Examples to understand Greedy Techniques
- Formalization of Greedy Techniques
- An overview of local and global optima
- Fractional Knapsack problem
- Huffman Codes
- A task scheduling algorithm

Unit 2: Divide & Conquer Technique
- General Issues in Divide and Conquer Technique
- Binary Search Algorithm
- Sorting Algorithm o Merge Sort o Quick Sort
- Matrix Multiplication Algorithm

Unit 3: Graph Algorithm -I
- Basic Definition and terminologies
- Graph Representation o Adjacency Matrix o Adjacency List
- Graph Traversal Algorithms o Depth First Search o Breadth First Search
- Topological Sort
- Strongly Connected Components

Block- 3 Design Techniques – II

Unit 1: Graph Algorithms- II
- Minimum Cost Spanning Tree problems Kruskal's Algorithm

Unit 2: Dynamic Programming Technique

- The Principle of Optimality
- Chained Matrix Multiplication
- Matrix Multiplication Using Dynamic Programming
- Optimal binary search trees problems
- Binomial coefficient computation
- Floyd Warshall algorithm

Unit 3: String Matching Techniques
- The naïve String-Matching Algorithm
- The Rabin Karp Algorithm
- Knuth –Morris Pratt Algorithm
-

Block- 4: NP- Completeness and Approximation Algorithm

Unit-1: NP-Completeness
- Concepts of Class-P, NPCompleteness, NP-Hard , Unsolvable problems
- Polynomial-time
- Polynomial-time Reductions
- Class P with Examples
- Knapsack and TSP problems

Unit 2: NP-Completeness and NP- hard Problems

- Polynomial Time verification
- Techniques to show NP- Hardness
- NP-Complete problems and P Vs NP problems?

Unit 3: Handling Intractability
- Approximation algorithms for Vertex Cover problem and minimizing make- span as parallel machines (Graham's algorithm)
- Parameterized algorithm for Vertex Cover problem
- Meta-heuristic Algorithms

Prim's Algorithm
- Single Source Shortest Path Problems Bellman Ford Algorithm Dijkstra's Algorithm
- Maximum Bipartite Matching Problem

MCS-212   Discrete Mathematics   Credit 4

Discrete mathematics deal with discrete objects (that is not continuous) like a set of PhD students in computer science departments. Foundation of Commuter Science is built upon discrete mathematics. It includes Prepositional calculus, sets, relations, function, graphs, Boolean algebra and advanced counting principles. Knowledge of discrete structures helps in analyzing algorithms, and understanding different areas of computer science courses. The revised course on discrete mathematics course includes **Finite State Machines:** Introduction to Finite Automata, Computability and Complexity, Moore and Mealy State Machines and Deterministic Finite Automata, **Regular Expression and Languages:** Formal Definition of Regular expression and language, Building Regular Expressions, Finite Automata and Regular Expressions, Kleene Closure Definition and Algebra of regular Expressions.

- What is a Proof?   o   Properties Common to Some Terminology   Logic and Sets o   Hypothesis   •   Relations o   Axioms   o   Representing relation using o   Lemmas   matrices
  - o   Corollary   o   Representing relation using
  - o   Conjunction   digraph
- Different Methods of Proof o   Cartesian Product o   Direct Proof   o Relations and their types

Course Structure*

Block-1 Elementary Logic and Proofs

Unit 1: Prepositional Calculus
- Introduction • Objectives
- Propositions
- Logical Connectives o Disjunction o Conjunction o Negation o Conditional Connectives o Precedence Rule
- Logical Equivalence
- Logical Quantifiers
- Application of Propositional Logic o Web Page Searching o Logic Circuits
- Summary
- Solutions/Answers

Unit 2: Methods of Proof
- Introduction
- Objectives
  - o   Indirect Proofs o   Counter examples
- Principle of Mathematical Induction
- Summary
- Solutions/Answers

Unit 3: Boolean Algebra and Circuits

- Introduction
- Objectives
- Boolean Algebras

- Logic Circuits
- Boolean Functions •   Summary
- Solutions/Answers

Block- 2 Sets and Languages

Unit 1: Sets, Relations and Function

- Introduction
- Objectives
- Introducing Sets
- Operations on Sets o   Basic Operations
  - o   Properties of Relations
- Functions o Types of Functions o Composition of Functions o Some Important function o Operations on Functions
- Summary
- Solutions /Answers

Unit 2: Finite State Machines
- Introduction to Finite Automata, Computability and Complexity
- Moore and Mealy State Machines
- Deterministic Finite Automata

Unit 3: Regular Expression and Languages
- Formal Definition of Regular expression and language

- Building Regular Expressions
- Finite Automata and Regular Expressions
- Kleene Closure Definition
- Algebra of regular Expressions

Block 3: Counting Principles

Unit 1: Combinatorics
- Introduction
- Objectives
- Multiplication and Addition Principles
- Permutations o   Permutations of Objects not Necessarily Distinct
    - o   Circular Permutations
- Combinations
- Binomial Coefficients &Identities
- Summary
- Solutions/Answers

Unit 2: Advanced Counting Principles

- Introduction
- Objectives
- Pigeonhole Principle
- Inclusion-Exclusion Principle
- Applications of Inclusion – Exclusion
    - o   Application to Subjective Functions o Application to Probability o Application to Derangements
- Summary
- Solutions/Answers

Unit 3: Recurrence Relations
- Introduction
- Objectives
- Three Recurrent Problems
- Divide and Conquer Technique to solve Recurrence Relation
- Some Other Methods o   Method of Inspection o   Method of telescoping Sums o   Method of Iteration o   Method of Substitution
- Summary
- Solutions/Answers

Unit 4: Partitions and Distributions
- Introduction
- Objectives
- Integer Partitions
- Distributions o Distinguishable Objects into Distinguishable Containers o   Distinguishable Objects into Indistinguishable Containers o   Indistinguishable Objects into Distinguishable Containers o   Indistinguishable Objects into Indistinguishable Containers
- Summary
- Solutions/Answers

Block-4 Graph Theory

Unit 1: Basic Properties of Graphs

- Introduction
- Objectives
- Graphs o Graph Models

o Social

• Trees

MCS-213　　Software Engineering (Credits:4)

The objective of the Course is to make the learner efficiently work as software engineer. S/he should be well acquainted with all the phases of Software Development Life Cycle as well as latest topics in Software Engineering. The learner should be able to apply the

Networks o
　　Communication Networks o
　　Web Graphs
• Degree, Regularity and Isomorphism
• Subgraphs
• Represent Graphs o Adjacency Matrices o Adjacency Lists o Incidence Matrix
• Summary
• Solutions/Answers

Unit 2: Connectedness
• Introduction
• Objectives
• Connected Graphs o Paths, Circuits and Cycles
　o　Components o
　　Connectivity
• Bipartite Graphs o   A complete bipartite graph

concepts learned for doing research.

Course Structure*

BLOCK 1: Overview of Software Engineering

Unit1: Software Engineering and its models
• Evolution of Software Engineering
• Software development models
• Capability maturity models
• Software process technology

Unit2: Principles of Software Requirements Analysis
• Engineering the product

• Summary
• Solutions/Answers

Unit 3: Eulerian and Hamiltonian Graphs

• Introduction
• Objectives
• Eulerian Graphs
• Hamiltonian Graphs o Dirac's Theorem o Ore's Theorem
• Travelling Salesperson Problem
• Summary
• Solutions /Answers

Unit 4: Graph Colouring
• Introduction
• Objectives
• Vertex Colouring
• Edge Colouring
• Planar Graphs
• Map Colouring Problem
• Summary
• Solutions/Answers

• Modeling the system architecture
• Software prototyping and specification

Unit 3 Software Design

• Data design
• Architectural design
• Interface design
• HCI design
• Modular design
• User Experience design
• Design for Mobility
• Pattern based Design

Unit 4 Software Quality and Security

- Quality Concepts
- Quality Assurance
- Security Engineering

BLOCK 2: Software Project Management

Unit 5: Software Project Planning
- Different types of project metrics
- Software project estimation
- Models for estimation
- Automated tools for estimation
- Software Analytics

Unit6: Risk management and Project Scheduling
- Identification of Software risks
- Monitoring of risks
- Management of risks
- Formulating a task set for the project
- Choosing the tasks of software engineering
- Scheduling methods
- The Software project plan

Unit 7: Software Testing
- Component Level Testing
- Integration Level Testing
- Mobility Testing

Unit 8 Software change management
- Baselines
- Version control
- Change control
- Auditing and reporting

BLOCK 3: Web, Mobile and CASE tools

Unit9: Web Software Engineering
- Different layers

- Issues of management of web-based projects
- Metrics
- Analysis
- Design
- Testing

Unit10: Mobile Software Engineering
- Transition from design to coding of mobile applications
- Elements of mobile applications
- Approaches to the development of mobile applications

Unit11: CASE tools
- Analysis tools
- Design tools
- SQA tools
- UI design tools
- Software testing tools
- Web engineering tools

Unit12: Advanced Software Engineering
- Clean room Software engineering
- Component based Software engineering
- Re-engineering
- Reverse engineering

Block-4: Advanced Topics in Software Engineering
- Unit-13: Software Process Improvement
- Unit-14: Emerging Trends
- Unit-15: Introduction to UML • Unit-16: Data Science for Software Engineers

MCS-214   Professional Skills and Ethics   (Credits: 2)

This course is aimed to develop the communicational skills, professional skills and ethics at the work place. In this course, we concentrate on English at the workplace. You are probably wondering whether business English (as it is also called) is a separate language to general English. Certainly not, business English is not a separate language. It is English used at the workplace using specific vocabulary, and in certain situations

having a different discourse. Every profession uses a certain 'jargon' and the business context in no different. While business English is firmly rooted in general English, nevertheless there are certain distinguishing features which are evident. In this Course, you will learn some theoretical inputs into the process of communication, its different types, the difference between written and oral communication. We then concentrate on the structure of conversation – its characteristics and conventions, effectively speaking over the telephone, preparing Curriculum Vitae for jobs and interviews, preparing and participating in the Group Discussions, Presentation Skills, Copyright and Plagiarism issues and many more.

Course Structure*

BLOCK1: Professional Skills Needed at the Work Place - I

Unit 1: The Process of Communication

- Introduction: What is Communication?
- The Process of Communication
- Barriers to Communication • Different Types of Communication
- Written vs. Oral Communication
- Different Types of Face-toFace Interactions
- Characteristics and Conventions of Conversation
- Conversational Problems of Second/Foreign Language Users
- Difference between Conversation and Other Speech Events

Unit2: Telephone Techniques

- Warm Up
- Speaking and Listening: Commonly Used Phrases in Telephone Conversations
- Reading: Conference Calls
- Vocabulary
- Writing and Listening: Leaving a Message
- Grammar and Usage: The Perfect Tenses

- Pronunciation: Contracted Forms

Unit3: Job Applications and Interviews

- Warmup
- Reading
- Vocabulary: Apply for a Job
- Curriculum Vitae
- Language Focus: Some Useful Words
- Study Skills: Preparing for an Interview
- Listening
- Speaking
- Writing
- Negotiation Skills

Unit4: Group Discussions

- Reading
- Writing Skills
- Listening: How to be Successful in a Group Discussion
- Study Skills
- Language Focus
- Vocabulary
- Speaking
- Grammar: Connectives
- Pronunciation

Unit5: Managing Organisational Structure

- Warm Up: Ability to Influence and Lead
- Reading: The Role of a Manager
- Vocabulary: Leadership
- Speaking and Listening

27

- Language Focus: Degree of Probability
- Grammar: Modals
- Writing: Reports
- Pronunciation

BLOCK 2: Professional Skills Needed at the Workplace - II

Unit6: Meetings

- Reading: A Successful Meeting
- Speaking: One to One Meetings
- Language Focus: Opening, Middle and Close
- Study Skills: Editing
- Listening: Criteria for Successful Meetings
- Vocabulary
- Grammar: Reporting Verbs
- Writing: Memos
- Pronunciation: Stress According to Part of Speech

Unit7: Presentation Skills -I
- Reading: Presentation Skills
- Grammar: Verbs often Required in Presentations

Successful Life at the Workplace

- The Changing Scenario in the Twentyfirst Century
- What Employers Want
- Qualities of a Star Performer
- Personal Competence
- Social Competence
- Neurolinguistic Programming (NLP)
- Implementing the Change
- Knowing Who and What Trigger You
- Becoming Aware of Our 'Blind Spots' and Learning to Overcome Them
- Collaboration and Cooperation

Unit10: Work Ethics and Social Media Etiquette

- Ethics at the workplace
- A Talk on Ethics
- Vocabulary: Positive Qualities
- Talking about Ethical and Unethical

MCS-215   Course: Security and Cyber Laws   (Credits:2)

This course introduces the students to some of the latest topics in the context of computer security and cyber laws. These topics are very relevant in the present time.

- Language Focus
- Listening: Importance of Body Language in Presentations
- Speaking: Preparing an Outline of a Presentation
- Pronunciation

Unit8: Presentation Skills –II
- Reading: Structure of Presentation
- Study Skills: Visual Aids
- Ending the Presentation
- Language Focus: Talking about Increase and Decrease
- Grammar: Prepositions
- Listening: Podium Panic
- Speaking
- Pronunciation: Emphasizing the Important Words in Context

Unit9: Developing Interpersonal Skills for a

- Practices
- Improving our Ethics

Unit11: Copyright and Plagiarism

- A Brief History of Copyright
- Evolution of Copyright Law in India • Who Owns a Copyright?
- Economic, Moral and Other Such Rights
- Plagiarism
- What needs to be acknowledged?

Course Structure* Block-1: Cyber Security Issues Unit-1: Cyber security issues and challenges (Will be Adapted from MIR-11 Unit-7, PGCCL)

- Introduction
- Objectives
- Digital Security: Pros & Cons
- Security Issues /breaches in Cyberspace
- Technology's Answers to Cyber Security
- Cyber Security and the Law

Unit-2: Cryptography Mechanisms (Will be Adapted from MIR-11 Unit-8, PGCCL)

- Introduction
- Objectives
- Introduction to Cryptography
- Functions of Cryptography • Steganography
- Encryption and Decryption
- Encryption Scheme: Public Key and Private Key Distribution
- Commonly used Crypto Algorithms
- RSA and DES
- Electronic Signature
- Authentication and Authorisation
- Hash Functions
- Access Control Derivatives/Mechanisms
- Public Key Infrastructure/ Data Encryption Standard

Unit-3: Data Security and Management (Will be Adapted from MIR-14 Unit-5, PGCCL)

- Introduction
- Objectives
- Security Requirements(CIA)
- Security Threats and Attacks
- Computer, Mobile and Internet
- Security Measures and Solutions
- Security Policy
- Security Management
- Security Audit
- Security & Usability

Block-2: Cyber Laws

Unit-1: Regulation of Cyberspace: An Overview (Will be Adapted from MIR-11 Unit-9, PGCCL)

- Introduction
- Objectives
- Desirability of Regulation of Cyberspace
- Need for Regulation of Cyberspace
- How Cyberspace can be regulated
- Legal and Self-Regulatory Framework
- Filtering devices and Rating Systems
- Government Policies and Laws Regarding Regulation of Internet Content
- UNCITRAL Model Law,1996
- Regulation of Cyberspace Content: Global Scenario

- United States
- European Union
- United Kingdom
- Regulation of Cyberspace Content in India
- International Initiatives for Regulation of
  Cyberspace
- Organisation for Economic Cooperation and Development(OECD)
- UNESCO
- BRICS

Unit-2: Cyber Crimes

- Introduction
- Objectives
- Classification of Cyber Crimes
- Penalties and compensation (Chapter IX) under IT Act, 2000
- Offences (chapter XI) under IT Act, 2000
- Investigation and procedure ((Chapters XII- 77A to 78 and80)
- Basics of Cyber Forensic
- Cyber Forensic Investigation Tools

- Patents

Unit-3: IPR issues in Cyber Space   • Linking, In-lining and framing

- Introduction   • Trademark Issues
- Objectives •   Domain Name Disputes – Cyber squatting
- Basic Concept: IPRs   • Search Engines and their Abuse
- Copyright issues in digital- medium, music •   Regulatory Framework- National and and goods   International Scenario.

