

PROGRAMME GUIDE
FOR
MASTER OF COMPUTER APPLICATIONS
(ONLINE)
(Programme Code: MCAOL)

January 2024



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

www.ignou.ac.in



Programme Guide:

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MESSAGE FROM THE PROGRAMME CO-ORDINATOR

Dear Students,

Welcome to the family of online learners and IGNOU's Master of Computer Applications Programme. It is a 2-years programme during which you will study a wide range of topics in Computer Science and Applications. The learning content will be made available through the Learning Management System (LMS) of IGNOU's online programmes portal link: <https://iop.ignouonline.ac.in/programme/p20>. In addition, you may also visit IGNOU website: <http://www.ignou.ac.in> for more information.

This Programme Guide contains instructional system of IGNOU online MCAOL (2 Years) programme, syllabus of MCAOL (2 Years) programme, details of evaluation scheme. The self-learning course material will be uploaded on the IGNOU LMS. You can download the assignments of the semester in which you have enrolled from our IGNOU online portal. Each course contains at least one assignment. All the assignments will be submitted online, and one must submit the assignment of every course before the due date to be eligible to appear for the related Term-end Examination. Centre for Online Education (COE), IGNOU will be facilitating your online learning process. You may contact COE at iopsupport@ignouonline.ac.in and coe@ignou.ac.in. Also, during the study, if you have any feedback, suggestions and comments to make about the LMS, please write to iopsupport@ignouonline.ac.in.

You will be provided online counselling for all the theory and practical courses for which you will get communication from the Nodal Regional Centre (RC)/ Study Center designated by Nodal RC for MCAOL. You must have a computer system with the necessary software for the practical 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.

As an online 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 MCAOL programme. Don't forget to re-register for the semesters as per schedule as you may not be able to pursue your studies without payment of the fee before due dates. 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>). We expect you to do all the academic activities regularly. You may also write to us at the email address given below. You must write your enrolment number and mention that you are a student of online mode in every communication.

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 visit the IGNOU Online Programmes website at URL <https://iop.ignouonline.ac.in/> for advice and day-to-day information.

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

Prof. Divakar Yadav
MCAOL Programme coordinator
Email: mcaolsocis@ignou.ac.in

1. BASIC INFORMATION

1.1 MCAOL Programme Objectives

The broad objective of the MCAOL 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 programme's thrust 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 MCAOL, 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**.

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 involves completion of both assignments as well as the Term-End Examination for each course in the programme and any bridge courses; if any.**

1.5 MCAOL 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.

MCAOL Programme Structure

Semester I			
Course Code	Course Title	Theory/ Practical	Credits
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

No. of Theory Courses– 15; No. of Practical Courses –6; Project – 1; Total Credits: 80

1.6 Admission Eligibility Criteria

The following are the eligibility criteria of Master of Computer Applications (MCAOL) programme:

Eligibility:

(a)

(i) Passed B.C.A/B.Sc (Computer Science)/ B.Sc. (IT)/ B.E.(CSE)/ B.Tech. (CSE)/B.E. (IT)/B.Tech. (IT) or Equivalent Degree.

OR

(ii) Passed any Graduation Degree (e.g.:B.E./B.Tech./B.Sc/B.Com./ B.A./B.Voc./etc.) preferably with Mathematics at 10+2 level or at Graduation level.

(b)

Obtained at least 50% marks (45% marks in case of candidates belonging to reserved category) in the qualifying examination.

The students of category a (ii) are required to register and successfully complete the following **compulsory Bridge courses** of IGNOU along with Master of Computer Applications programme:

- Students **WITH** Mathematics at 10+2 level or at Graduation level: 1. MCS-201 (Programming in C and Python) 2. MCS-208 (Data Structures and Algorithm)
- Students **WITHOUT** Mathematics at 10+2 level or at Graduation level: 1. BCS-012 (Basic Mathematics) 2. MCS-201 (Programming in C and Python) 3. MCS-208 (Data Structures and Algorithm)
- Students who have already successfully completed any of these Bridge courses, viz., BCS-012, MCS-201, MCS-208 of IGNOU, are required to register and successfully complete the remaining bridge courses only.

1.7 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 5th May, 2004 & 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 recognized from 2018-19 to2022-23. Master of Computer Applications (Online) is approved by AICTE. 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>

1.8 Student Support

The University may not always be able to communicate to all the students individually. Most of the information about the Programme would be displayed on IGNOU online portal (<https://iop.ignouonline.ac.in/>). You are, therefore, advised to keep visiting the IGNOU online web site on a more regular basis so as to get the latest information about assignments, submission schedules (assignments and examination forms), declaration of results, etc.

1.8.1 MCAOL Nodal Regional Centre

The Nodal Regional center for MCAOL students is RC Delhi-1 (mcaol@ignou.ac.in, rcdelhi1@ignou.ac.in).

1.9 iGRAM

With the objective of putting in place a system for quick resolution of students problems IGNOU has developed iGRAM. **For quick response and redress you may send your query/grievance on iGRAM at <http://igram.ignou.ac.in/>.**

1.10 How to contact the MCAOL Programme Coordinator?

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

2. INSTRUCTIONAL SYSTEM

The methodology of instruction for online mode in this University is different from that of the conventional universities. The online learning mode of the University system is more learner-oriented, and the student has to be an active participant in the teaching-learning process. The University follows a multi-channel approach for instruction. After admission is confirmed, learner will receive credentials through email for accessing the learning management system (<https://iop.ignouonline.ac.in/programme/p20>). In addition to the components, which are placed on the course pages of LMS, learner shall also get the support for learning through the following:

- ☞ Self-Learning Material (SLM) in pdf or other electronic form
- ☞ Self-assessment check your progress questions as part SLMs
- ☞ Video programmes for various courses
- ☞ Online theory counselling
- ☞ Recorded video of counselling sessions
- ☞ Compulsory online practical counselling sessions
- ☞ eGyankosh
- ☞ Web based support
- ☞ Assignments
- ☞ Gyan Darshan Channel, including teleconferencing,
- ☞ Gyan Vani
- ☞ SWAYAMPBABHA-DTH (channel-19)

2.1 Self-Learning Material

Self-Learning Materials and video programmes are the primary form of instructional materials. A basic unit of material is called a block. 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-learning material is made available in through IGNOU's online portal. 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-learning material alone may not be sufficient to write assignments and prepare for the Term-end Examinations.