MCSL-216   DAA and Web Design Lab   Credits: 2

Main objective of this laboratory course is to provide hands on exercises to the learners based on DAA and Web Design Course.

Lab Sessions:

- There will be 20 practical sessions (3 hours each) of which 10 sessions will be on DAA and 10 sessions will be on Web Designing.
- The practice problems for all 20 sessions will be listed session-wise in the lab manual.

MCSL-217 Software Engineering Lab   Credits: 2

Main objective of this laboratory course is to provide hands on exercises to the learners based on Software Engineering Course.

Lab Sessions:

- There will be 20 practical sessions (3 hours each)
- The practice problems for all 20 sessions will be listed session-wise in the lab manual.

Syllabus of Bridge Courses *(Only for the students who are required to register for these courses based on eligibility conditions for admission to MCA programme)*

MCS-201   **Programming in C and Python**
        Credits– 4

Objective
The course is aimed to develop problem-solving strategies, techniques and skills that can be applied to computers and problems in other areas which give students an introduction to computer and analytical skills to use in their subsequent course work and professional development. Emphasis of this course is to act as an introduction to the thinking world of computers, to help students develop the logic, ability to solve the problems by using C & Python as programming languages. Knowledge in a programming language is prerequisite to the study of most of computer science courses. This knowledge area consists of those skills and concepts that are essential to problem solving and programming practice independent of the underlying paradigm. The student will learn various concepts and techniques for problem solving and will implement those ideas using C and Python programs.

Block and Unit Structure
C PROGRAMMING (BLOCK - 1 & 2)
BLOCK 1: An Introduction to C

Unit 1:   Programming Fundamentals
        •
- Problem - Solving Techniques o Steps for Problem - Solving
  o Using Computer as a Problem Solving Tool Basics of Algorithms o Definition o Features of Algorithm
- Flowcharts o   Basic Symbols used in Flowchart Design
- Structured Programming concepts
- C Language and its features
- Structure of a C Program
- Writing a C Program

- Compiling a C Program o The C Compiler o Syntax and Semantic Errors
- Link and Run the C Program o Run the C Program through the Menu o Run from an Executable File o Linker Errors o Logical and Runtime Errors o

Unit 2: Data Types Operators and Expressions
- Character Set
- Identifiers and Keywords o Rules for Forming Identifiers
- o Keywords
- Data Types and Storage
- Data Type Qualifiers
- Variables
- Declaring Variables
- Initialising Variables
- Constants o Integer Constants o Floating Point Constants o Character Constants o String Constants o Symbolic Constants
- Preprocessor directives
- Assignment Statements
- Arithmetic Operators
- Relational Operators
- Logical Operators
- Comma and Conditional Operators
- Type Cast Operator
- Size of Operator
- C Shorthand
- Priority of Operators

Unit 3: Decision and Loop Control Statements
- Decision Control Statements o The *if* Statement o The *switch* Statement
- Loop Control Statements o The *while* Loop o The *do-while* Statement o The *for* Loop o The Nested Loop
- The *Goto* Statement

- The *Break* Statement
- The *Continue* Statement

Unit 4: Arrays & Strings
- Array Declaration o Syntax of Array Declaration o Size Specification
- Array Initialization o Initialization of Array Elements in the Declaration
- o Character Array Initialization
- Subscript
- Processing the Arrays
- Multi-Dimensional Arrays o Multi-Dimensional Array Declaration o Initialization of Two-Dimensional Arrays
- Declaration and Initialization of Strings
- Display of Strings Using Different Formatting Techniques
- Array of Strings
- String Functions and Applications

BLOCK 2: Functions, Structures, Pointers and File Handling in C Unit 5: Functions
- Definition of a Function
- Declaration of a Function
- Function Prototypes
- The Return Statement
- Types of Variables and Storage Classes o Automatic Variables o External Variables o Static Variables
- o Register Variables

- Types of Function Invoking
- Call by Value
- Recursion

Unit 6: Structures and Unions
- Declaration of Structures
- Accessing the Members of a Structure
- Initializing Structures

32

- Structures as Function Arguments
- Structures and Arrays
- Unions
- Initializing an Union
- Accessing the Members of an Union
- Bit fields

Unit 7:   Pointers

- Pointers and their Characteristics
- Address and Indirection Operators
- Pointer Type Declaration and Assignment o   Pointer to a Pointer o   Null Pointer Assignment
- Pointer Arithmetic
- Passing Pointers to Functions o   A Function Returning More than

o String Input / Output Functions   • Package Creation and Importing o Formatted Input / Output   • Standard Library Modules Functions

o Block Input / Output Functions **Block-4 Advanced Features in Python**

- Sequential Vs Random Access Files **Unit-13 Classes in Python**
- Positioning the File Pointer
- The Unbuffered I/O - The UNIX like File Routines

PYTHON PROGRAMMING (BLOCK-3&4)

Block-3 Introduction to Python Programming

One Value o   Function Returning a Pointer
- Arrays and Pointers
- Array of Pointers
- Pointers and Strings

Unit 8:   File Handling
- File Handling in C Using File Pointers o   Open a file using the function *fopen ( )*
  o   Close a file using the function *fclose( )*
- Input and Output using file pointers o   Character Input and Output in Files

Unit-9 Introduction to Python
- History of Python
- Need of Python

- Packages for Cross platform application of Python
- Getting started with Python
- Program structure in python
- Running the First program

Unit-10 Data Structures and control statements in Python
- Data Types
- Data Structures o Arrays o Linked Lists o Stacks o Queues
- Sequence, Selection and Iteration constructs
- Recursion

Unit-11 Functions and File Handling in

- Introduction   to   Object Oriented
- Paradigms
- Classes and instances
- Classes method calls
- Inheritance and Compositions
- Static and Class Methods
- Operator Overloading Polymorphism

Python
- Function definition and call
- Function Scope
- Arguments
- Function Objects
- Lambda Functions
- Anonymous Functions
- File Operations
- Creating. Opening and using files

Unit-12 Modules and Packages
- Module Creations and Usage
- Module Search Path
- Module Vs. Script

Unit-14 Exception Handling in Python Programming
- Default Exception Handler

MCS-208   **Data Structures and Algorithms**   **4 Credits**

Objectives

The learner should become well versed with Algorithms and various data structures. S/he should be able to use them appropriately as per need during development of programs. Also, the learner should know different sorting and searching techniques so that correct techniques can be used in different programs so that the complexity of the program does not increase due the sorting/search technique employed. The course also includes Advanced Data Structures which will enable learner to apply them in solving complex problems.

Block and Unit Structure

BLOCK 1: Introduction to Algorithms and Data Structures

Unit 1: Analysis of Algorithms

- Mathematical Background
- Process of Analysis
- Calculation of Storage Complexity
- Calculation of Run Time Complexity

Unit 2: Arrays, Pointers and Structures

- Arrays and Pointers
- Sparse Matrices
- Structures
- Polynomials
- Representation of Arrays o Row Major Representation o Column Major Representation
- Applications **Unit 3: Lists**
- Abstract Data Type-List
- Array Implementation of Lists
- Linked Lists-Implementation
- Doubly Linked Lists-Implementation

- Circularly Linked Lists-Implementation
- Skip lists
- Applications   **Unit 6: Trees**
- Abstract Data Type-Tree **BLOCK 2:**
  Implementation of Tree
- Raise an exception
- User defined exception

Unit-15 Advanced Concepts

- Decorators

- Generators

Unit 4: Stacks

- •Abstract Data Type-Stack Implementation of Stack
  o Implementation of Stack using Arrays o Implementation of Stack using Linked Lists
- Algorithmic Implementation of Multiple Stacks
- Applications

Unit 5: Queues

- •
  Abstract   Data   Type-Queue Implementation of Queue o Array
- Implementation   o   Linked   List
- Implementation Implementation of Multiple Queues Implementation of Circular Queues o Array Implementation o Linked List Implementation of a circular queue
- Priority Queues
  Implementation of DEQUEUE o
      Array Implementation of a dequeue o   Linked List Implementation of a *dequeue*

Stacks, Queues and Trees   •

- Co-routines

Unit-16 Data Access using Python
- Database concepts
- Creating database
- Querying Database

34

- Using SQL to get more out of database

- Tree Traversals
- Binary Trees
- Implementation of Binary Tree
- Binary Tree Traversals o Recursive Implementation of Binary Tree Traversals o Non Recursive Implementations of Binary Tree Traversals
- Applications

BLOCK 3: Graph Algorithms and Searching Techniques

Unit 7: Advanced Trees

- Binary Search Trees o Traversing a Binary Search Trees o Insertion of a node into a Binary Search Tree o Deletion of a node from a Binary Search Tree
- AVL Trees o Insertion of a node into an AVL Tree o Deletion of a node from and AVL Tree o AVL tree rotations o Applications of AVL Trees
- B-Trees o Operations on B-Trees o Applications of B-Trees
- Splay Trees o Splaying steps o Splaying Algorithm
- Red-Black trees o Properties of a Red-Black tree
- AA-Trees

Unit 8: Graphs

- Definitions
- Shortest Path Algorithms o Dijkstra's Algorithm o Graphs with Negative Edge costs o Acyclic Graphs o All Pairs Shortest Paths Algorithm
- Minimum cost Spanning Trees o Kruskal's Algorithm o Prims's Algorithm o Applications
- Breadth First Search
- Depth First Search
- Finding Strongly Connected Components

Unit 9: Searching and Sorting Techniques

- Linear Search
- Binary Search
- Applications
- Internal Sorting o Insertion Sort o Bubble Sort o Quick Sort o 2-way Merge Sot o Heap Sort
- Sorting on Several Keys
- External Sorting Algorithms

BLOCK 4: File Structures and Advanced Data Structures

Unit 10: Hashing o Introduction o Index Mapping o Collision Handling o Double Hashing o Load Factor and Rehashing

Unit 11: Advanced Data Structures

- Scapegoat Trees
- Tries
- Binary Tries
- X-Fast Tries
- Y-Fast Tries

Unit 12: File Structures

- Terminology
- File Organisation
- Sequential Files o Structure o Operations o Disadvantages o Areas of use
- Direct File Organisation
- Indexed Sequential File Organisation

SEMESTER - II

MCS-218   **Data Communication and Computer Networks**   **Credits: 4**

The course introduces the fundamental concepts of data communication and Computer Networks. In the networking field, significant changes have taken place: (i) evolution of the Internet and wireless networks (ii) growth of networking services and applications. Network security has become very important topics because things are becoming digital and networked with each other. One extra unit has been added to cover the security topics. The objective of the revised courses is to reflect these changes besides explaining the basic principles of computer networking. A several new topics have been introduced in the revised course: Personnel Area network: Bluetooth and Zigbee, Cellular Networks : Architecture, Handoff, 3G,4G and 5G networks, Mobile IP, IPV6, Mobile Adhoc Networks, Wireless Sensor Networks, Internet of Things (IOT), Network Layer Security: IPSec, VPN, Securing TCP Connections: SSL, WLAN Security, Cyber Threats and Attacks and Counter Measures, Taxonomy of various Cyber Attacks, Virus, Worm and Trojan , DoS attack, DDOS attack, Phishing attacks, Malware, Ransom, vulnerabilities, Buffer Overflow, SQL Injection, Browser Vulnerabilities, OS vulnerabilities, Basics Computer Forensics, Recent Cyber Attacks and Firewalls and Intrusion Detection Systems.

Course Structure*

Block- 1 Introduction to Data Communication

Unit 1: Introduction to Internet
- Introduction
- Objectives
- What is the Internet?
  ISP and Internet Backbone
  Interconnection of ISPs
  - Taxonomy of Network
  - Standard Internet Protocols
  - Public Network & Private Network (Intranet)
  - Accessing the Internet
  - Telephone Network
  - Cable Network
  - Wireless Network
- Internet Services
  Network Topology
  Network Models
- OSI Model
- TCP/IP Model
- Summary
- Solutions/Answers

Unit 2: Data Transmission basics & transmission media
Introduction

Objectives
Data Communication Terminology
 Channel
 Baud
 Bandwidth
 Frequency
Modes of Data Transmission
 Serial and Parallel Communication
 Synchronous, Asynchronous and Isochronous Communication
 Simplex, Half Duplex and Full Duplex Communication
Analog and Digital Data Transmission
Transmission Impairments
 Attenuation
 Delay Distortion
 Noise
 Signal to Noise ratio
 Concept of Delays
Transmission Media and its Characteristics
 Guided media
 Unguided media
Wireless Transmission
 Microwave Transmission
 Radio Transmission
 Infrared and Millimeter Waves
Wireless LAN
Summary
Solutions/Answer

Unit 3: Data Encoding & multiplexing

Introduction
Objectives
Encoding
Analog to Analog Modulation
Analog to Digital Modulation
Digital to Analog Modulation
Digital to Digital Encoding
 Multiplexing
        Frequency Division Multiplexing
     Time   Division   Multiplexing
Summary
Solutions/Answers

**Block- 2 Media Access Control and
        Data Link Layer**

Unit 1: Data Link Layer Fundamentals
Introduction
Objectives
The services provided by the link layer
Framing
Error Correction and Detection
- Type of errors
- Single bit error
- Burst error
- Error Detection and Correction
  Techniques
- Parity Check
- Checksum Methods
- Cyclic Redundancy check
DLC Protocols
- HDLC (High Level Data Link
  Control)
- PPP Protocol (Point to Point
  Protocol)
Flow Control
Summary
Solutions/Answers

Unit 2: Retransmission Strategies
Introduction
Objectives
Stop & Wait ARQ
Sliding window Protocols
     Piggybacking and Pipelining
          Concepts
 Go-Back-N ARQ (Automatic Repeat Request)
   Selective Repeat N.
Summary
Solutions/Answers
Further Readings

**Unit 3: Contention-based Media
        Access Protocols**

Introduction
Objectives
Advantages of Multiple Access
Sharing of Channel Resources Pure
ALOHA
Slotted ALOHA
Carrier Sense Multiple Access(CSMA)
CSMA with Collision Detection
     (CSMA/CD)
Ethernet Frame Format (IEEE802.3)
Summary
Solutions/Answers
Further Readings

**Unit 4: Polling-based Media Access
        Control Protocols**
- Introduction
- Objectives
- Characteristics of Wireless
  Link and Wireless Network
- Introduction to Wireless LAN
- Wireless LAN Architecture
  (IEEE802.11)
- Hidden Station and Exposed
  Station Problems •
          Wireless LAN
  Protocols:
   MACA and MACAW
- IEEE 802.11 Protocol Stack
- The 802.11 Physical Layer
- The 802.11 MAC Sub-layer
  Protocol •   Switching at
  Data Link Layer
- Personnel Area network:
  Bluetooth and Zigbee
- Cellular Networks:
  Architecture, Handoff
- 3G, 4G and 5G networks
- Summary
- Solutions/Answers
- Further Readings

Block- 3 Network Layer

**Unit 1: Introduction to Layer
Functionality and Design Issues**
- Introduction ○ Objectives ○
  Connection Oriented vs.
          Connection-less Services

38

- Elements of Transport Layer Protocols
  - o Addressing o Multiplexing o Flow Control and Buffering o Connection Establishment o Crash Recovery
- Summary
- Solutions/Answers
- Further Readings

Unit 2: TCP/UDP

- Introduction
- Objectives
- Services Provided by Internet Transport Protocols o TCP Services o UDP Services
- Introduction to UDP
- Introduction to TCP
- TCP Segment Header
- TCP Connection Establishment
- TCP Connection Termination
- TCP Flow Control
- TCP Congestion Control
- Remote Procedure Call
- TCP in wireless environments
- Summary
- Solutions/Answers
- Further Readings

Unit 3: Network Security I

- Introduction
- Objectives •   What is Internet Security?
- Principles of Cryptography
- Symmetric Key Cryptography
- Public Key Cryptography

- RSA Public Key Algorithm • Application of Public Key Cryptography (Digital Signature)
- Management of Public Keys
- Kerberos
- Network Layer Security: IPSec, VPN
- Securing TCP Connections: SSL
- WLAN Security
- Summary
- Solutions/Answers
- Further readings

Unit 4: Network Security-II

- Introduction
- Objectives
- Cyber Threats and Attacks and Counter Measures
- Taxonomy of various Cyber Attacks
- Virus, Worm and Trojan , DoS attack, DDOS attack, Phishing attacks, Malware, Ransom
- vulnerabilities
- Buffer Overflow
- SQL Injection
- Browser Vulnerabilities
- OS vulnerabilities
- Basics Computer Forensics
- Recent Cyber Attacks
- Firewalls and Intrusion Detection Systems
- Summary
- Solutions/Answers
- Further Readings

MCS-219   **Object Oriented Analysis and Design**   **4 Credits**

Object oriented analysis and design is a popular paradigm of analysis and design of the systems. This Course is designed to help in learning object oriented analysis and design concepts. This Course is having coverage of UML diagrams and will help in developing understanding in the area of system analysis and design concepts using object-oriented approach. This Course will cover different aspects of OOAD with explaining object modeling dynamic modeling and functional modeling. The topics covered in the course include:

Object Oriented Modeling and UML

Introduction to Object Oriented Modelling: OOT Object Oriented Modeling, Characteristics Object Oriented Modeling (Class and Objects, Links and Association, Generalization and Inheritance), An Object Model, Benefits of OO Modeling, Introduction to OOAD tools

Object Oriented Analysis: Object Oriented Analysis, Problem Statement: an Example, Differences between Structured Analysis and Object Oriented Analysis, Analysis Techniques (Object Modeling, Dynamic Modeling, Functional Modeling), Adding Operations, Analysis Iteration

Using UML: UML: Introduction, Object Model Notations: Basic Concepts, Structural Diagrams (Class, Object, Composite, Package, Component, Deployment), Behavioural Diagrams (Use Case, Communication, Sequence, Interaction Overview, Activity, State), Modelling with Objects

Object Oriented Design

System Design: System Design: An Object-Oriented Approach, Breaking into Subsystems, Concurrency Identification, Management of data store, Controlling events between Objects, Handling Boundary Conditions

Object Design: Object Design for Processing, Object Design Steps, designing a Solution, Choosing Algorithms, Choosing Data Structures, Defining Classes and delegation of Responsibilities to Methods

Advance Object Design: Control and its Implementation (Control as a State within Program, Control as State Machine Engine, Control as Concurrent Task), Inheritance Adjustment, Association: Design, Object Representation, Design Optimization, Design Documentation

Modeling

Object Modeling: Advance Modeling Concepts (Aggregation, Abstract Class), Multiple Inheritance, Generalization as an Extension, Generalization as a Restriction, Metadata, Constraints, An Object Model

Dynamic Modeling: Events, State and State Diagram, Elements of State Diagrams, Examples of State Diagrams, Advance Concepts in Dynamic Modeling, Concurrency, A Dynamic model Functional Modeling: Functional Models, Data Flow Diagrams, Features of a DFD, Design flaws in DFD, A Functional model, Relationship between Object, Dynamic, and Functional Models **Implementation**

Implementation Strategies: Implementation (Using Programming Languages, Using Database System), Unidirectional Implementation, Bi-directional Implementation, implementing associations, Implementing Constraints, Implementing State charts, Persistency

Object Mapping with Databases: Relational Database Schema for Object Modes, Object Classes to Database Tables, Mapping Associations to Tables, Mapping Generalizations to Tables, Interfacing to Database, Object Mapping with Databases: an Example.

Course Structure*

Block 1: Object Oriented Analysis and UML

Unit 1: Introduction to Object Oriented Modeling

- Introduction to Object Orientation
- Basic Philosophy of Object Orientation
- Principals of Object Orientation
- Abstraction
- Encapsulation
- Inheritance
- Polymorphism
- Basic Constructs in Object Orientation ○ Class and Objects ○ Links and Association ○ Generalization and Special
- Identifying Class and Object
- Benefits of Object Orientation
- Introduction to OOA & Design Tools

Unit 2: Structural Modeling using UML

- Introduction to UML
- Basic Structural Modeling o
  Classes o   Relationships,
  o   Common Mechanisms o
  Class Diagram
- Advanced Structural Modeling o
  Advance Classes ▪ Advanced
  Relation
    ▪ Interference Type and Roles
- Packages,
- Instance and Object Diagrams

Unit 3: Behavioral Modeling using UML

- Basic Behavioral Modeling
- Interactions,
- Use Cases and Use Case
  Diagram
- Interaction Diagram
- Activity Diagram

Unit 4: Advanced Behavioral Modeling using UML

- Events and Signals
- State Machines
- Process and Threads
- Time and Space
- State Chart Diagram

Unit 5: Architectural Modeling

- Components
- Deployment
- Collaboration
- Component Diagrams
- Deployment Diagrams

Block 2:Modeling
Unit 1: Object Modeling

- Advanced Modeling Concepts o
  Aggregation
        Abstract Class
- Multiple Inheritance •
      Generalization and
  Specialisation

- Meta Data and Keys
- Integrity Constraints
- An Object Model

Unit 2: Dynamic Modeling

- Events
- State and State
  Diagram
- Elements of a State
  Diagram
- Advanced Concepts in
  Dynamic Modeling
- Concurrency
- A Dynamic Model

Unit 3: Functional Modeling •
 Functional
 Models

- Data Flow Diagrams
- Features of a DFD o
  Processes o Data
  Flows o Actors o Data
  Stores o Constraints o
  Control Flows
- Design Flaws in DFD
- A Sample Functional
  Model •   Relation
  of Functional to
   Object and Dynamic
   Model

Block 3: Object Oriented Design

Unit 1: Basics of System Design

- OOA to OOD
- System Design: An
  Object-Oriented
  Approach
- Breaking into
  Subsystems
- Concurrency
  Identification
- Management of a Data
  Store
- Controlling Events
  Between Objects
- Handling Boundary
  Conditions

42

Unit 2: Object Design

- Object Design for Processing
- Object Design Steps
- Choosing Algorithms o Selecting Data Structure o Defining Internal Classes and Operations o Assigning Responsibility for Operation
- Implementation of Control o State as Location within a Program o State Machine Engine o Control as Concurrent Tasks
- Adjustment of Inheritance o Rearranging Classes and Operations o Abstracting Out Common Behavior
- Design of Associations o Analyzing Association Traversal o One-way Associations o Two-way Associations

Unit 3: Advance Object Design

- Control and its Implementation o Control as a State within Program o Control as a State Machine Engine o Control as Concurrent Task
- Inheritance Adjustment
- Association: Design
- Object Representation
- Design Optimization
- Design Documentation

Block 4: Implementation

Unit 1: Implementations Strategies -1

- Mapping Design to Code

- Creating Class Definition from Class Diagram
- Implementing Associations
- Unidirectional Implementations o Optional Associations o One-to-One Associations o Associations with Multiplicity 'Many'

- Bi-directional Implementations o One-to-One and Optional Associations o One-to-Many Associations o Immutable Associations

Unit 2: Implementation Strategies-2

- Creating Methods from Collaboration Diagram
- Implementing Constraints
- Implementing State Charts
- Persistency

Unit 3: Objects Mapping With Databases
- Relational Database Schema for Object Modes o General DBMS Concepts o Relational DBMS Concepts o RDBMS Logical Data Structure
- Object Classes to Database Tables o Extended Three Schema Architecture for Object Models o The use of Object IDs o Mapping Object Classes to Tables
- Mapping Associations to Tables o Mapping Binary Associations to Tables
o Mapping Many-to-Many Association to Tables o Mapping Ternary Associations to Tables

43

MCS-220   Web Technologies   4 Credits

Main objective of the Course is to introduce concepts, tools/technologies and programming to develop distributed secure, reliable and scalable Web Application using J2EE Technologies application. This course discusses some commonly used design patterns, servlet, JSP, Spring Boot & Hibernate (ORM), and Web Security. The topics covered in the course include:

Introduction to Advance Java (J2EE) J2EE Architecture and Design patterns (MVC, Repository Design pattern, Singleton, Factory, etc.), Building java Application JAR and WAR and deployment in tomcat.

Introduction to Servlets, Http Protocol & Http Methods, Web Server & Web Container, Servlet Architecture, Servlet Life Cycle, Steps to create a Servlet, Servlet Communication (Servlet- Browser, Web-component,) , Session Management, Database Connectivity in Servlet, Java Server Pages(JSP) Overview, JSP Life Cycle, JSP API, Components of JSP(Directives, Scripting, Action), JSP Implicit Objects, JSP Standard Tag Library (JSTL), Exception handling using JSP, Database Connectivity in JSP.

Introduction to J2EE Frameworks, discuss about various Frameworks available for J2ee Development (Struts, Hibernate, Spring)- Maven and Introduction of Annotation. Spring MVC- Configuration, Create, Read, Update, and Delete (CRUD) Application. Spring MVC with Bootstrap CSS- Configuration of Bootstrap in Application and Apply custom CSS in pages.

Spring Boot & Hibernate (ORM) - Introduction to Spring boot, Configuration of Hibernate (ORM)

CRUD Application using spring boot and Hibernate.

Web Security- Spring Security configuration, Custom login using Security, Role based login.

- Mapping Generalizations to Tables
- Interfacing to Databases

Course Structure*

Block 1: Web Application Development using J2EE
Unit 1: Introduction to J2EE, Architecture and Design pattern
- Web Server & Web Container,
- Introduction to J2ee
- Design Patters
    1. MVC
    2. Repository Design pattern
    3. Singleton
    4. Factory
- Building java Application JAR and WAR and deployment in tomcat

Unit 2: Basics of Servlet
- Introduction to Servlets
- Http Protocol & Http Methods
- Servlet Architecture

- Servlet Life Cycle
- Creating a Servlet
- Servlet Communication (Servlet-Browser and Webcomponent)

Unit 3: Session Management and Database Connectivity in Servlet
- Session Management
- Database Connectivity in Servlet,
- Servlet Communication (Servlet-Browser, Webcomponent)
- Servlet Collaboration
- Session Management
- Database Connectivity

Unit 4: JSP
- JSP Overview
- JSP Life Cycle
- JSP API

- Components of JSP (Directives, Scripting, Action)
- JSP Implicit Objects
- An Introduction to JSP Standard Tag Library (JSTL)
- Exception handling using JSP
- Database Connectivity

Block 2: Frameworks for J2EE

Unit 5: Introduction to J2EE Frameworks
- Introduction of Struts
- Introduction of Spring including Boot and MVC
- Introduction of Hibernate with Java Persistence API (JPA)
- Introduction of Annotation **Unit 6: Discuss about various Frameworks available for J2EE Development (Struts, Hibernate, Spring)**
- Struts: Features
- Spring Boot and MVC: features
- Hibernate with JPA: Features
- Compare amount these frameworks
- Maven: Introduction., Overview and configuration
- Create First Project using Maven

Unit 7: Spring MVC
- Setting up Development Environment for Spring MVC
- First Hello World Project using Spring MVC
- Inversion of Control (IoC) and Dependency Injection
- Creating Controllers and Views
- Request Params and Request mapping
- Form Tags and Databinding
- Form Validation

Unit 8: Spring MVC with Bootstrap CSS
- Configuration of Bootstrap in Spring Application
- Apply custom CSS in pages
- Setting UP Database using Hibernate
- Create, Read, Update, and Delete (*CRUD*)

- CRUD examples in Spring MVC and Hibernate

Block 3: Spring Boot and Hibernate (ORM)

Unit 9: Introduction to Spring boot
- Spring Boot: Overview
- Spring Boot Dev Tools and Spring Boot Actuator
- Spring boot- Application Properties
- Running Spring Boot Apps from command line

Unit 10: Configuration of Hibernate (ORM)
- Hibernate Overview
- Hibernate Configuration with Annotation
- REST (REST stands for Representational State Transfer) JPA Overview
- Creating JPA DAO implementation for REST API
- Hibernate CRUD (Create, Read, Update, and Delete)Features

Unit 11: CRUD Application using Spring boot and Hibernate
- Create records using Spring Boot and Hibernate
- Read records using Spring Boot and Hibernate
- Update records using Spring Boot and Hibernate
- Delete records using Spring Boot and Hibernate

Block 4: Web Security

Unit 12: Spring Security configuration
- Introduction to Web Securities ○ Introduction of Java Cryptography Architecture (JCA) ○ Introduction of Java Secure Socket Extension (JSSE)
- Issues and Challenges of Web Security
- Spring Security Overview
- Java based configuration
- Create Spring Initializer class
- Create Controller and View
- Run Application

Unit 13: Custom login using Security
- Custom login form creation
- Spring Config for Custom Login Form
- Create Request mapping and building Custom Login Form
- Testing Custom Login Form
- Adding Logout Support

Unit 14: Role based login
- Display User Id and Roles Overview
- Roles based login Example
- Restrict Access based on Roles
- Testing the Application
- Cross Site Request Forgery (CSRF)

MCS-221   Data Warehousing and Data Mining   4 Credits

The course objectives are:

- To understand the underlying concepts of Data Warehousing

- To identify the components of the Data Warehouse Architecture

- To know the difference between the Data Warehouse and Data Marts

- To understand the Data Warehouse Development Life Cycle

- To elucidate the dimensional modeling techniques

- To understand the ETL, OLAP concepts and other evolving trends

- To learn data mining concepts and understand association rules mining

- To discuss classification algorithms, learn how data is grouped using clustering techniques

- To develop the abilities of critical analysis to data mining systems and applications

- To implement practical and theoretical understanding of the technologies for data mining

- To understand the strengths and limitations of various data mining models The topics

  covered in the course include:

Introduction to Data Warehousing, Evolution of Data Warehousing, Features of Data Warehousing, Benefits of Data Warehousing, Data Granularity, Metadata, Data Warehousing Architecture, Data Warehouse and Data Marts, Building Data Marts, Issues in building data marts, Data Warehouse Schema, Dimensional Modeling, The Star Schema, The Snowflake Schema, Aggregate Tables, Fact Constellation Schema, Dimensional Modeling, Extraction, Transformation and Loading (ETL) process, OLAP and Data Warehousing, OLTP and Data Warehousing, Trends in Data Warehousing

Introduction to Data Mining Systems, How Data Mining Works, Classification of Data Mining Systems Issues, Applications of Data Mining, Data Mining Tools, Issues in Data Mining, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and Discretization, Data similarity and dissimilarity measures, Mining Frequent Patterns, Associations, Classification using Frequent Patterns, Decision Tree Induction , Bayesian Classification, Rule Based Classification, Classification by Back Propagation, Support Vector Machines, K- nearest Neighbor classification, Clustering, Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Hierarchical Clustering,

Outlier Detection, Text and Web Mining.