2.2 eGyankosh, SWAYAMPBABHA-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>

The **SWAYAM PRABHA-DTH Channel-19** (Professional and Vocational 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/Under Graduate/Post Graduate courses pertaining to Computer Science/Application, Management Studies, Vocational Education, Engineering & 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 Channel-19

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

Professional and Vocational Education (Channel-19):

https://www.swayamprabha.gov.in/index.php/program/current_he/19

Archive Video: https://www.swayamprabha.gov.in/index.php/program/archive_he/19

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 theory and practical counselling sessions may be conducted through online mode. The details of the theory and practical counselling sessions are given in the following sections.

Theory Sessions

In online mode the interaction 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.

There are academic counsellors to provide online counselling and guidance to you in the courses that you have chosen for study. Normally, these sessions will be held online on Saturdays and Sundays. However, theory counselling sessions may be conducted on weekdays too.

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 MCAOL programme. In these sessions, you must try to resolve your subject-based difficulties and any other related problems.

Practical counselling Sessions and Compulsory Attendance

The practical counselling sessions will also be held online. The participants should have their own facility to use the computer and software packages relevant to the syllabus. No hardware or software will be provided by IGNOU. 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 re-register for that lab course. For fee details and the application form, you may contact your coordinator.
- iii) Students are required to prepare a separate lab record for each lab course. These lab records should be mailed to practical counsellor after each session.
- iv) Student attendance for practical sessions will be recorded course wise on receipt of lab record.
- v) Strictly follow the guidelines given in the Lab manuals for the respective lab courses.
- vi) No hardware or software facility will be provided by IGNOU for the online students. They have to make their own arrangements.

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 expected number of counselling sessions for 1st to 4th Semesters of MCAOL. **The exact dates of and schedule may be put on IGNOU LMS. The actual number of sessions may change, as per requirements.**

MCAOL 1st Semester Schedule

Course	Theory/Practical	Credits	No. of Theory Counselling Sessions*	No. of Practical Counselling Sessions**
MCS-211	Theory Sessions	4	6	-
MCS-212	Theory Sessions	4	6	-
MCS-213	Theory Sessions	4	6	-
MCS-214	Theory Sessions	2	3	-
MCS-215	Theory Sessions	2	3	-
MCSL-216	Practical Sessions	2	-	20
MCSL-217	Practical Sessions	2	-	20

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

Course	Theory/Practical	Credits	No. of Theory	No. of Practical
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			Counselling Sessions*	Counselling Sessions**
BCS-012	Theory Sessions	4	6	
MCS-201	Theory Sessions	4	6	-
MCS-208	Theory Sessions	4	6	-

MCAOL 2nd Semester Schedule

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

MCAOL 3rd Semester Schedule

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

MCAOL 4th Semester Schedule

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

Semester	No. of Sessions	No. of Hours
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	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

Note: 75% attendance is compulsory in Practical Lab Sessions.

MCAOL 1st Semester Schedule

MCS-211 : Design and Analysis of Algorithms

Counselling Sessions

Sessions	Session Number	Topics to be Concerned
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 Concerned
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 Concerned
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 Concerned
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 Concerned
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 Concerned
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 Concerned
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 MCAOL programme)

MCS-201: Programming in C and Python**Counselling Sessions**

Sessions	Session Number	Topics to be Concerned
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 Concerned
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

MCAOL 2nd Semester Schedule**MCS-218: Data Communication and Computer Networks****Counselling Sessions**

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

MCAOL 3rd Semester Schedule

**MCS-224: Artificial Intelligence and Machine Learning
Counselling Sessions**

Sessions	Session Number	Topics to be Concerned
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 Concerned
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 Concerned
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 Concerned
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 Concerned
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 Concerned
Practical Counselling	1-10	All topics of Cloud
	11-20	All topics of Data ScienceLab

MCAOL 4th Semester Schedule

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

Sessions	Session Number	Topics to be Concerned
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 Concerned
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

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.

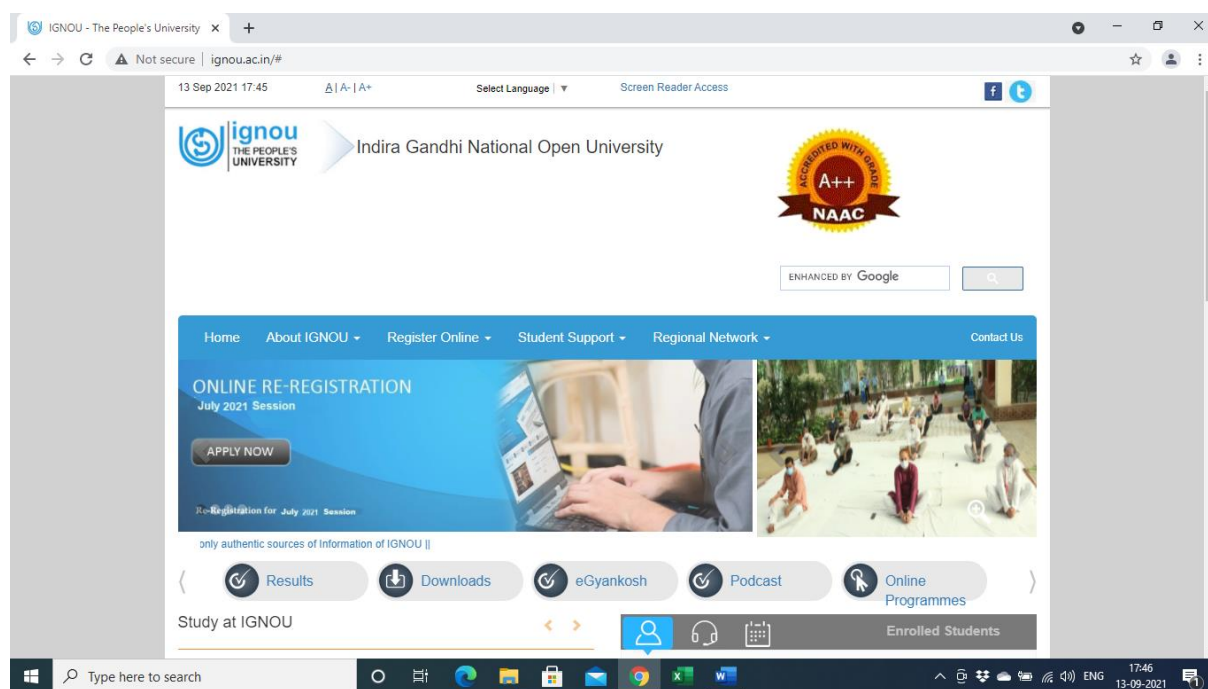


Figure 1: IGNOU Website

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 Ph.D in Computer Science, MCAOL, 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.

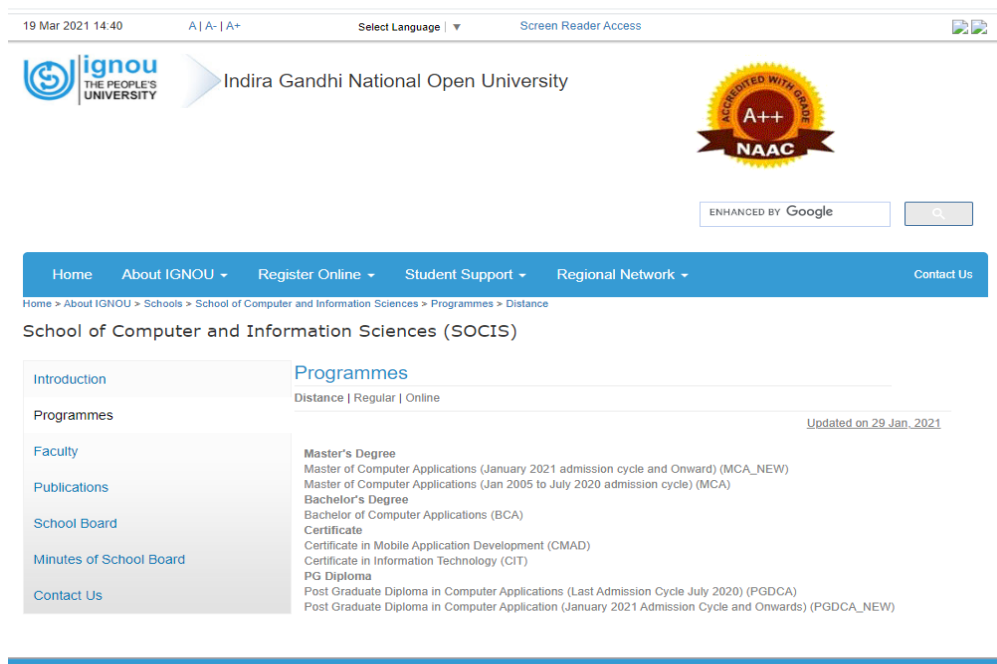


Figure 2: SOCIS Programmes

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. The question paper pattern for MCAOL is different from MCA_NEW. Hence, please do not rely on old question papers patterns.

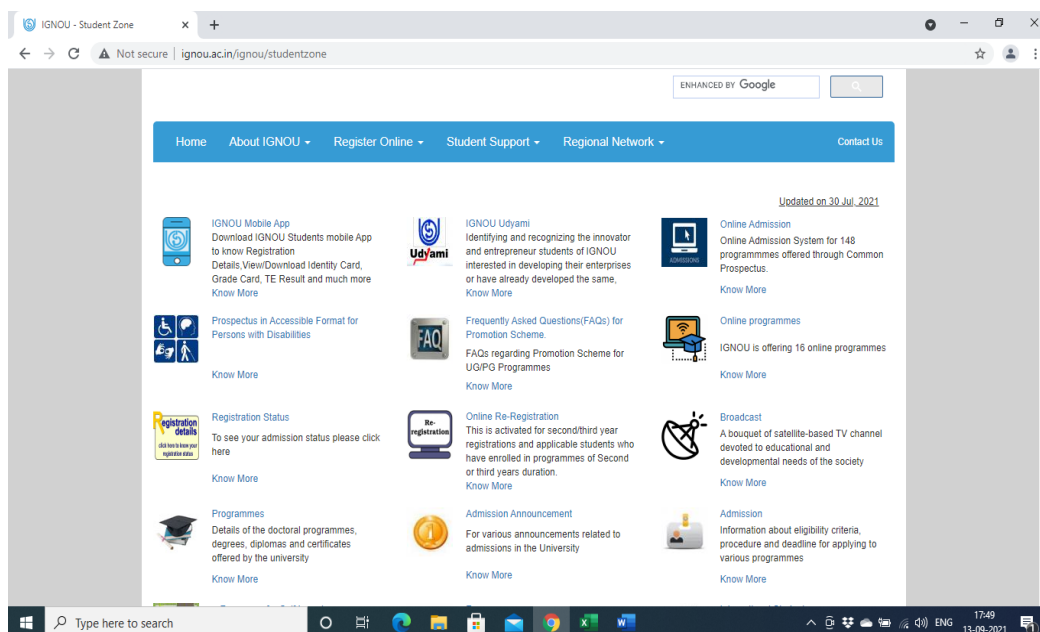


Figure 3: Student Zone page

Navigation from IGNOU's online Home Page

The learners can have access to IGNOU's online website at the following address (URL) <https://iop.ignouonline.ac.in/>. As students get connected to this site, the following page displays the Home Page of IGNOU's online web site (Figure 4). Students need to click on

online program inside the programmes tab.