Course Structure*

BLOCK 1: DATA WAREHOUSE FUNDAMENTALS AND ARCHITECTURE

UNIT 1: Fundamentals of Data Warehouse

- Introduction to Data Warehousing
- Evolution of Data Warehousing
- Data Warehousing Concepts
- Online Transaction Processing Systems
- Differences between OLTP Systems and Data Warehouse
- Characteristics of Data Warehouse
- Data Granularity
- Metadata and Data Warehousing
- Functionality of Data Warehouse
- Advantages of Data Warehouse
- Applications of Data Warehouse
- Concerns in Data Warehouse
- Types of Data Warehouses ○ Enterprise Data Warehouse ○ Operational Data Store
  - ○ Data Mart

Unit 2: Data Warehouse Architecture

- Introduction to Data Warehouse Architecture
- Characteristics of Data Warehouse Architecture
- DW Architecture Goals
- Components of Data Warehouse ○ Load Manager ○ Warehouse Manager ○ Query Manager • Data Mart
- Building Data Marts
- DW and Data Marts
- Issues in Building Data Marts
- Co-existence of DW and Data Mart
- Planning and Requirements ○ Planning Data Warehouse and Key Issues ○ Planning and Project Management in constructing Data Warehouse
- ○ Data Warehouse Development Life Cycle ○ Methodologies
  - Top- Down, Bottom-Up and Hybrid Development Methodology

Unit 3: Dimensional Modeling

- Introduction to Dimensional Modeling and its Strengths
- Identifying Facts and Dimensions
- Star Schema
- Pros and Cons of Star Schema
- Snowflake Schema
- Pros and Cons of Snowflake Schema
- Aggregate Tables ○ Need for Building Aggregate Fact Tables ○ Limitations of Aggregate Fact Tables
- Fact Constellation Schema ○ Aggregate Fact Tables and Derived Dimension Tables
- Pros and Cons of Fact Constellation Schema

BLOCK 2: ETL, OLAP ANDTRENDS

Unit 4: Extract, Transform and Loading

- Overview of ETL
- ETL requirements and steps
- Data Extraction
- Extraction Methods - Logical Extraction Methods and Physical Extraction Methods
- Data Transformation
- Basic Tasks in Transformation
- Major Data Transformation Types
- Data loading; Data Loading Techniques
- Data Quality

Unit 5: Introduction to Online Analytical Processing

- Need for OLAP
- Characteristics of OLAP
- OLAP and Multidimensional Analysis
  ○ Multidimensional Logical Data Model and its Users ○ Multidimensional Structure ○ Multidimensional Operations
- OLAP Functions • Data Warehouse and OLAP:
  Hypercube & Multi-cubes
- OLAP Applications
- Steps in the OLAP Creation Process
- Advantages of OLAP
- OLAP Architectures - MOLAP, ROLAP, HOLAP,DOLAP

Unit 6: Trends in Data Warehouse
- Data Lakes Complex Data Marts
- Cloud Data Warehousing
- Real Time Data Warehousing
- Data Warehousing and Hadoop
- Data Warehouse Automation

BLOCK 3: DATA MINING FUNDAMENTALS AND FREQUENT PATTERN MINING

Unit 7: Data Mining – An Introduction
- Introduction
- Data Mining – From What Kind of Data ○ Relational Databases ○ Data Warehouses ○ Transactional Databases

- ○ Advanced Data and Informational Systems
- How does Data Mining Works?
- Classification of Data Mining Systems
- Applications of Data Mining
- Data Mining and Data Warehousing
- Data Mining Tools
- Major Issues in Data Mining

Unit 8: Data Preprocessing

- Introduction
- Data Preprocessing Overview
- Data Cleaning ○ Missing Values ○ Noisy Data ○ Data Cleaning as a Process
- Data Integration and Transformation ○ Data Integration ○ Data Transformation
- Data Reduction ○ Data Cube Aggregation ○ Attribute Subset Selection ○ Dimensionality Reduction ○ Numerosity Reduction
- Discretization and Binarization • Measures of Similarity and Dissimilarity-Basics

Unit 9: Mining Frequent Patterns and Associations
- Problem Definition
- Frequent Item Set Generation
- The APRIORI Principle
- Support and Confidence Measures
- Association Rule Generation
- APRIORI Algorithm: Finding Frequent Itemset Using Candidate Generation
- Generating Association Rules from Frequent Item set
- Improving the efficiency of Apriori
- Correlation Analysis
- From Association Analysis to Correlation Analysis

BLOCK 4: CLASSIFICATION, CLUSTERING AND WEB MINING

Unit 10: Classification
- Introduction
- Classification: Problem Definition

- General Approaches to solving a classification problem
- Evaluation of Classifiers
- Classification techniques
- Decision Trees-Decision tree Construction
- Methods for Expressing attribute test conditions
- Measures for Selecting the Best Split
- Algorithm for Decision tree Induction
- Bayesian Classification o Bayes' Theorem o Naive-Bayesian Classification o Bayesian Belief Networks
- Support Vector Machines o The Case when the data are linearly separable
  - o The Case when the data are linearly inseparable

Unit 11: Clustering
- Clustering: Problem Definition
- Clustering Overview
- Categorization of Major Clustering Methods o Partitioning Method
  - o Hierarchical Method

- o Density-based Method o Grid-Based Method o Model-Based Method o Constraint-based Method
- Partitioning Method o K-Means Algorithm
  - o K-Medoids
- Hierarchical Clustering o Agglomerative Method o Divisive Method
- Key Issues in Hierarchical Clustering
- Strengths and Weakness
- Outlier Analysis – Outlier Detection methods

Unit 12: TEXT AND WEB MINING
- Text and Web Mining: Introduction
- Text Data Analysis and Information Retrieval
- Dimensionality Reduction for Text
- Text Mining Approaches
- Web mining
- Web content mining
- Web structure mining
- Mining Multimedia Data on the Web
- Automatic Classification of Web Documents
- Web usage mining

MCSL-222   OOAD and Web Technologies Lab   2 Credits

Main objective of this laboratory course is to provide hands on exercises to the learners based on Object Oriented Analysis and Design & Web Technologies Courses.

Lab Sessions:

- There will be 20 practical sessions (3 hours each) of which 10 sessions will be on OOAD and 10 sessions will be on Web Technologies.

- The practice problems for all 20 sessions will be listed session-wise in the lab manual.

MCSL-223   Computer Networks and Data Mining Lab   2 Credits

Main objective of this laboratory course is to provide hands on exercises to the learners based on Computer Networks and Data Mining Courses.

Lab Sessions:
- There will be 20 practical sessions (3 hours each) of which 10 sessions will be on Computer Networks and 10 sessions will be on Data Mining.

- The practice problems for all 20 sessions will be listed session-wise in the lab manual.

SEMESTER - III

MCS-224   **Artificial Intelligence and Machine Learning (CREDITS-4)**

The course relates to the conceptual understanding of the Artificial Intelligence and Machine Learning. Generally, Artificial Intelligence (AI) is considered as the discipline, to deal with the solution of the hard and insolvable problems using reasonable amount of time, by exploiting the knowledge of the problem domain. In view of the significance of knowledge in AI, in this course, a number of knowledge representation formalisms are introduced. The formalisms discussed include Propositional Logic, First Order Predicate Logic, Rule-based systems, Semantic Networks and Frames. Further, the course introduces the various concepts of Machine learning, Viz. Supervised learning, Unsupervised Learning and their respective application areas. Currently these two fields i.e. Artificial Intelligence and Machine Learning are in high demand, the course will help the learners to build the understanding of these fields.

Course Structure*

Block-1   Artificial   Intelligence - Introduction:

Unit-1   Introduction to   Artificial Intelligence -
What is AI? Examples of AI systems, Approaches to AI, Brief history of AI, Comparison Between Artificial intelligence, Machine Learning, and Deep Learning, Intelligent Agent: stimulusresponse agents. components of intelligence.

Unit-2 Problem Solving using Search –
Single agent search: Introduction to State Space Search, Statement of Search problems: state space graphs, Searching explicit state spaces. Feature based state spaces. Problem types, examples (puzzle problem, n-queen, the road map) Two agent search: Adversarial search: Two agent games (alpha-beta pruning). MinMax Search.

Unit-3 Uninformed and Informed Search –
Uninformed Search: Formulating the state space, iterative deepening, bidirectional search. Informed Search Strategies: Using evaluation functions. A* & AO* , admissibility of A* , Iterative deepening A*, recursive best first search.

Unit-4 Predicate and Propositional Logic –
Propositional logic, syntax, semantics, semantic rules, terminology - validity, satisfiability. interpretation, entailment, proof systems. Propositional Logic inference rules, natural deduction, propositional resolution.

Block-2 Artificial Intelligence - Knowledge Representation:

Unit-5 First Order Logic - First Order Logic: Motivation, Syntax, Interpretations, semantics of quantifiers, Entailment in FOL, Interpretation, Inference in FOL: First Order resolution. Conversion to clausal form. Unification. Most general unifier. Resolution with variables Proving validity.

Unit-6 Rule based Systems and other formalism -
Rule Based Systems: Forward chaining. Backward chaining. Conflict resolution. Semantic nets, Frames, Scripts.

Unit-7 Probabilistic Reasoning
Reasoning with uncertain information Review of Probability Theory, Introduction to Bayesian Theory, Bayes' Networks, Probabilistic

Inference, Basic idea of inferencing with Bayes networks. Other paradigms of uncertain reasoning.
Dempster-Scheffer Theory

Unit-8 Fuzzy and Rough Set Fuzzy Reasoning Introduction to Fuzzy sets, Fuzzy set representation, Fuzzy inferences, Rough Set Theory

Block-3 Machine Learning - I:

Unit-9 Introduction to Machine Learning Methods – Introduction to Machine Learning, Techniques of Machine Learning, Reinforcement Learning and algorithms, Deep Learning and its Algorithms, Ensemble Methods.

Unit-10 Classification –
Understanding of Supervised Learning, Introduction to Classification, Classification Algorithms: Naïve Bayes, K-NN, Decision Trees, Logistic Regression, Support Vector Machines.

Unit-11 Regression –
Introduction to Regression, Regression algorithm Linear Regression and Polynomial Regression, Support Vector Regression

Unit-12 Neural Networks and Deep Learning:

Overview of Artificial Neural Networks, Multilayer Feedforward Neural networks with Sigmoid activation functions; Back propagation Algorithm; Representational abilities of feed forward networks, Feed forward networks for Classification and Regression, Deep Learning

Block-4 Machine Learning - II:

Unit-13 Feature selection and Extraction: Introduction to Feature Selection and Extraction, Dimensionality Reduction, Principal Component Analysis, Linear Discriminant Analysis, Singular Value Decomposition.

Unit-14 Association Rules –
Introduction to Pattern search and its algorithms: Apriori Algorithms. and its variants, FP Tree Growth, Pincer Search.

Unit-15 Clustering –
Introduction to Clustering, Types of Clustering, Partition Based, Hierarchical Based, Density Based Clustering Techniques, Clustering algorithms: KMeans, Agglomerative and Divisive, DBSCAN, Introduction to Fuzzy Clustering.

Unit – 16 Machine Learning Programming using Python

Implementations of various algorithms learned in different units of this course

MCS-225   Accountancy and Financial Management   (Credits:4)

Financial Management and Accountancy course is aimed at making students aware of the basic accounting procedures and financial management processes. The central purpose of accounting is to make possible the periodic matching of costs (efforts) and revenues (accomplishments). The course describes four major topics: Accounting System, Understanding and Analysis of Financial Statements, Financial Management and Decisions and Working Capital Management. Accounting System deals with the framework of accounting. The focus is on scope and function of accounting in modern business. Understanding and Analysis of Financial Statements deals with preparation of final accounting statements, which includes preparation and analysis of Profit and Loss A/c. In this topic we also discuss ratio analysis. Ratio analysis is one of the most widely used analytic tool for financial analysis. Financial Management and Decisions deals with various aspects of financial management. Working Capital Management topic deals with the various sub components of working capital, which includes cash and treasury management –
The main objective of cash management is to maintain an optimum level of cash balance.

The objectives of this course are:

- Understand how debit and credit are determined for business transactions.

- Understanding the basics of business entries.

- Understanding Trial Balance and the techniques to prepare it.

- Understanding the preparation process of final accounts.

- Understanding and analysing the information contents of final accounts.

- Understand what gives money its time value.

- Understand how the various factors influence working capital requirements.

- Understand the various methods of computing working capital.

- Preparation of cash budget.

- Understand the role and function of treasury management.

- Understand the need for establishing sound credit policy along with NPA management.

- Understand the process for managing inventory.

Course Structure*

Block 1: Accounting System

Unit 1: Accounting and its Functions

- Introduction
- Objectives
- The Scope of Accounting
- The Emerging Role of Accounting
- Accounting as an Information System
- The Role and Activities of an Accountant
- Accounting Personnel
- The Nature of the Accounting Function
- The Organisation for Accounting and Finance
- Summary
- Keywords
- Self-Assessment Questions/Exercises
- Further Readings

Unit 2: Accounting Concepts and Standards

- Introduction
- Objectives
- The Accounting Framework
- Accounting Concepts

- Accounting Standards
- The Changing Nature of Generally Accepted Accounting Principles
- Attempts towards Standardisation
- Accounting Standards in India
- International Financial Reporting Standard(IFRS)
- Summary
- Keywords
- Self-Assessment Questions/Exercises
- Further Readings

Unit 3: Basic Accounting Process: Preparation of Journal, Ledger, Trial Balance and Bank Reconciliation Statement

- Introduction
- Objectives
- Accounting Equation
- Classification of Accounts
- Definitions of Journal and Ledger ○ The Journalising Process ○ Ledger Posting ○ Balancing an Account
- Trial Balance
- Objectives of Preparing Trial Balance ○ The Total Method of Preparing the Trial Balance
  - ○ The Balance Method of Preparing the Trial Balance

52

- Self-Assessment Questions/Exercises
- Solutions/Answers

Block 3: Financial Management and Decisions

Unit 1: Introduction to Financial Management
- Introduction
- Objectives
- Evolution of Financial Management
- Significance of Financial Management
- Principles of Financial Management ○ Investment Decision ○ Financing Decision ○ Dividend Decision ○ Liquidity Decision
- Objectives of Financial Management
- Economic Profit vs. Accounting Profit
- Agency Relationship ○ Problems Related with Agency Relationship ○ Costs of the Agency Relationship
- The Changing Financial Landscape
- Organisation of Financial Management
- Tasks and Responsibilities of Modern Financial Manager
- Summary
- Self-Assessment Questions/Exercises
- Solutions/Answers

Unit 2: Time Value of Money

- Introduction
- Objectives
- Determining the Future Value ○ Shorter Compounding Period ○ Effective vs. Nominal Rates ○ Continuous Compounding
- Annuity
- Summary
- Self-Assessment Questions/Exercises
- Solutions/Answers

Unit 3: Cost of Capital

- Introduction
- Objectives
- Significance of the cost of capital
- Opportunity cost of capital
- Determining component cost of capital
  ○ Cost of debt ○ Cost of preference capital ○ Cost of equity capital
- Weighted average cost of capital
- Summary
- Self-Assessment Questions

Unit 4: Investment Decision Methods

- Introduction
- Objectives
- The Investment Problem
- Capital Investment and Firm's Value ○ Stages in Capital Budgeting Process ○ Importance of Capital Investment Decisions ○ Types of Investment Decisions
- Investment Evaluation Criteria ○ Non-Discounts Cash Flow techniques ○ Discounted Cash Flow techniques
- Summary
- Self-Assessment Questions/Exercises
- Solutions/Answers

Unit 5: Working Capital Decisions

- Introduction
- Objectives
- Characteristics of Current Assets
- Operating Cycle Concepts
- Factors Influencing Working Capital Requirements
- Sources of Working Capital
- Strategies of Working Capital Management
- Estimating Working Capital Requirement
- Summary
- Self-Assessment

Questions/Exercises

MCS-226   Data Science and Big Data   Credit :4

This course introduces the students to the concepts of data science and big data, its architecture and a programming technique R that can be used to analyse big data.

Block 1: Basics of Data Science

Unit 1: Introduction to Data Science Definition of Data Science Data Answers

Block 4: Working Capital Management

Unit 1: Cash and Treasury Management
- Introduction
- Objectives
- Facets of Cash Management ○ Motives for Holding Cash ○ Cash Planning ○ Determining Optimum Cash Balance
- Methods of Cash Flow Budgeting
- Investing Surplus Cash
- Cash Collection and Disbursements
- Treasury Management ○ Treasury Risk Management ○ Functions of the Treasury Department
- Summary
- Self-Assessment Questions/Exercises
- Solutions/Answers

Unit 2: Receivables Management

- Introduction
- Objectives
- Terms of Payment
- Credit Policy Variables
- Credit Evaluation
- Monitoring Receivables
- Factoring
- Non-Performing Assets
- Summary
- Self-Assessment Questions
- Solutions/Answers

Unit 3: Inventory Management
- Introduction
- Objectives
- Reasons for Holding Inventory

- Objectives of Inventory

Analysis:
Types of Data
Sampling
Descriptive – Summaries without

Management
- Techniques of Inventory Control ○ Traditional Techniques ○ Modern Techniques
- Summary
- Self-Assessment Questions/Exercises
- Solutions/Answers
    interpretation
    Exploratory – No guarantee if discoveries will hold in a new sample Inferential, Causal Predictive
    Common Mistakes – Correlation is not causation, Simpson's paradox, Data Dredging
    Applications of Data Science
    Data Science Life cycle

Unit 2: Portability and Statistics for Data Science
Statistics: Correlation
Probability: Dependence and Independence, Conditional Probability, Bayes Theorem, Random Variables, Some basic Distributions, the Normal Distribution, The Central Limit Theorem
Hypothesis: Statistical Hypothesis
Testing, Confidence Intervals,

Unit 3: Data Preparation for Analysis Data Preprocessing
Selection and Data Extraction
Data cleaning
Data Curation
Data Integration
Knowledge Discovery

Unit 4: Data Visualization and
Interpretation Different types of plots
- Histograms
- Boxplots
- Scatter plots
- Plots related to regression
- Data Interpretation using Examples

Block 2: Big Data and its Management Unit 5: Big Architecture Big Data and Characteristics and Applications (Big Data and its importance, Four Vs) Big data Application Structured vs semi-structured and unstructured data Big Data vs data warehouse
- Distributed file system
- Map Reduce and HDFS
- Apache Hadoop 1 and 2 (YARN)
- Hadoop Ecosystem – Name node, data node, Job tracker

Unit 6: Programming using MapReduce
Map Reduce Operations
- Loading data into HDFS
- Executing the Map phase
- Shuffling and sorting
- Reduce phase execution.
- Algorithms using map reduce – Word counting, Matrix-Vector Multiplication

Unit 7: Other Big data Architecture and Tools
Apache SPARK framework HIVE HBASE
Other tools

Unit 8: No SQL database
Column based
Graph based
Key-value pair based
Document based

Block 3: Big Data Analysis

Unit 9: Mining Big Data

Finding Similar Items

Jaccard Similarity of Sets
Similarity of Documents
Collaborative Filtering as a Similar-Sets Problem Documents and Shingles
Distance Measures
- Euclidean Distances
- Jaccard Distance
- Cosine Distance Edit Distance
- Hamming Distance
Introduction to Other Techniques
- Supervised Learning
- Unsupervised Learning

Unit 10: Mining Data Streams

Model for Data Stream Processing
Data Stream Management Example
Queries of Data stream
Issues and challenges
Data sampling in data streams
- Example of representation sample
Filtering of data streams
- Bloom filter
Algorithm to count different elements in stream

Unit 11: Link Analysis

Purpose of Link analysis
Page Ranking Different mechanisms of finding page Rank and their problem
Web structure and associated issues
Use of page rank in search engines Page Rank computation using Mapreduce
Topic sensitive Page Rank
Link Spam
Hubs and Authorities

Unit 12: Web and Social Network Analysis

Introduction to Web Analytics
Advertising on the Web
Issues in On-Line Advertising
Advertising Opportunities on Web

Direct Placement of Ads and its issues
On-Line and Off-Line Algorithms
Recommendation Systems
Recommendation Systems Model and its Applications, The Utility Matrix
The Long Tail
Content-Based Recommendations
Mining Social-Network
Social Networks as Graphs
Varieties of Social Networks
Distance measure of social network Graphs
Use of Clustering for social media

Block 4: Programming for Data Analysis

Unit 13: Basic of R Programming
Environment of R
Data types, Variables, Operators, Factors
Decision Making, Loops, Functions
Data Structures in R
Strings, Vector
Lists, Frames
Matrices, Arrays

Unit 14: Data Interfacing and Visualisation in R
CSV, Excel files
Binary files
XML files JSON interface
Database
Web Data
Data cleaning, Processing
Bar Charts
Box Plots Histograms Line
Charts Scatter plots etc.

Unit 15: Data Analysis and R
Chi-square test
Linear Regression
Multiple Regression
Logistic Regression
Time Series Analysis

Unit 16: Advance Analysis using R
Decision Trees
Random Forest
Classification
Clustering
Association rules

MCS-227   Cloud Computing and IoT   (4 Credits)

After completing this course, the student will be able to:

• Understand the differences between the traditional computing and cloud computing

• Compare and contrast various deployment models and service delivery models of a cloud computing architecture.

• Understand the ways of virtualization

• Interpret the resource pooling, sharing and provisioning

• Understand the concept of scaling and load balancing in cloud

• Elaborate the need of security in cloud computing

• Define IoT and related terminology, technology and its applications

• Interpret the impact and challenges posed by IoT networks leading to new architectural models.

• Compare and contrast the deployment of smart objects and the technologies to connect them to network.

• Appraise the role of IoT protocols for efficient network communication.

• Elaborate the need Security in IoT.

- Illustrate different Case Studies from various sectors.

The topics includes in the course are:

Introduction to Cloud Computing, Traditional Computing Approaches, Comparison of Cluster, grid and Cloud Computing, Evolution of Cloud Computing, Benefits and Challenges, Cloud Deployment Models (Public, Private, Community and Hybrid), Service Delivery Models (IaaS, PaaS, SaaS etc..), Cloud Architecture, Resource Virtualization, Resource Pooling, Sharing and Provisioning, Scaling in the Cloud, Load Balancing, Security Issues in Cloud Computing.

IoT-An Introduction, Characteristics, IoT categories, Baseline Technologies of IoT, M2M and IoT, Multihoming, IoT Identification and Data protocols (IPv4, IPv6, MQTT, CoAP, SMPP, AMQP), Connectivity Technologies (IEEE, 802.15.4, Zigbee, 6LoWPAN, RFID, NFC, Bluetooth, Z-wave), IoT Application Development, Framework for IoT Applications, Implementation of Device Integration, Data Acquisition and Integration, Device Data Storage, Fog Computing, Edge Computing, Comparison of Cloud, Fog and Edge, IoT Case Studies (Smart Homes, Smart Grids, Smart Cities, Connected Vehicles, Industrial IoT.

Course Structure*

BLOCK 1:CLOUD COMPUTING FUNDAMENTALS ANDVIRTUALIZATION

Unit 1: Cloud Computing: An Introduction
- Traditional Computing Approaches
- Evolution of Cloud Computing
- Comparison between Cluster, Grid and Cloud Computing
- Utility Computing
- Characteristics of Cloud Computing
- Benefits of Cloud Computing
- Applications of Cloud Computing
- Challenges of Cloud Computing

Unit 2: Cloud Deployment Models, Service Models and Cloud Architecture
- Cloud Deployment Models o   Public Cloud o   Private Cloud o Community Cloud o   Hybrid Cloud
- Choosing Appropriate Deployment Model
- Service Delivery Models o Infrastructure As a Service (IaaS) o Platform As a Service (PaaS) o Software As a Service (SaaS) o Other Services (Security
    Management, Identity
      Management, Storage, Database,

Back-up, Compliance etc.)
- Cloud architecture
- Layers and Anatomy of the Cloud
- Network Connectivity in Cloud Computing **Unit 3: Resource Virtualization**
- Virtualization and Underlying Abstraction o   Virtualizing Physical Computing Resources
- Advantages of Virtualization
- Machine or Server Level Virtualization
    o   Hosted
    Approach o   Bare
    Metal Approach
  Exploring Hypervisor or V3irtual
        Machine Monitor o
    Hypervisor Based
    Virtualization
        Approaches
        (Full Virtualization, Para
    Virtualization, Hardware Assisted
        Virtualization)
- Operating System Level Virtualization
- Other Virtualizations (Network, Storage, Desktop)
- Xen Server Vs VM ware (comparison
    w.r.t features like Guest O/S
    support, Open Source, Live VM
    Snapshots for

Backups, Thin Provisioning, Asset Management and Configuration mapping, Dynamic Resource Allocation and Failover, Bare Metal Hypervisor, Graphics Support and Pricing, Licensing, Host Sever Management, Storage Specifications etc.)

BLOCK 2: RESOURCE PROVISIONING, LOAD BALANCING AND SECURITY

Unit 4: Resource Pooling, Sharing and Provisioning
• Resource Pooling
• Resource Pooling Architecture ○ Computer Vs Server Pool ○ Storage Pool ○ Network Pool
• Resource Sharing ○ Multi Tenancy ○ Types of Tenancy ○ Tenancy at Different Level of Cloud Services
• Resource Provisioning and Approaches ○ Static Approach ○ Dynamic Approach ○ Hybrid Approach
• VM Sizing

Unit 5: Scaling
• Scaling primitives
• Scaling Strategies ○ Proactive Scaling ○ Reactive Scaling ○ Combinational Scaling
• Auto Scaling in Cloud
• Types of Scaling ○ Vertical Scaling or Scaling Up
    ○ Horizontal Scaling or Scaling Out

Unit 6: Load Balancing
• Importance of Load Balancing
• Goals of Load Balancing
• What are to Load Balance and how it is done
• Levels of Load Balancing ○ VM Provisioning ○ Resource Provisioning
• Categories of Load Balancing ○ Static Approach ○ Dynamic Approach
• Dynamic Load Balancing

Unit 7: Security Issues in Cloud Computing
• Threats to Cloud Security

• Infrastructure Security
• Information Security
• Identity Management and Access Control
• Cloud Security Design Principles • Security as a Service

BLOCK 3: IoT FUNDAMENTALS AND CONNECTIVITY TECHNOLOGIES
Unit 8: Internet of Things: An Introduction
• Introduction to IoT
• Characteristics of IoT
• IoT Categories
• IoT Enablers and Connectivity Layers
• Baseline Technologies of IoT
• Sensors
    ○ Characteristics of a Sensor ○ Classification of Sensors
• Actuators ○ Types of Actuators
• Computing Components (Arduino, Raspberry Pi),
• IoT Architecture
• Applications of IoT
• Challenges of IoT

Unit 9: IoT Networking and Connectivity Technologies
• M2M and IoT Technology
• Components of Networking
• Gateway Prefix Allotment
• Impact of Mobility on Addressing
• Multihoming
• IoT Identification and Data Protocols ○ (IPV4, IPv6, MQTT, CoAP, XMPP, AMQP)
• Connectivity Technologies ○ (IEEE 802.15.4, ZigBee, 6LoWPAN, RFID, NFC, Bluetooth, Z-wave etc.)

BLOCK 4: Application Development, Fog Computing and Case Studies

Unit 10: IoT Application Development
• Framework for IoT Applications
• Implementation of Device Integration
• Data Acquisition and Integration
• Device Data Storage

- Unstructured Data Storage on Cloud/Local Server
- Authentication, Authorization of Devices
- Security Aspects in IoT

Unit 11: Fog Computing and Edge Computing
- Introduction to Fog Computing
- Cloud Computing Vs Fog Computing
- Fog Architecture
- Working of Fog
- Advantages of Fog
- Applications of Fog
- Challenges in Fog
- Edge Computing
- Working of Edge Computing
- Cloud Vs Fog Vs Edge Computing (w.r.t location of data processing, processing power and storage capabilities, purpose)
- Applications of Edge Computing

Unit 12: IoT Case Studies
- Smart Homes
- Smart Grids
- Smart Cities
- Connected Vehicles
- Industrial IoT

MCSL-228   **AI and Machine Learning Lab**   **(Credits 2)**

Main objective of this laboratory course is to provide hands on exercises to the learners based on Artificial Intelligence and Machine Learning Course.
Lab Sessions:

- There will be 20 practical sessions (3 hours each) of which 10 sessions will be on AI and 10 sessions will be on machine learning.

- The practice problems for all 20 sessions will be listed session-wise in the lab manual.

MCSL-229   **Cloud and Data Science Lab**   **(Credits 2)**

Main objective of this laboratory course is to provide hands on exercises to the learners based on Cloud Computing and Data Science Courses.

Lab Sessions:

- There will be 20 practical sessions (3 hours each) of which 10 sessions will be on cloud computing and 10 sessions will be on Data Science.

- The practice problems for all 20 sessions will be listed session-wise in the lab manual.

SEMESTER – IV

MCS-230   **Digital Image Processing and Computer Vision**   **(CREDITS - 4)**

The course relates to the formation of fundamental understanding of the various concepts of Digital Image processing and Computer Vision. The content coverage will help the learners to get the insight of the subject both theoretically and practically.

Course Structure*

Block-1 Digital images Processing -I

Unit-1 Introduction to digital image – Digital image, Image acquisition, Digitization of images (Sampling and Quantization), Types of images, Image Characteristics (Brightness, luminance, contrast, intensity), Image resolution

Unit-2 Image Transformation - Definition of 1-D and 2-D signals, Orthogonal and Unitary transforms of 2-D signals,

Properties of Unitary Transforms

Unit-3 Image enhancement in spatial domain - Point operations, Contrast stretching, Clipping and thresholding,

Digital Negative, Intensity levels slicing, Bit - Basics of filtering in frequency domain, Image smoothing, Image sharpening, Image degradation model, Noise models (additive, Gaussian, Rayleigh, uniform, gamma, impulse), Inverse filtering, Wiener filtering.

Unit-7 Color image processing - Human Vision system, Color models (RGB, HIS, CMY)

Block-3 Computer Vision-I

Unit-9 Introduction to computer Vision, camera models, Transformations: Orthogonal, Euclidean, Affine and Projective

Unit-10: Single Camera: Camera Models, Perspective projection, Homography, Camera Calibration, Affine motion models

Unit-11Multiple Cameras: Stereo Vision, Point correspondence, Epipolar geometry, Motion, Optical flow.

extraction.