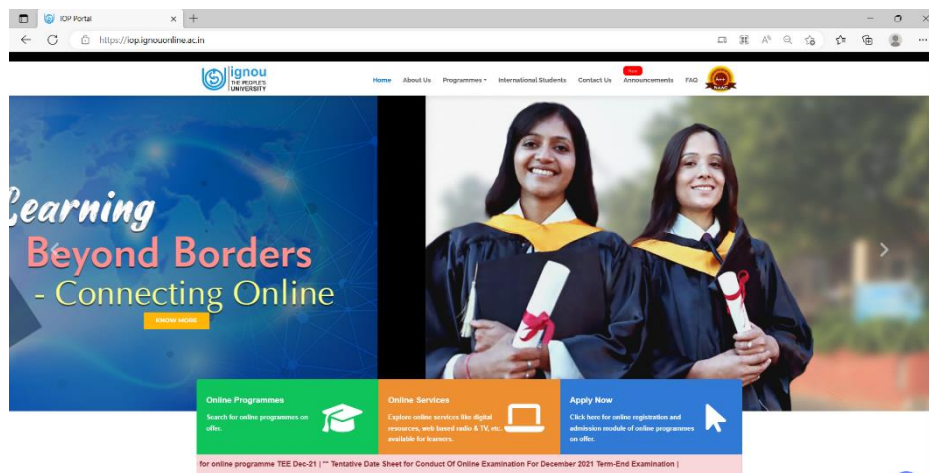


Figure 4: IGNOU's online programme home page

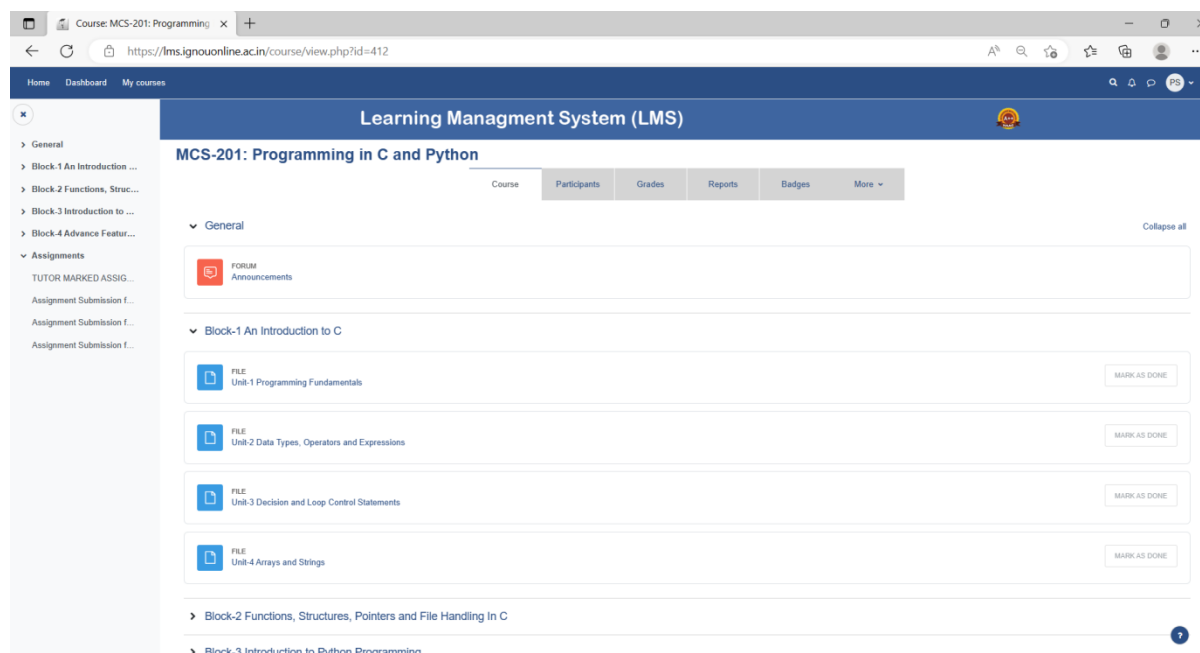


Figure 5: Learning Management System page

After successful login Students can go through Self Learning Materials and assignments course wise, as shown in Figure 5.

Navigation from eVidyaBharti Project

The learners can have access to eVidyaBharti online website at the following address (URL) <https://e-vbab.ignouonline.ac.in/>. As students get connected to this site, the following page displays the Home Page of eVidyaBharti web site (Figure 6). Students need to click on online program inside the programmes tab.

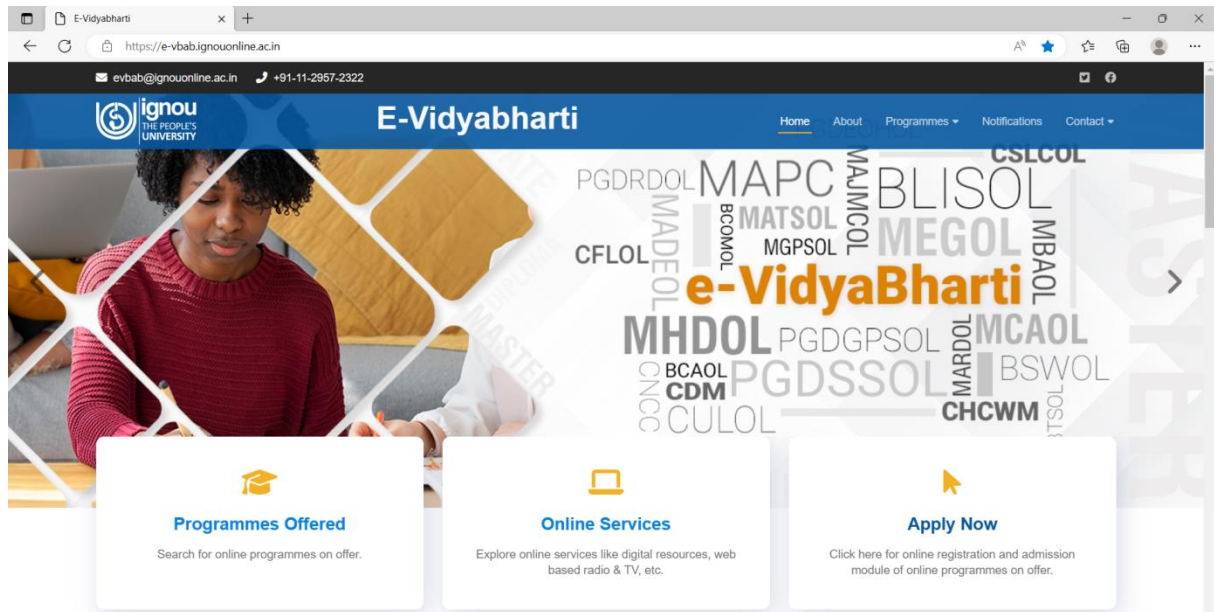


Figure 6: Home page of eVidyaBharti portal.

4. MCAOL 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 make span 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
 - Merge Sort
 - Quick Sort
- Matrix Multiplication Algorithm

Unit 3: Graph Algorithm -I

- Basic Definition and terminologies
- Graph Representation
 - Adjacency Matrix
 - Adjacency List
- Graph Traversal Algorithms
 - Depth First Search
 - 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
 - Prim's Algorithm
- Single Source Shortest Path Problems
 - Bellman Ford Algorithm

Dijkstra's Algorithm

- Maximum Bipartite Matching Problem

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, NP-Completeness, 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

Discrete mathematics deal with discrete objects (that is not continuous) like a set of PhD students in computer science departments. Foundation of Computer Science is built upon discrete mathematics. It includes Propositional 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.

Course Structure*

Block-1 Elementary Logic & Proofs

Unit 1: Propositional Calculus

- Introduction
- Objectives
- Propositions
- Logical Connectives
 - Disjunction
 - Conjunction
 - Negation
 - Conditional Connectives
 - Precedence Rule
- Logical Equivalence
- Logical Quantifiers
- Application of Propositional Logic
 - Web Page Searching
 - Logic Circuits
- Summary
- Solutions/Answers

Unit 2: Methods of Proof

- Introduction
- Objectives
- What is a Proof?
 - Some Terminology
 - Hypothesis
 - Axioms
 - Lemmas
 - Corollary
 - Conjunction
- Different Methods of Proof
 - Direct Proof
 - Indirect Proofs

- 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
 - Basic Operations
 - Properties Common to Logic and Sets
- Relations
 - Representing relation using matrices
 - Representing relation using digraph
 - Cartesian Product
 - Relations and their types
 - Properties of Relations
- Functions
 - Types of Functions

- Composition of Functions
- Some Important function
- 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
 - Permutations of Objects not Necessarily Distinct
 - 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
 - Application to Subjective Functions
 - Application to Probability

- 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
 - Method of Inspection
 - Method of telescoping Sums
 - Method of Iteration
 - Method of Substitution
- Summary
- Solutions/Answers

Unit 4: Partitions and Distributions

- Introduction
- Objectives
- Integer Partitions
- Distributions
 - Distinguishable Objects into Distinguishable Containers
 - Distinguishable Objects into Indistinguishable Containers
 - Indistinguishable Objects into Distinguishable Containers
 - Indistinguishable Objects into Indistinguishable Containers
- Summary
- Solutions/Answers

Block-4 Graph Theory

Unit 1: Basic Properties of Graphs

- Introduction
- Objectives
- Graphs
 - Graph Models
 - Social Networks
 - Communication Networks
 - Web Graphs

- Degree, Regularity and Isomorphism
- Subgraphs
- Represent Graphs
 - Adjacency Matrices
 - Adjacency Visits
 - Incidence Matrix
- Summary
- Solutions/Answers

Unit 2: Connectedness

- Introduction
- Objectives
- Connected Graphs
 - Paths, Circuits and Cycles
 - Components
 - Connectivity
- Bipartite Graphs
 - A complete bipartite graph
- Trees
- Summary
- Solutions/Answers

Unit 3: Eulerian and Hamiltonian Graphs

- Introduction
- Objectives
- Eulerian Graphs
- Hamiltonian Graphs
 - Dirac's Theorem
 - 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

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 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
- 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 SoftwareEngineering

- 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

Unit1: 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-to-Face Interactions
- Characteristics and Conventions of Conversation
- Conversational Problems of Second/Foreign Language Users
- Difference between Conversation and Other Speech Events

Unit2: Telephone Techniques

- WarmUp
- 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 aJob
- CurriculumVitae
- 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
- 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: PresentationSkills
- Grammar: Verbs often Required in Presentations
- 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 Successful Life at the Workplace

- The Changing Scenario in the Twenty-first 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 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?

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.

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 Authorization
- 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
 - Organization 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

Unit-3: IPR issues in Cyber Space

- Introduction
- Objectives

- C Language and its features
- Structure of a C Program
- Writing a C Program
- Compiling a C Program
 - The C Compiler
 - Syntax and Semantic Errors
- Link and Run the C Program
 - Run the C Program through the Menu
 - Run from an Executable File
 - Linker Errors
 - Logical and Runtime Errors
 -

Unit 2: Data Types Operators and Expressions

- Character Set
- Identifiers and Keywords
 - Rules for Forming Identifiers
 - Keywords
- Data Types and Storage
- Data Type Qualifiers
- Variables
- Declaring Variables
- Initialising Variables
- Constants
 - Integer Constants
 - Floating Point Constants
 - Character Constants
 - String Constants
 - 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
 - The *if* Statement
 - The *switch* Statement
- Loop Control Statements

- The *while* Loop
- The *do-while* Statement
- The *for* Loop
- The Nested Loop
- The *Goto* Statement
- The *Break* Statement
- The *Continue* Statement

Unit 4: Arrays & Strings

- Array Declaration
 - Syntax of Array Declaration
 - Size Specification
- Array Initialization
 - Initialization of Array Elements in the Declaration
 - Character Array Initialization
- Subscript
- Processing the Arrays
- Multi-Dimensional Arrays
 - Multi-Dimensional Array Declaration
 - 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
 - Automatic Variables
 - External Variables
 - Static Variables
 - 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

- 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
 - Pointer to a Pointer
 - Null Pointer Assignment
- Pointer Arithmetic
- Passing Pointers to Functions
 - A Function Returning More than One Value
 - Function Returning a Pointer
- Arrays and Pointers
- Array of Pointers
- Pointers and Strings

Unit 8: File Handling

- File Handling in C Using File Pointers
 - Open a file using the function *fopen ()*
 - Close a file using the function *fclose()*
- Input and Output using file pointers
 - Character Input and Output in Files
 - String Input / Output Functions
 - Formatted Input / Output Functions
 - Block Input / Output Functions
- Sequential Vs Random Access Files
- Positioning the File Pointer
- The Unbuffered I/O - The UNIX like File Routines