Unit-4 Image Filtering Operations in spatial domain - Spatial averaging, Spatial low pass filtering, Spatial high pass filtering,

Median filtering, Min, Max filtering, Histogram modeling: Histogram equalization, Histogram specification.

Block-2 Digital images Processing –II

Unit-5 Transformation Techniques - Transformations in the Frequency domain (DFT, DCT, DWT, Haar), Discrete Fourier Transform, Discrete Cosine Transform, Discrete Wavelet Transform, Haar Transform

Unit-6 Image enhancement and Filtering

Block-4 Computer Vision-II

Unit-12 Object detection- Line detection, Region detection, Boundary detection, feature extraction techniques, image segmentation techniques

Unit-13 Object Recognition using Supervised Learning Approaches - Supervised learning, Discriminant function (linear and nonlinear), Bayesian classification, Minimum distance classifiers.

Unit-14 Object Classification using Unsupervised Learning Approaches - Unsupervised learning, Hierarchical Clustering, Partition based clustering, K-NN clustering.

MCS-231   **Mobile Computing**   **(4 Credits)**

The following are the objectives of this course:

• Introduce Mobile Communications

• Introduce Mobile Computing Architecture

• Overview of Pervasive Computing

• Introduce GSM and GPRS

• Introduce 4G and 5G Networks
• Discuss Database Management Issues in Mobile Computing

• Introduce Mobile Adhoc Networks

• Introduce WLAN and PAN protocols

• Introduce Virtual and Cloud Networks

• Introduce Mobile Internet Applications

• Introduce Mobile Application Languages

• Introduce Mobile Operating Systems
• Introduce Mobile Software Development Environments

Course Structure*
**Block-1: Introduction to Mobile
    Computing**

**Unit-1: Introduction to Mobile
    Communications**

Introduction
    Objectives
    Mobile Communication
    Multiplexing (TDMA, CDMA,
     FDMA)
    GSM
    GPRS and2.5G
    3G
    4G –LTE
    Summary
    Further Readings

**Unit-2: Introduction to Mobile
    Computing Architecture**

Introduction
    Objectives
    Mobile IP, Cellular and WLAN
    IEEE 802.11X Networks
    AdHoc Networks

Mobile Computing Operating
 System
Client Server Computing using
 Mobile
Mobile Computing Architecture
Design considerations for Mobile
Computing
Mobile Computing and the Apps
Summary
Further Readings

**Unit-3: Mobile Client Devices and
    Pervasive Computing**

Introduction
    Objectives
    Smart Sensors, Actuators and
    Mobile Robotic Systems
    Smart Home and Appliances
    Automotive Systems
    Limitations and Devices Design
    Considerations
    Summary
    Further Readings

Unit-4: GSM and GPRS

Introduction
    Objectives
    GSM Architecture
    Public Land Mobile Network
     (PLMN) Interface
    Call Handling
    Handover
61
    SMS
    GPRS
    High Speed Circuit Switched
    Data
    WLL Application
    Summary
    Further Readings

**Block-2: Mobile IP and Issues in
    Mobile Computing**

Unit-5: 4G and 5G Networks

Introduction
    Objectives
    High Speed Packet Access
    MIMO in HSPA
    LTE and WIMAX16E
    Ultra-Wide Band and Broadband
    Wireless Access
    4G Networks: HS-OFDM, LTE
    Advanced and WiMax 16M
    Features of 5G Networks
    Summary
    Further Readings

Unit-6: Mobile IP Network Layer
Introduction
    Objectives
    Mobile IP
    IP Header: Encapsulation and
    Routes Optimization
    Mobility Binding
    Cellular IP
    Mobile IP with IPv6
    Voice over IP
    IP Security
    Summary
    Further Readings

Unit-7:Mobile Transport Layer

Introduction
    Objectives
    UDP and TCP
    Indirect TCP
    Snooping TCP

    Mobile TCP
    Summary
    Further Readings

**Unit-8: Database Management Issues
    in Mobile Computing**

Introduction
    Mobile Device Database
    Management
    Mobile Device Data Store
    Methods
    Client Server Computing with
    Adaptation for Mobile Computing
    Adaptation Software for Mobile
    Computing
    Summary
    Further Readings

**Block-3: Introduction to various
    Network Technologies**

Unit-9: Mobile Adhoc Networks

Introduction
    Objectives
    Introduction to MANETs
    Routing and Classifications of
    Routing Algorithms
    QoS in MANETs
    Security in MANETs
    Summary
    Further Readings

Unit-10: WLAN and PAN protocols
Introduction
    Objectives
    Introduction to WLANs
    Introduction to WAP
    Introduction to WML
    Bluetooth

WiMax
ZigBee and WiFi
Summary
Further Readings

Unit-11: Virtual and Cloud Networks
Introduction
Objectives
Wireless Enterprise Networks
Virtual Networks
Mobile Cloud Networks
Summary
Further Readings

Unit-12: Mobility, Portability, Replication and Clustering

Introduction
Objectives
Mobile Data Management
Data Replication Schemes
Adaptive Clustering
Summary
Further Readings

Block-4: Introduction to Mobile Software Environments

Unit-13: Smart Client and Enterprise Server based Architecture

Introduction
Objectives
Introduction to Smart Client Architecture
Data Synchronization Formats
Data Synchronization at Clients and Servers
Mobile Devices Support
Infrastructure and Management
Summary
Further Readings

Unit-14: Mobile Internet Applications
Introduction
Objectives
Introduction to Mobile Applications Development
Introduction to XML

Handheld Device Markup Language and WML
HTML 5
Summary
Further Readings

Unit-15: Mobile Application Languages

Introduction
Objectives
Introduction to J2EE

Introduction to J2ME   Introduction to Mobile Operating
Introduction to Python   Systems
Summary   Application Programming
Further Readings   Linux for Mobile Devices
                                               Development Process
                                               Development Tools and Emulators
                                               Apple IOS
Unit-16: Mobile Operating Systems and   Android
Development Environments   Summary
                                               Further Readings
Introduction
    Objectives

* The course structure may be subject to changes.

MCSP-232   PROJECT   (CREDITS-12)

The objective of the MCA project work is to develop quality software solution by following the software engineering principles and practices. It is only possible when a learner goes about with the task independently. During the development of the project the students should involve in all the stages of the software development life cycle like requirements engineering, systems analysis, systems design, software development, testing strategies and documentation with an overall emphasis on the development of reliable software systems. The primary emphasis of the project work is to understand and gain the knowledge of the principles of software engineering practices, so as to participate and manage a large software engineering projects in future.

Students are encouraged to spend efforts equavilant to 12 credits working on a project preferably in a software industry or any research organization. Topics selected should be complex and large enough to justify as a MCA project. The courses studied by the students during the MCA programme provide them the comprehensive background to work on diverse application domains. Students should strictly follow and adhere to the project guidelines. Project Guidelines will be prepared and uploaded on to the IGNOU website/printed.

5.   EVALUATION SCHEME

Completion of the programme requires successful completion of both assignment component and the Term-end Examination component for each course in the programme. The total numbers of courses in this MCA programme are 22 (including a Project course) and the total number of credits is 80. In addition, two bridge courses, MCS-201 and MCS208 are required to be successfully completed by those *students who are required to register for these courses based on eligibility conditions for admission to Master of Computer Applications programme***.**

Evaluation for each course of MCA programme (except project course) and bridge courses covers two aspects:

a)   Continuous evaluation through Assignment with a weightage of 30% (please refer to the table below). *Viva- voce is compulsory for all the Assignments for which 20 marks are allocated.*

b)   Term-end examination with a weightage of 70% (please refer to the table below).

Note: *A learner should not apply for appearing at the term-end examination of any course without getting registered for the same and that if s/he does so, her/his result would not be declared and the onus shall be on her/him.*

Award of Final Division:

The final score of a student is computed as follows:
•   The marks obtained in a 4-credit course are computed out of maximum of 100
•   The marks obtained in a 2-credit course are computed out of maximum of 50 • The marks obtained in the Project course are computed out of maximum of 200 • Bridge course marks are NOT used for computation of percentage.
•   The marks of all the semesters are added. These marks are out of maximum of 1900 marks.

The final division of a student is awarded as follows:

Marks Range	Division
75% and above	First Division with Distinction
60% or more but less than 75%	First Division
50% or more but less than 60%	Second Division
40% or more but less than 50%	Third Division

5.1 Assignments and Term – End Examination

The main purpose of assignments is to test student's comprehension of learning the materials they receive from the University and also to help them get through the courses by providing feedback to them. The information given in the course materials should be sufficient for answering the assignments. However, as Computer Science is an ever-enhancing area, the students should make an attempt and work with extra reading material, which is easily available at the Learner Support Centre / Regional Centre libraries or through websites, for working on the assignments. This will enhance your learning capabilities. Mostly the assignments are designed in such a way as to help you concentrate mainly on the course material, exploit their personal experiences and apply the knowledge gained from various sources.

Assignments

There will be **at least one assignment for each course worth 100 marks (weightage of 30%)**. The set of all the assignments for each semester is uploaded on the IGNOU's website. The table shown below provides the detailed marking scheme for the MCA courses.

Seme-ster	Course Code	Course Title	Credits	Continuous Evaluation Assignment (Weightage – 30%)	Term End Examination Theory OR Practical* (for Lab courses only) (Weightage – 70%)

				Max Marks	Min. Marks	Duration	Max. Marks	Min. Mark s
I	MCS-211	Design and Analysis of Algorithms	4	100	40	3	100	40
	MCS-212	Discrete Mathematics	4	100	40	3	100	40
	MCS-213	Softwrae Engineering	4	100	40	3	100	40
	MCS-214	Professional Skills and Ethics	2	100	40	2	50	20
	MCS-215	Sycurity and Cyber Laws	2	100	40	2	50	20
	MCSL-216	DAA and Web Design Lab	2	100	40	2	50	20
	MCSL-217	Software Engineering Lab	2	100	40	2	50	20
	Bridge Courses (*Only for the students who are required to register for these courses based on eligibility conditions for admission to Master of Computer Applications programme*)							
	MCS-201	Programming in C and Python	4	100	40	3	100	40
	MCS-208	Data Structures and Algorithms	4	100	40	3	100	40
II	MCS-218	Data Communication and Computer Networks	4	100	40	3	100	40
	MCS-219	Object Oriented Analysis and Design	4	100	40	3	100	40
	MCS-220	Web Technologies	4	100	40	3	100	40
	MCS-221	Data Warehousing and Data Mining	4	100	40	3	100	40
	MCSL-222	OOAD and Web Technologies Lab	2	100	40	2	50	20
	MCSL-223	Computer Networks and Data Mining Lab	2	100	40	3	50	20
III	MCS-224	Design and Analysis of Algorithms	4	100	40	3	100	40
	MCS-225	Accountancy and Financial Management	4	100	40	3	100	40
	MCS-226	Data Science and Big Data	4	100	40	3	100	40
	MCS-227	Cloud Computing and IoT	4	100	40	3	100	40
	MCSL-228	AI and Machine Learning Lab	2	100	40	2	50	20
	MCSL-229	Cloud and Data Science Lab	2	100	40	2	50	20
IV	MCS-230	Digital Image Processing and Computer Vision	4	100	40	3	100	40
	MCS-231	Mobile Computing	4	100	40	3	100	40
	MCSP-232	Project**	12	Report – 150 (Min. 60) and Viva 50 (Min. 20)				

* **Practical examination will be conducted for the lab courses only. The letter 'L' in the course code represents the lab course. Pass in each and every part in the practical course of Term-End Practical Examination is compulsory in order to get it declared successful in the respective course.**

** The **Project consist of 2 components namely project report evaluation and viva. Viva-voce is compulsory and forms part of evaluation**. A student in order to be declared successful in the project must secure 40% marks in each component (i) Project Evaluation and (ii)Viva-voce.

All the assignments and term-end exams will be scored on a **numerical marking scheme.** Any component that has not been attempted would be treated as having a score of zero marks. The requirement for passing would be at least **40% in continuous evaluation (assignment) and 40% in the term-end examinations,** with an **overall average of 40% for a pass in the course.**

The viva voce is compulsory for the assignment evaluation. For any course, in case, if a student submitted the assignment but did not attend the viva-voce, then the assignment is treated as **not successfully completed** and would be marked as **ZERO.**

In order to be able to appear for the Term-end examination, it is a requirement that the student submit all the assignments according to the prescribed schedule. All students will be required to give an undertaking to this effect, and should it be later found that they had in fact not submitted the assignments as prescribed; the results for the Term-end examination will be treated as cancelled.

Viva-voce is compulsory for all the Assignments for which 20 marks are allocated.

Unfair means in attempting the assignments

If the learners copy the assignments, which is an important component of the ODL system, such assignments will be awarded "zero" and such students will be directed to re-attempt the fresh assignments pertaining to the next year which will indirectly delay the award of degree by a semester/ year.

Additional guidelines for Lab Course assignments and TEE

A student MUST maintain lab records of all the practical sessions attended by him/her. This lab record has weightage in continuous evaluation of lab courses. The following are the evaluation guidelines for the lab courses.

(i)   Evaluation of the assignments of lab courses

Evaluation of the assignments of lab courses consist of three parts:
•   Continuous assessment of practical sessions (lab records) (total 40 marks),
•   Assignment questions (total 40 marks)
•   A combined comprehensive **viva-voce** (total 20 marks)

The marks allotment details for various lab courses are shown in the following table:

Course code	Continuous assessment of practical sessions lab records (40)	Assignment problems (40)	Combined Viva (20)	Total marks (100)
MCSL-216	Part–1(20) Part–2(20)	Part–1(20) Part–2(20)	20	100
MCSL-217	Part–1(40)	Part–1(40)	20	100

MCSL-222	Part–1(20) Part–2(20)	Part–1(20) Part–2(20)	20	100
MCSL-223	Part–1(20) Part–2(20)	Part–1(20) Part–2(20)	20	100
MCSL-228	Part–1(40)	Part–1(40)	20	100
MCSL-229	Part–1(20) Part–2(20)	Part–1(20) Part–2(20)	20	100

It is to be noted that minimum passing marks in assignments are overall (lab records + problems + viva) **40% in each assignment**.

(ii)   Evaluation of term-end practical exam for Lab Courses

The term-end examination of the practical courses consists of several sections. Each section will be evaluated separately. The viva-voce for each section will also be separate. The following table shows the details:

(Practical questions –80 % and Viva-voce – 20 %)

Course Code	Duration of term-end practical exam. (Each section gets Equal time)	Term-end practical examination and viva-voce	
		Marks Section-1	Marks Section-2
MCSL-216 (2 credits)	2 hours	20 (P) +5(V) = 25 marks	20(P) + 5(V) = 25 marks
MCSL-217 (2 credits)	2 hours	40(P) + 10 (V) = 50 marks	#
MCSL-222 (2 credits)	2 hours	20(P) + 5(V) = 25 marks	20(P) + 5(V) = 25 marks
MCSL-223 (2 credits)	2 hours	20(P) + 5(V) = 25 marks	20(P) + 5(V) = 25 marks
MCSL-228 (2 credits)	2 hours	40(P) + 10 (V) = 50 marks	#
MCSL-229 (2 credits)	2 hours	20(P) + 5(V) = 25 marks	20(P) + 5(V) = 25 marks

P- problems given in the exam paper, V –viva-voce for that section.

A student needs to obtain a minimum of 40% in each section of the term-end practical examination for successful completion of that particular section. In case a student does not secure the minimum passing marks in a section, s/he needs to appear for the term-end practical examination again for that section only.