PYTHON PROGRAMMING (BLOCK-3&4)

Block-3 Introduction to Python Programming

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
 - Arrays
 - Linked Lists
 - Stacks
 - Queues
- Sequence, Selection and Iteration constructs
- Recursion

Unit-11 Functions and File Handling in 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
- Package Creation and Importing
- Standard Library Modules

Block-4 Advanced Features in Python

Unit-13 Classes in Python

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

Unit-14 Exception Handling in Python Programming

- Default Exception Handler

- Catching Exceptions
- Raise an exception
- User defined exception

Unit-15 Advanced Concepts

- Decorators
- Generators
- Iterators

- Co-routines

Unit-16 Data Access using Python

- Database concepts
- Creating database
- Querying Database
- Using SQL to get more out of database

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
 - Row Major Representation
 - 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

BLOCK 2: Stacks, Queues and Trees

Unit 4: Stacks

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

Unit 5: Queues

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

Unit 6: Trees

- Abstract Data Type-Tree
- Implementation of Tree
- Tree Traversals
- Binary Trees
- Implementation of Binary Tree

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

BLOCK 3: Graph Algorithms and Searching Techniques

Unit 7: Advanced Trees

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

Unit 8: Graphs

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

Unit 9: Searching and Sorting Techniques

- Linear Search

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

BLOCK 4: File Structures and Advanced Data Structures

Unit 10: Hashing

- Introduction
- Index Mapping
- Collision Handling
- Double Hashing
- 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
 - Structure
 - Operations
 - Disadvantages
 - 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

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 models
- 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 LinkControl)
- 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 RepeatN.

Summary

Solutions/Answers

Further Readings

Unit 3: Contention-based Media Access Protocols

Introduction

Objectives

Advantages of Multiple Access Sharing of Channel Resources

PureALOHA

SlottedALOHA

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
 - Connection-oriented Services
 - Connection-less Services
 - Implementation of the Network Layer Services
 - Packet Switching
 - Implementation of Connection-oriented Services
 - Implementation of Connection-less Services
 - Comparison between Virtual Circuit and Datagram Subnet
 - Addressing
 - Hierarchical Versus Flat Address
 - Static vs. Dynamic Address
 - IP Address
 - Concept of Congestion
 - Routing Concept
 - Main Issues in Routing
 - Classification of Routing Algorithm
 - Summary
 - Solutions/Answers
 - Further Readings

Unit 2: Routing Algorithms

Introduction

Objectives

Flooding

Shortest Path Routing Algorithm

Distance Vector Routing

- Comparison
- The Count-to-Infinity Problem
- Link State Routing
- Hierarchical Routing
- The Internet Protocol (IP)
 - IPV4 addressing
 - Datagram Format
 - IPV6
 - IP Datagram Fragmentation
 - Internet control message protocol
 - Dynamic host configuration protocol
 - IP Security

- Routing with Internet
 - Inter Autonomous System
 - Routing in the Internet: RIP & OSPF
 - Inter Autonomous System
 - Routing BGP
- Multicast Routing
- Mobile IP
- Summary
- Solution/Answers
- Further Readings

Unit 3: Congestion Control Algorithms

- Introduction
- Objectives
- Reasons for Congestion in the network
- Congestion Control vs. Flow Control
- Congestion Prevention Mechanism
- General Principles of Congestion Control
- Open Loop Control
 - Admission Control
 - Traffic Policing and its Implementation
 - Traffic Shaping and its Implementation
 - Leaky Bucket Shaper
 - Token Bucket Shaper
 - Difference between Leaky Bucket Traffic Shaper and token Bucket Traffic Shaper
- Congestion Control in Packet-switched Networks
- Summary
- Solution/Answers
- Further Readings

Unit 4: Emerging Networking Technology

- Mobile Adhoc Networks
- Wireless Sensor Networks
- Internet of Things(IOT)

Block- 4 Transport Layer and Application Layer Services

Unit 1: Transport Services and Mechanism

- Introduction
- Objectives
- Transport Services
 - Types of Services
 - Quality of Services
 - Data Transfer
 - Connection Management
 - Expedited Delivery
- Elements of Transport Layer Protocols
 - Addressing
 - Multiplexing
 - Flow Control and Buffering
 - Connection Establishment
 - Crash Recovery
- Summary
- Solutions/Answers
- Further Readings

Unit 2: TCP/UDP

- Introduction
- Objectives
- Services Provided by Internet Transport Protocols
 - TCP Services
 - 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
 - Classes
 - Relationships,
 - Common Mechanisms
 - Class Diagram
- Advanced Structural Modeling
 - 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
 - Aggregation
 - AbstractClass
- MultipleInheritance
- 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
 - Processes
 - Data Flows
 - Actors
 - Data Stores
 - Constraints
 - 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

Unit 2: Object Design

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

Unit 3: Advance Object Design

- Control and its Implementation
 - Control as a State within Program
 - Control as a State Machine Engine
 - 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
 - Optional Associations
 - One-to-One Associations
 - Associations with Multiplicity 'Many'
- Bi-directional Implementations
 - One-to-One and Optional Associations
 - One-to-Many Associations
 - 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
 - General DBMS Concepts
 - Relational DBMS Concepts
 - RDBMS Logical Data Structure
- Object Classes to Database Tables
 - Extended Three Schema Architecture for Object Models
 - The use of Object IDs
 - Mapping Object Classes to Tables
- Mapping Associations to Tables
 - Mapping Binary Associations to Tables
 - Mapping Many-to-Many Association to Tables
 - Mapping Ternary Associations to Tables
- Mapping Generalizations to Tables
- Interfacing to Databases

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 to it.

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.

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 into it

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 Web-component)

Unit 3: Session Management and Database Connectivity in Servlet

- Session Management
- Database Connectivity in Servlet,
- Servlet Communication (Servlet-Browser, Web-component)
- 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 inpages
- 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 formcreation
- 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 associationrules 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 AND TRENDS

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 testconditions
- Measures for Selecting the Best Split
- Algorithm for Decision tree Induction
- Bayesian Classification
 - Bayes'Theorem
 - Naive-Bayesian Classification
 - Bayesian Belief Networks
- Support Vector Machines
 - The Case when the data are linearly separable
 - The Case when the data are linearly inseparable

Unit 11: Clustering

- Clustering: ProblemDefinition
- Clustering Overview
- Categorization of Major Clustering Methods
 - Partitioning Method

- Hierarchical Method
- Density-based Method
- Grid-Based Method
- Model-Based Method
- Constraint-based Method
- Partitioning Method
 - K-Means Algorithm
 - K-Medoids
- Hierarchical Clustering
 - Agglomerative Method
 - 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 contentmining
- Web structuremining
- 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 DataMining.
- The practice problems for all 20 sessions will be listed session-wise in the labmanual.

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: stimulus-response 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). Min-Max 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

VectorRegression

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 : K-Means, 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
 - The Limitations of Trial Balance
- The Accounting Cycle
- Bank Reconciliation Statement
 - Causes of differences in bank balance as per cash book and passbook
 - Utility of bank reconciliation statement
- Preparation of bank reconciliation statement
- KeyWords
- Summary
- Solutions /Answers
- Further Readings

**Block 2: Understanding and Analysis
of Financial Statements**

**Unit 1: Preparation and Analysis of
Final Accounts**

- Introduction
- Objectives
- Trading Account
 - Opening/Closing Stock
 - Net Purchases

- Direct Expenses
- Net Sales
- Profit and Loss Account
- Difference between Trading and Profit & Loss Account
- Balance Sheet
- Constructing a Balance Sheet
- Classification of Balance Sheet's Items
- Adjustment Entries
 - Closing Stock
 - Depreciation
 - Bad Debts
 - Provision for Bad and Doubtful Debts
 - Outstanding Expenses (Assets)
 - Prepaid Expenses (Assets)
 - Accrued Income
 - Income Received in Advance (Liability)
- Forensic Accounting
- Summary
- KeyWords
- Solutions/Answers
- Further Readings

Unit 2: Cash Flow Statement

- Introduction
- Objectives
- Statements of Changes in Financial Positions (SCFP)
- Analysing Changes in Working Capital
- Fund Flow Statement
- Sources of Funds
- Uses (Applications) of Funds
- Preparation of Fund Flow Statement
- Cash Flow Statement
- Sources and Uses of Cash
- Preparation of Cash Flow Statement and analysis
- Summary
- KeyWords
- Self-Assessment Questions
- Further Readings

Unit 3: Ratio Analysis

- Introduction
- Objectives
- Categories of Ratios
 - Long-term Solvency Ratios
 - Liquidity Ratios (Short-term Solvency Ratios)
 - Activity or Turnover Ratios
 - Profitability Ratios
 - Market Test Ratios
- Utility of Ratio Analysis
- Diagnostic Role of Ratios
- Application of Formulas
- Summary
- Self-Assessment Questions/Exercises
- Solutions/Answers

Unit 4: Reading and Interpretation of Financial Statements

- Introduction
- Objectives
- Annual Report
- Financial statements and information gap
- Analysis of Profit and Loss A/c
- Analysis of Cash Flow Statement
- Analysis of Balance Sheet
- Techniques of financial statement analysis
- Summary
- 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
- Solutions/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 Management
- Techniques of Inventory Control
 - Traditional Techniques
 - Modern Techniques
- Summary
- Self-Assessment Questions/Exercises
- Solutions/Answers

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 Analysis:
Types of Data
Sampling
Descriptive – Summaries without 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 Map-

Reduce 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
- Rank computation using Map-reduce
- 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

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 included 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
AND VIRTUALIZATION**

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
 - Public Cloud
 - Private Cloud
 - Community Cloud
 - Hybrid Cloud
- Choosing Appropriate Deployment Model
- Service Delivery Models
 - Infrastructure As a Service (IaaS)
 - Platform As a Service (PaaS)
 - Software As a Service (SaaS)
 - 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
 - Virtualizing Physical Computing Resources
- Advantages of Virtualization
- Machine or Server Level Virtualization
 - Hosted Approach
 - Bare Metal Approach
- Exploring Hypervisor or V3irtual Machine Monitor
 - 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-waveetc.)

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 labmanual.

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

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, Bitextraction.

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

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

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*

Further Readings

Block-1: Introduction to Mobile Computing

Unit-4: GSM and GPRS

Unit-1: Introduction to Mobile Communications

Introduction

Introduction

Objectives

Objectives

GSM Architecture

Mobile Communication

Public Land Mobile Network

Multiplexing (TDMA,

(PLMN) Interface

CDMA,FDMA)

Call Handling

GSM

Handover

GPRS and2.5G

SMS

3G

GPRS

4G –LTE

High Speed Circuit Switched Data

Summary

WLL Application

Further Readings

Summary

Further Readings

Unit-2: Introduction to Mobile Computing Architecture

Block-2: Mobile IP and Issues in Mobile Computing

Introduction

Unit-5: 4G and 5G Networks

Objectives

Introduction

Mobile IP, Cellular and WLAN

Objectives

IEEE 802.11X Networks

High Speed Packet Access

AdHoc Networks

MIMO in HSPA

Mobile Computing Operating

LTE and WIMAX16E

System

Ultra-Wide Band and Broadband

Client Server Computing using

Wireless Access

Mobile

Mobile Computing Architecture

4G Networks: HS-OFDM, LTE

Design considerations for Mobile

Computing

Mobile Computing and the Apps

Summary

Further Readings

Features of 5G Networks

Summary

Further Readings

Unit-3: Mobile Client Devices and Pervasive Computing

Unit-6: Mobile IP Network Layer

Introduction

Introduction

Objectives

Objectives

Smart Sensors, Actuators and

Mobile IP

Mobile Robotic Systems

IP Header: Encapsulation and

Smart Home and Appliances

Routes Optimization

Automotive Systems

Mobility Binding

Limitations and Devices Design

Cellular IP

Considerations

Mobile IP with IPv6

Summary

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 Python
Summary
Further Readings

**Unit-16: Mobile Operating Systems
and Development Environments**

Introduction
Objectives
Introduction to Mobile Operating
Systems
Application Programming
Linux for Mobile Devices
Development Process
Development Tools and Emulators
Apple IOS
Android
Summary
Further Readings

*** The course structure may be subject to changes.**

MCSP-232

PROJECT

(CREDITS-12)

The objective of the MCAOL 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 equivalent 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 MCAOL project. The courses studied by the students during the MCAOL 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 LMS.