5.2 Instructions for Assignments

While answering Assignments, the following guidelines are required to be followed:

The word limits for answering most of the questions are mentioned with them. If no word limit is prescribed, then assume it to be about 300 words. You will find it useful to keep the following points in mind:

i) **Planning:** Read the assignment carefully. Go through the units on which they are based. Make some points regarding each question and rearrange these in logical order.

ii) **Organisation:** Be a little more selective and analytical before drawing up a rough outline of your answer. In an essay-type question give adequate attention to your introduction and conclusion. The introduction must offer brief interpretation of the question and how you propose to develop it. The conclusion must summarize your response to the question. Make sure that your answer:

a) is logical and coherent;

b) has clear connection between sentences and paragraphs;

c) is written correctly giving adequate consideration to your expression, style and presentation;

d) does not exceed the number of words indicated (if any) in your questions. iii) **Presentation:** Once you are satisfied with your answers, you can write down the final version for submission, writing each answer neatly and underlining the points you want to emphasize.

2. The following format is to be followed for submission of the assignment:

The top of the first page of your response sheet for each assignment should look like this:

PROGRAMME TITLE:.............................   ENROLMENT No. :................................

COURSE CODE:......................................   NAME :..

COURSE TITLE:.....................................   ADDRESS:..

ASSIGNMENT CODE :............................   SIGNATURE :..

LEARNER SUPPORT CENTRE:....................   DATE : ....

---

3. Read instructions for submission of assignments given here. The assignments response sheets should be handwritten. However, the software coding, snapshots, test cases, etc. can be in the printed form. Students should not reproduce their answers from the units sent to them by the University. If they reproduce from the units, they will get poor marks for the respective question**.**

4. The students should write each assignment separately. All the assignments should not be written in continuity.

5. The students should write the question number with each answer. Photocopy of the submitted assignment is to be retained by the student for his or her own record and future reference, if any.

6. The students should use only A4 size paper for their response and tag all the pages carefully. Avoid using very thin paper. They should allow a 4-cm. margin on the left and at least 4 lines in between each answer. This may facilitate the evaluator to write useful comments on the margins at appropriate places.

7. The students should not copy the assignments from others. If copying is noticed, the assignments of such students will be rejected, and disciplinary action will be taken against the students as per rules of the University.

8. **The completed assignment response should be sent to the Coordinator of the Learner Support Centre**. **Under no circumstances should they be sent to the SED Division or the School at Headquarters**, for evaluation. After submitting the assignment at the Learner Support Centre in person, the students should get the acknowledgement from the Coordinator on the prescribed assignment-cum-acknowledgement card (**Form No. 1**); otherwise, the assignment response should be sent under certificate of posting through post. The students should get back evaluated assignments from their Learner Support Centres within one month of its submission for the feedback and for their future guidance.

9. In case the student has requested for a change of LSC, s/he should submit her/his assignments only to the original LSC until the University effects the change of LSC.

5.3 Guidelines Regarding the Submission of Assignments

1. It is compulsory for the students to submit all the prescribed assignments. They will not be allowed to appear for the term-end examination of a course if they do not submit the specified number of assignments in time for that course.

2. Students should download the latest assignment from the IGNOU website.

3. The assignment responses should be complete in all respects. Before submission, the students should ensure that they have answered all the questions in all assignments. Incomplete answer sheets bring poor grades.

4. The Coordinator of the LSC has the right to reject the assignments received after the due date. Therefore, the students are advised to submit their assignments before the due date.

5. Students should enclose a self-addressed stamped assignment remittance-cum-acknowledgement card (**Form No. 2)** with each assignment response to ensure the delivery of assignments before the last dates prescribed for submission of assignments.

6. In case any student fails to submit the assignments or fails to score minimum qualifying marks, s/he has to wait for fresh assignments meant for the current batch of students.

7. For their own record, students should retain a photocopy of all the assignment responses, which they submit to the Coordinator of their LSC. If they do not get back their duly evaluated assignment within a month after submission, they should try to get it from their LSC personally. This may help them to improve upon future assignments.

8. As per the University norms, once the student's scores pass marks in an assignment, they cannot re-submit it for improvement of marks.

9. Assignments are not subject to re-evaluation except for factual errors, if any. The discrepancy noticed by the students in the evaluated assignments should be brought to the notice of the Coordinator of the LSC, so that he forwards the correct score to the SED at the Headquarters.

10 The students should not enclose or express doubts for clarification, if any, along with the assignments. They should send their doubts in a separate cover to the Registrar, SED, Indira Gandhi National Open University, Maidan Garhi, New Delhi - 110 068. While doing so they should give their complete Enrolment number, name, address, programme code.

> ***Note*: Please submit your Assignments on or before the due date at your LSC.**

11. In case of not successfully completed or missed; the assignments should be demanded only if your registration for that course is valid.

12. Assignments should not be demanded to improve your score if you have secured minimum qualifying score in a course.

13. Please do not submit your assignment responses twice either at the same LSC or at different LSC for evaluation.

14. There is no provision for reevaluation of Assignments, practical examination and project evaluation.

5.4 General Guidelines Regarding the Term-End Examination

1. To be eligible to appear the Term-end Examination in any course, the students are required to fulfil the following conditions:

   a) registration for the courses, in which they wish to appear is valid,

   b) they should have opted and pursued the prescribed courses

   c) minimum time to pursue these courses is elapsed

   d) they have also submitted the required number of assignment(s), if any.

   e) they have submitted the online examination form of IGNOU and have paid the requisite examination fees.

2. The University conducts term-end examination twice a year, in June and December. The student can take the examination only after the minimum period prescribed for the course of study has elapsed.

3. Examination schedule indicating the date and time of examination which is available at IGNOU website http://www.ignou.ac.in for each session i.e. June/December.

4. The online examination form is to be filled up from IGNOU website about 2-3 months prior to examination. (You MUST visit IGNOU website for actual cutoff dates. The details of late fee are also displayed on the website.). You are required to pay examination fee per course at the time of filling up of the form. For December 2021 term-end examination this fee was @200/- per course for theory courses and @200/- per course for practical courses. You can pay online using Credit Card / Debit Card /Net Banking while filling up the form. It may also be noted that in case, examination fee needs to be returned to student due to technical reasons, the fee will be refunded to the same account (Credit card/ Debit card/ Net Banking) from which the payment was made.

The link to online Examination form, in general, is put on the HOME page of IGNOU website.

YOU MUST READ and FOLLOW all the instructions very carefully. You can save these instructions for any future reference. These instructions relates to:

• Dates for the Submission of Online Term End Examination form

• Prerequisite for the submission of the Term End Examination Form

• Process to submit Term End Examination Form

• Examination fee and Mode of Payment
• Un-successful Submission of Exam Form

• Related to Refund excess Examination Fee

• Hall Ticket for Term End Examination

• Contact Details

Important Guidelines and instructions for submission of Term End Examination form and other forms (Please note that guidelines and fee for forms may change, therefore, you are advised to read guidelines and fee details as per latest forms available online or on the IGNOU website)

1. Please ensure that you have already submitted the assignments as applicable for the courses you are filling in the Examination Form. You are required to pay examination fee for every course of theory as well as practical.

2. Students are requested to check the result status before filling examination form.

3. Select and enter Programme code and Examination Centre Code from the options available. If the centre opted by the student is not activated as examination centre or not allotted for any other reason, alternative examination centre will be allotted.

4. Select courses carefully. Courses for theory as well as practical need to be selected separately from the list appearing on the screen.

5. Students will be allowed to appear in Term-end Examination for the course(s) for which registration is valid and not time-barred and assignment(s) is/are submitted. Examination Fee once submitted will not be refunded.

6. Students should carry their **Identity Card and Hall ticket** (download hall ticket from IGNOU website indicating Centre and Date of Examination) to the Examination Centre.

7. In case a student fails to receive the intimation slip/Hall ticket may please contact at SED (SE-II) http://www.ignou.ac.in/ignou/aboutignou/division/sed/contact branch.

8. Students must carry IGNOU Identity-Card in the Examination Hall for writing Examination. In case, students do not have IGNOU Identity card due to various reasons, they must get it issued (i.e. duplicate copy of IGNOU Identity card) from Regional Centre concerned well before the start of the Examination. Students are required to contact the RC in person (by post) and get the duplicate Identity card for attending Examination.

9. The students will be entitled to appear for the examination only at the examination centre allotted to them and **NOT** at any other centre without specific permission from the University. The Examination Centre once opted for in a form shall not be changed.

10. Although all efforts will be made to declare the results in time, there will be no binding on the University to declare the results of the last examination before the commencement of next examination. The students may, therefore, fill up the examination form without necessarily waiting for the result and get it cancelled at a later date, if so desired. In case the student gets result after filling up the exam form, s/he should not re-appear in the course qualified by her/ him with a view to improve the qualified score.

11. Students who fail to complete the minimum required number of course(s) prescribed for the Programme within the allotted period of study shall cease to be on the rolls of this University for that programme till they re-enroll themselves, if they wish to do so. Such students are advised to get in touch with the Regional Director concerned.

12. **Obtaining Photocopy of Answer Scripts:** After the declaration of result, if the students are not satisfied with the marks awarded, they can request the University for Photocopy of Answer Scripts on payment of ₹100/- per course. The request for obtaining Photocopy of Answer Scripts by the student must be made within 30 days from the date of declaration of result to the Evaluation Centre concerned in the prescribed format along with the fee of
₹100/- per course in the form of Demand Draft in favour of IGNOU payable at the city where submitting the request for Photocopy. Format is available on the IGNOU website: http://www.ignou.ac.in

13. **Early Declaration of Results:** In order to facilitate the students who have got offer of admission and or selected for employment etc. and are required to produce markssheet/grade card by a specified given date may apply for early process of their answerscripts and declaration of the results for this purpose. The students are required to apply in the specified format available on the University website with a fee of ₹1000/- per course through Bank Draft drawn in favour of IGNOU along with the attested photocopy of the offer of admission/employment offer. The students can submit their requests for early declaration before the commencement of the Term-end Examination i.e., before 1st June and 1st December respectively. The University in such cases will make arrangements for processing the answer-scripts and declare the results as a special case.

14. **Re-evaluation of Answer-script(s):** The University has replaced the scheme of rechecking with the re-evaluation whereby the answer-scripts will be re-evaluated by another Evaluator in case the students are not satisfied with the marks/grades secured by them in Term-end Examination. Such students can apply for re-evaluation within one month from the date declaration i.e. the date on which the results are made available on the University Website on payment of ₹750/- per course in the prescribed application form available on the University Website. The better of the two courses or original marks/grades and re-evaluated marks/grades will be considered and the revised marks/grades shall be incorporated in the students' record as applicable and the revised grade card/marks sheet will be sent to the students within one month from the receipt of application. Re-evaluation is not permissible for Projects, Practical, Assignments and Seminars etc.

15. **Improvement of Division/Class:** Keeping the interest of students who have completed their Bachelor's Degree and Master's Degree Programmes, but falling short of 2% marks for securing 1st Division/ 2nd Division the university has made a provision for allowing such students to improve their performance. The improvement is permissible only in

theory papers and the students may apply for improvement of their performance on the prescribed application format along with a fee of ₹750/- per course through a Bank Draft drawn in favour of IGNOU payable at Delhi and submit the application and fee to the Registrar, SRE Division, IGNOU, Maidan Garhi, New Delhi. The improvement is not permitted to those students who have completed their maximum duration of the programme. The students will

be given only one opportunity to improve the marks/grades and they can apply for improvement a maximum of 25% of the credits for successful completion of the respective programme. However, the sealing for the number of courses in which the student can improve is five courses. The better of the two examinations i.e., marks already awarded and the marks secured in the improvement examination will be considered.

6.   OTHER USEFUL INFORMATION

6.1 Reservation of Seats

The University provides reservation of seats for Scheduled Castes, Scheduled Tribes and Physically Handicapped students as per the Government of India rules.

6.2 Scholarships and Reimbursement of Fee

Reserved Categories, viz., Scheduled Castes, Scheduled Tribes and Physically Handicapped students etc. have to pay the fee at the time of admission to the University along with other students. Physically Handicapped students admitted to IGNOU are eligible for Government of India scholarships. They are advised to collect scholarship forms from the respective State Government Directorate of Social Welfare or Office of the Social Welfare Officer and submit the filled-in forms to them **through the Regional Director of IGNOU concerned.**

Similarly, SC/ST students have to submit their scholarship forms to the respective State Directorate of Social Welfare or Office of the Social Welfare Officer, **through the Regional Director of IGNOU concerned for suitable reimbursement.**

The Application for reimbursement of Programme Fee to SC/ST students can be downloaded from the link**:**
http://ignou.ac.in/userfiles/Application%20form%20for%20Reimbursement%20of%20 fee.pdf

6.3 Change/Correction of Address

There is a proforma **(Form No. 1)** for change/correction of address available in this programme guide. This form duly filled in is to be submitted to the **Regional Director concerned**. Students are advised not to write letters to any other officer in the University in this regard. Normally, it takes 4-6 weeks to effect the change. Therefore, the students are advised to make their own arrangements to redirect the mail to the changed address during this period.

6.4 Change of Regional Centre and Learner Support Centre

Counselling facilities are not available for all the programmes at all the Learner Support Centres. As such, students are advised to make sure that counselling facilities are available, for the subject s/he has chosen, at the new centre opted for. Request for change of Learner Support Centre is acceded subject to availability of seats for the programme at the new centre asked for only on compelling grounds. Students are required to get a NOC from the Regional center where they are willing to get themselves transferred in view of the practical sessions involved in MCA. When a student wants transfer from one region to another, s/he has to write to that effect to the Regional Centre from where s/he is seeking a transfer, marking copy to the Regional Centre where s/he would like to be transferred to and also to Registrar, Student Registration Division (SRD), IGNOU, Maidan Garhi, New Delhi-110068. Further, s/he has to obtain a certificate from the Coordinator of the Learner Support Centre from where s/he is seeking transfer from, regarding the number of assignments submitted. The Regional Director from where the student is seeking the transfer will transfer all records including details of fee payment to the Regional Centre where the student is going, under intimation to the Registrar, SRD and the student. The transfer will be permitted only if seats are available at the new Learner Support Centre.

6.5 Procurement of Official Transcripts

The University provides the facility of obtaining official transcripts on request, made by the learners in prescribed application form for official transcript, which provides details of fee, where to apply etc. Link to this form is given in the Section 9.

6.6 Duplicate Grade Card

The learner can apply for obtaining duplicate Grade Card in case the same has been lost/misplaced/damaged, by making a request in prescribed application form for Duplicate Grade card, which provides details of fee, where to apply etc. Link to this form is given in the Section 9 on print of Rs.200/-

6.7 Self instructional Materials of Your Programme of Study

Self-instructional material will be available through eGyankosh, IGNOU eContent App and later the self-instructional materials may be dispatched to the student's registered address.

You should visit your Regional Centre (RC)/ Learner Support Centre (LSC) concerned with ID card for schedule of theory and practical counselling sessions.

6.8 Disputes on Admission and other University Matters

In case of any dispute, the place of jurisdiction for filing of a suit/plaint/petition will be only at New Delhi / Delhi.