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 number of courses in this MCAOL programme are **22** (including a Project course) and the total number of credits are **80**. In addition, three bridge courses, BCS-012, MCS-201 and MCS-208 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 MCAOL 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.*

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 through websites. 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%)**. Assignments, course wise are uploaded to LMS (<https://lms.ignouonline.ac.in/>) course pages. The table shown below provides the detailed marking scheme for the MCAOL courses.

Semester	Course Code	Course Title	Credits	Continuous Evaluation		Term End Examination Theory OR Practical* (for Lab courses only) (Weightage – 70%)		
				Assignment (Weightage – 30%)		Duration	Max. Marks	Min. Marks
				Max Marks	Min. Marks		Max. Marks	Min. Marks
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	Software Engineering	4	100	40	3	100	40
	MCS-214	Professional Skills and Ethics	2	100	40	3	100	40
	MCS-215	Security and Cyber Laws	2	100	40	3	100	40
	MCSL-216	DAA and Web Design Lab	2	100	40	-	50	20
	MCSL-217	Software Engineering Lab	2	100	40	-	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	-	50	20
	MCSL-223	Computer Networks and Data Mining Lab	2	100	40	-	50	20
	III	MCS-224	Design and Analysis of Algorithms	4	100	40	3	100
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	-	50	20
MCSL-229		Cloud and Data Science Lab	2	100	40	-	50	20
IV		MCS-230	Digital Image Processing and Computer Vision	4	100	40	3	100
	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 practical examination includes Viva Voce only.

** 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 online programme, 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.

Course Code	Term-end practical examination through viva-voce	
	Marks Section-1	Marks Section-2
MCSL-216 (2 credits)	25 marks	25 marks
MCSL-217 (2 credits)	50 marks	#
MCSL-222 (2 credits)	25 marks	25 marks
MCSL-223 (2 credits)	25 marks	25 marks
MCSL-228 (2 credits)	50 marks	#
MCSL-229 (2 credits)	25 marks	25 marks

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.

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

5.2 Instructions for Assignments

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

1. 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:

- 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.
- Organization:** 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.
- 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:
ONLINE ASSIGNMENT SUBMISSION 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 content of the Units of the courses, as given on the LMS. If they reproduce from the Units, they will get poor marks for the respective question.

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

5. The students should write the question number with each answer. 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, also write page numbers on each page. Avoid using very thin paper. They should allow a 4-cm. margin on the left and at least 4 lines in between each answer.

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 handwritten completed assignment response of a specific course should be scanned by a good scanner and submit through LMS. Student must make sure that the scanned assignment response is readable. Under no circumstances should they be sent to the SED Division or the School at Headquarters, for evaluation. The students should appear for the viva-voce of the assignment on the stipulated time.

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 LMS of IGNOU's online programmes website course wise.

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. IGNOU 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. 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.
6. For their own record, students should retain a scanned copy of all the assignment responses, which they submitted.
7. As per the University norms, once the student's scores pass marks in an assignment, they cannot re-submit it for improvement of marks.
8. 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, so that 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 email. While doing so they should give their complete Enrolment number, name, address, programme code.

Note: Please submit your duly scanned Assignment response on or before the due date through LMS.

11. In case of not successfully completed or missed; the assignments should resubmit assignment, if your registration for that course is valid.
12. Assignments should not be resubmitted to improve your score if you have secured minimum qualifying score in a course.
13. Please do not submit your assignment responses twice.
14. There is no provision for reevaluation of Assignments, practical examination and project evaluation.

5.4 General Guidelines Regarding the Term-End Examination

Please refer the Announcements section in the online portal.

<https://iop.ignouonline.ac.in/announcements/0>

6. OTHER USEFUL INFORMATION

6.1 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.

6.2 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.

6.3 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 (Email: registrarsed@ignou.ac.in)
(iii) Admission, Fees, Scholarship, Change of Address/Learner Support Centre/Regional Centre, Change of Course/Programme, Issue of Bonafide Certificate, Migration Certificate, Duplicate Identity Card	Regional Director of the Regional Centre concerned.
(iv) Academic Matters	MCAOL Programme Coordinator SOCIS, C-Block, New Academic Complex IGNOU, Maidan Garhi, New Delhi - 110 068 Phone: 011-29572902 Email: mcaolsocis@ignou.ac.in
(v) 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 Email: exam1@ignou.ac.in
(vi) Issue of Provisional Certificates and Grade Cards	Dy Registrar (Exam-3) Phone No: 011-29536743; Intercom No. 2210/2212
(vii) 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 011-29572210/2212
(viii) Non incorporation of assignment marks	Assistant Registrar (Assignment) Intercom No. 1319/1325 E-mail: assignments@ignou.ac.in
(ix) Online students grievances Portal	http://igram.ignou.ac.in/

(x) Students' General Enquiries	Student Support Centre, Indira Gandhi National Open University, Maidan Garhi New Delhi -110068, Phone: 011-29535714, 29572512, 29572514, 29533869 and 29533870, Email: ssc@ignou.ac.in
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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 Regional Centre/Study Centre for advance/timely/day-to-day information or visit the website with URL www.ignou.ac.in.

8. PATTERN OF QUESTION PAPERS

TERM-END EXAMINATION FOR COURSES OF ONLINE PROGRAMMES

Question Paper Sample

Total Marks: 100

Sl. No.	Characteristics	No. of Questions to be set	No. of questions to be attempted by the Student	Maximum marks for each question	Total Marks
1.	Short Answer	07	05	04	5X4=20
2.	Medium Answer	07	05	10	5X10=50
3.	Long Answer	03	02	15	2X15=30
	Total	17	12		

N.B. 12 questions will be required to attempt by the students out of total 17 question set in a question paper.

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

- **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>

Re-registration

- **Link to Online Re-Registration for proceeding to subsequent semester.**
<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.