7.   SOME USEFUL ADDRESSES

For your information, the following officers deal with different educational aspects:

(i) Student Registration Related issues	Registrar, SRD, Indira Gandhi National Open University, Maidan Garhi, New Delhi -110068, 011-29532741 (SRD), 1302/1316 (SRD), Email: :registrarsrd@ignou.ac.in
(ii) Exam Centres, Results, Re-checking of answer-scripts, Discrepancies in Result, marks update, etc.	Registrar, SED, Indira Gandhi National Open University, Maidan Garhi, New Delhi -110068, Phone No: 011-29535828/2482 (SED), 011-29572204/2205(SED), FAX No.011-29534429 068
(iii) Admission, Fees, Scholarship, Change of Address/ Learner Support Centre/ Regional Centre, Change of Course, Issue of Bonafide Certificate, Migration Certificate.	Regional Director of the Regional Centre concerned.
(iv) Academic Matters	MCA Programme Coordinator SOCIS, C-Block, New Academic Complex IGNOU, Maidan Garhi, New Delhi - 110 068 Phone: 011-29572902 Email: mca@ignou.ac.in
(v) Administrative and counselling matters missing score of TMAs/Project assignments/Practical assignments, Assessment Sheets	Co-coordinator of your Learner Support Centre/Regional Director of the Regional Centre concerned
(vi) Issue of Degree/ Diploma/ Certificate, Dispatch of returned Degrees, Verification of Degree	Dy. Registrar (Exam-1) Examination –1 Indira Gandhi National Open University, Maidan Garhi New Delhi -110068, Phone No.011-29535438 011-29572224/2213 e-mail: exam1@ignou.ac.in
(vii) Issue of Provisional Certificates and Grade Cards	Dy Registrar (Exam-3) Phone No: 011-29536743; Intercom No. 2201
(ix) Declaration of pending results of TEE, Incorporation of practical marks, Verification of provisional certificate and grade card, Issue of transcripts	Dy. Registrar (Exam-3) Phone No: 011-29536103/6743 011-29572201/2211
(x) Non incorporation of assignment marks	Assistant Registrar (Assignment) Phone No: 011-29532294 Intercom No. 1319/1325 E-mail: assignments@ignou.ac.in

(xi) Online students grievances Portal	http://igram.ignou.ac.in/
(xii) Students' General Enquiries	Student Support Centre Indira Gandhi National Open University, Maidan Garhi New Delhi -110068, Phone: 011-29535714, 29572512, 29572514, 29533869 and 29533870 e-mail: ssc@ignou.ac.in

Telephone numbers of the Divisions/ Schools are also provided on the website under the "Contact Us" option. Students are advised to be in touch with their LSCs for advance/timely/day-to-day information or visit the website with URL www.ignou.ac.in

8. LINK TO OLD QUESTION PAPERS

The old question papers of MCA_New are not available. However, you can download the previous year's question papers from IGNOU website for earlier 3-years programme. The following is the process of downloading the question papers from IGNOU website:

Visit the IGNOU website at URL: http://www.ignou.ac.in and select the Download Button on IGNOU web site. On this Download Page select *Question Papers* link. The following page will be displayed (please note that URL of this page is: *https://webservices.ignou.ac.in/Pre-Question/*
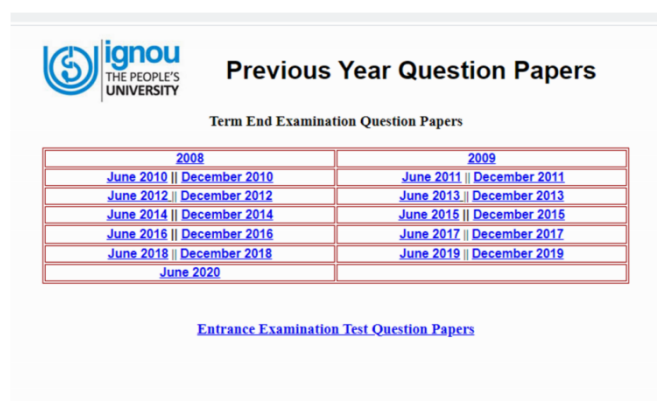

Figure 4: The Previous Year Question papers of IGNOU

Select the year of Question paper, this will display School wise list of Question papers, as the list is large you may use *find on page* option of your browser to find MCA old question papers (please note that you can search MCA old question papers by searching *MCS.*)

9. LINKS TO FORMS AND ENCLOSURES

In this section, we are enclosing the IGNOU website links to various forms, which are useful for you. Whenever you have to correspond with the university, please download the form from

the Website and fill it carefully and send as per instructions therein. The detailed instructions for all these-forms are provided in form itself. Some of these links may change, in those cases please use search option to find the desired link.

> *Note: You must download the Forms from the Website*

Forms and Useful links

- *Change of Address (Form No.1)*
- *Assignments Remittance-Cum-Acknowledgement Card (FormNo.2)*
- *Link to Latest Assignment(s)*
- *Link to Online Re-Registration for MCA Programme*
- *Link to Online Term end Examination form*
- *Link to form for early declaration of result*
- *Link to form for obtaining photocopy of the answer script*
- *Link to form for Re-evaluation of Answer script*
- *Link to Application form for improvement in Division/ Class*
- *Link to form for obtaining Duplicate Grade Card /Mark-sheet*
- *Link to form for issue of Official Transcript*
- *Link to form for issue of Migration Certificate*

Change of Address (Form 1) You may also check online form for this.

Assignments related links
Assignment Remittance-cum-Acknowledgement (Form 2)

Link to Latest Assignment(s)
https://webservices.ignou.ac.in/assignments/schools/socis/mca_new/mca_new.html

Re-registration

Link to Online Re-Registration for MCA Programme
https://onlinerr.ignou.ac.in/

Last date of Re-Registration is announced on the IGNOU website. In general, the re-registration is to be done 2-3 months prior to the start of session.

Term end Examination and related links

Link to online Term End Examination form
https://exam.ignou.ac.in/

Link to form for Early Declaration of Result
http://www.ignou.ac.in/userfiles/APPLICATION%20FORM%20FOR%20EARLY%20DECLARATION%20OF%20RESULT%20OF%20TERM-END%20EXAMINATION.pdf

Link to Application Form for Obtaining Photocopy of the Answer Script
http://www.ignou.ac.in/userfiles/Application%20Form%20for%20botaining%20photocopy%20of%20the%20answer%20script.pdf

Link to form for Re-evaluation of Answer script
http://www.ignou.ac.in/userfiles/Application%20form%20for%20Reevaluation%20of%20Answer%20Scripts.pdf

Link to Application form for Improvement of Division/Class
http://www.ignou.ac.in/userfiles/Improvement%20form.pdf

Link to form for Duplicate Grade Card/Mark-sheet
http://www.ignou.ac.in/userfiles/Duplicate%20mark%20sheet%20form.pdf

Link to form for Issue of Official Transcript
http://www.ignou.ac.in/userfiles/Official%20Transcript%20form.pdf

Link to form for Issue of Migration Certificate
http://ignou.ac.in/userfiles/Migration%20Certificate.pdf

(For Change of Address, send it duly filled-in to the concerned Regional Director, who will forward it to the Registrar (SRD), Maidan Garhi, New Delhi after verification)

Application for Change of Address

Date: _____

To

The Regional Director
IGNOU Regional Center

_____

_____

_____

THROUGH THE REGIONAL DIRECTOR CONCERNED

EnrolmentNo.   _____

Programme   _____

Name (in caps)   _____

1. DETAILS FOR CHANGE/CORRECTION OF MAILING ADDRESS

New Address   **Old Address**

City   Pin   City _____ Pin _____

State   State _

                                        Signature of the Student

Please retain a photocopy of any document that you submit to the University.

ASSIGNMENTS REMITTANCE -CUM-
ACKNOWLEDGEMENTCARD

Enrol.No._____
Programme Title:_____
_____

Name:_____

Course Code:_____Medium:

S.No.	Assignment No.	
		For Office Use Only
		S.No._____
		Date of Receipt:_____
		Name of Evaluator:_
		_____
Signature of the Student Date:_____		Date of despatch to the Evaluator: _____
		Date of receipt from the Evaluator:

INDIRA GANDHI NATIONAL OPEN UNIVERSITY
ASSIGNMENTS REMITTANCE -CUM-ACKNOWLEDGEMENT CARD

Enrol.No._____   Programme Title:
_____Name:_____
Medium:_____
Course Code:_____   For Office Use Only

S.No.	Assignment No.	
		S.No._____
		Signature of the receiver_____
		Date:_____

Signature of the Student   Seal

Name:_____
Address of the Student:_____
Date:_____
(Please write your complete address and affix adequate postal stamp on reverse)

Affix
Stamp
Here

From: To

The Coordinator   (ADDRESS OF THESTUDENT) Study Centre concerned
   ………………………..
                                    ………………………..
                                    ………………………..

QR Code of Some of the Useful Web Links

eGyankosh
(for Online Course Materials)

Online Re-Registration Form

iGRAM
(IGNOU Grievance portal)

To Watch Live Telecast/
To listen live Broadcast

**Note: The above QR Codes can be scanned and open through
and QR Code Scanner Application/App.**

10. LINKS TO VIDEOS FOR VARIOUS COURSES

MCS-211: Design and Analysis of Algorithms, (as on 25th April, 2024)

Session No.	Gyan Darshan Programme Title	Link
1	Analysis of Polynomial Evaluation	https://youtu.be/TVfCS-Zt4Jw?t=3848
2	Recurrence Relation	https://youtu.be/08mzIPolCOU?t=41
3	Solving Recurrence Relation	https://youtu.be/kNeKg76IyP0?t=31
4	Basic Building Blocks of an Algorithm	https://youtu.be/VioMy2Pie10?t=39
5	Analysis of Algorithms	https://youtu.be/3iMb9SD7TIk?t=2167
6	Analysis of Simple Algorithms	https://youtu.be/DMs0oXy1JP4?t=2018
7	Fractional Knapsack Problem	https://youtu.be/tII7yokdznY?t=3824
8	Prim's Algorithm – A Greedy Approach of Minimum Cost Spanning Tree	https://youtu.be/daokAqWwvJk?t=3765
9	Kruskal's Algorithm of Minimum Cost Spanning Tree	https://youtu.be/n3slmKuT-4k?t=44
10	Dijkstra's Shortest Path Algorithm	https://youtu.be/c_bkMGhzwDs?t=63
11	Dynamic Programming Algorithm for Matrix Chain Multiplication Problem	https://youtu.be/F1Ylbjowpc4?t=45
12	Optimal Binary Search Tree	https://youtu.be/dK0U9wlYkvE?t=55
13	Huffman Code	https://youtu.be/I98B1RX4MKg?t=45

MCS-219 Object Oriented Analysis and Design

Session No.	Gyan Darshan Programme Title	Link
1	Structural Modeling using UML	https://www.youtube.com/watch?v=8tUQ2YQupi8
2	Relationships and its Types in UML	https://www.youtube.com/watch?v=9aEVRxhe1rE
3	Activity Diagrams	https://www.youtube.com/watch?v=1LrRSUwlJw0&t=9s
4	Basics of Object Oriented Analysis and Design	https://www.youtube.com/watch?v=zbr89Gvnspw

MCS-221: Data Warehousing and Data Mining

Session No.	Title of the Session & Date of the Session Live/Recorded	MCS-221 Course Material Unit	Time Stamp for the Start of the Video
1.	Fundamentals of Data Warehousing (17th Nov, 2022)	Unit -1	https://youtu.be/K-aWvaV6Ssc?t=3772
2.	Design Approaches and Types of Data Warehouses (25th Jan, 2023)	Unit -1	https://youtu.be/Kth0D4layig?t=1871
3.	Data Warehouse Applications and Popular Data Warehouse Platforms	Unit -1	https://youtu.be/LKbATN_8ZLQ?t=79

	(17th Feb, 2023)		
4.	Components of DW Architecture (22nd March, 2023)	Unit-2	https://youtu.be/p9-3F-03uxA?t=56
5.	Data Marts (17th April, 2023)	Unit-2	https://youtu.be/7GBiPRnXBYY?t=7
6.	Dimensional Modeling and Star Schema (10th May, 2023)	Unit-3	https://youtu.be/81jreIGa_uo?t=37
7.	Dimensional Modeling – Snowflake Schema and Fact Constellation Schema (31st July, 2023)	Unit-3	https://youtu.be/54ESvLNPCkY?t=178
8.	Working of ETL in a Data Warehouse (29th Aug, 2023)	Unit-4	https://youtu.be/UAp6JRQZI8g?t=3888
9.	ETL Tools and ELT in Data Warehousing (4th Sept, 2023)	Unit-4	https://youtu.be/tII7yokdznY?t=5568
10.	OLAP and Data Warehousing (9th Oct, 2023)	Unit-5	https://youtu.be/W7T2arIcDW0?t=5529
11.	Types of OLAP Architectures	Unit-5	https://youtu.be/-R6PXaq8Smw?t=3856

	(7th Nov, 2023)		
12.	Trends in Data Warehousing (6th Dec, 2023)	Unit-6	https://youtu.be/n3slmKuT-4k?t=5603
13.	Trends in Data Warehousing (Complex Data, Cloud Data Warehousing)(23rd Jan, 2024)	Unit-6	https://www.youtube.com/watch?v=dovD1m43smQ
14.	Trends in Data Warehousing (Real Time Data Warehousing) (16th Feb,2024)	Unit-6	https://youtu.be/LLDYDVunU-k?t=44
15.	Trends in Data Warehousing (Hadoop & Data Warehousing, DW-Automation) (22nd Mar,2024)	Unit-6	https://www.youtube.com/watch?v=-KG40j95rFA15
16.	Introduction to Data Mining(9th April, 2024)	Unit-7	https://youtu.be/zqeEyUZnhow?t=200
17.	Data Mining – An Introduction (17th March, 2023)	Unit-7	https://youtu.be/H94e8I85d8E?t=64
18.	Data Preprocessing (4th May, 2023)	Unit-8	https://youtu.be/Ktnju-H55MI?t=24
19.	Mining	Unit-9	https://youtu.be/YKHh6XyaJbo?t=45

	Frequent Patterns and Association Rule Mining (28th June, 2023)		
20.	Understanding Apriori Algorithm Using an Example (26th July, 2023)	Unit-9	https://youtu.be/73mrCtE498k
21.	Classification and Prediction (11th Aug, 2023)	Unit-10	https://youtu.be/gXLwCLlCF3E?t=56
22.	Classification by Decision (8th Nov, 2023)	Unit-10	https://youtu.be/ANK4jh-BBh4?t=3775
23.	Decision Tree Induction: Attribute Selection Measure(18th Jan, 2024)	Unit-10	https://www.youtube.com/watch?v=wupqJOKFJGE
24.	Clustering Techniques (5th April, 2024)	Unit-11	https://youtu.be/Yz2MFFeRJGk?t=58
25.	Major Clustering Methods (17th May, 2024)	Unit-11	https://www.youtube.com/watch?v=B5SuyW1BZ3s
26.	Text Mining (22nd May, 2024	Unit - 12	https://www.youtube.com/watch?v=5lA8q_fvbq0
27.	Text Mining – Text Preprocessing	Unit-12	https://www.youtube.com/watch?v=f5JttYrr908

	(22nd Aug, 2024)		

MCS-227: Cloud Computing and IoT

Session No.	Title of the Session & Date of the Session Live/Recorded	MCS-227 Course Material Unit	Time Stamp for the Start of the Video
1.	Fundamentals of Cloud Computing and IoT	Unit -1	https://www.youtube.com/watch?v=V0ije_yB-_g
2.	Cloud Deployment Models and Service Models	Unit -2	https://www.youtube.com/watch?v=Xgap7_d4lxE
3.	Cloud Service Delivery Models and Cloud Architecture	Unit-3	https://youtu.be/kkLrxKZahZY?t=44
4.	Resource Virtualization	Unit-4	https://youtu.be/Tm_qIQKgJ30