GNSU Handbook

of

MCA (Masters in Computer Applications)

AY-2023-24

August-2023

Table of Contents

1.1	**1.1 Vision of the Faculty of Information Technology**
	To emerge as a leading destination in the field of Computer Science and Engineering education and research, by providing quality technical education to the aspiring students.
1.2	**Mission of the Faculty of Information Technology**
	1. To educate the students with state-of-the-art technologies to meet the current needs of the industry and society. 2. To inculcate ethical values, team spirit and leadership qualities among the students. 3. To create an environment that will encourage higher study and research.
2.1	**Program Educational Objectives (PEOs):** After 3-4 years of graduation, the students of the program will be able to:
	PEO1: Technical Expertise: To develop among the students the ability to plan, analyze, design, code, implement, test and maintain the software product for real time systems that are technically sound, economically feasible and socially acceptable.
	PEO2: Successful Career: The students after passing out of the course should exhibit ethical attitude, exhibit professionalism with updated technologies in Computer Application based career and they should have capability to set up their own enterprise in various sectors.
	PEO3: Soft Skills: The students should develop team work, communication skills and leadership quality in their professional multidisciplinary projects and they should be well adapted to current trends by engaging in lifelong learning
	PEO4: Life Long Learning: Prepare the students to pursue higher studies by acquiring knowledge in computing, mathematical and engineering principles in their field of work and to motivate them to work in the fields of teaching and research Program Outcomes and the Program Specific Outcomes are listed below-
2.2	**Program Outcomes (POs) -** On Completion of MCA program, the post-graduates are expected to **PO 01: Engineering Knowledge:** Ability to apply knowledge of computing, science, mathematics and engineering fundamentals appropriate to the discipline **PO 02: Problem Analysis:** Ability to identify, critically analyze, formulate the computing requirements appropriate to its solution and develop computer applications **PO 03: Design/Development of Solutions:** Ability to design, implement and evaluate a computer-based complex system, process, component, or program to meet desired needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations **PO 04: Conduct Investigations of Complex Problems:** Use of research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions and develop Software with complete

	satisfaction to the Customer. **PO 05: Modern Tool Usage:** Ability to apply current technologies, skills, and modern IT tools necessary for computing practice with an understanding of the limitations. **PO 06: The Engineer and Society:** Ability to understand the impact of system solutions in a contemporary, global, economical, environmental and societal context for sustainable development. **PO 07: Environment and Sustainability:** Ability to understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate theknowledge of, and need for sustainable development. **PO 08: Ethics:** Ability to discharge their duties with professional and ethical responsibilities asan individual as well as in multidisciplinary teams with positive attitude. **PO 09: Individual and Team Work:** Ability to function individually in effective manner and on teams, including diverse and multidisciplinary, to accomplish a common goal. **PO 10: Communication:** Ability to communicate effectively with a range of audiences and be customer friendly. **PO 11: Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as amember and leader in a team to manage projects and in multidisciplinary environments and should be economically feasible. **PO 12: Life-Long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological changes.
2.3	**List of Program Specific Outcomes (PSOs):** The post-graduates of Master of Computer Application Program will demonstrate:
	PSO1: Software System Design and Development: The ability to apply software development life cycle principles to design and develop the application software that meets the automation needs of society and industry.
	PSO2: Computing and Research ability: The ability to employ modern computer languages, environments and platforms in creating innovative career paths in SMAC (Social, Mobile,Analytics and Cloud) technologies.
	PSO3: Professionalism and Ethics: Efficient team leaders, effective communicators and capable of working in multi-disciplinary environment following ethical values.
3.1	**Teaching and Learning Process:** The whole process/system for Teaching and Learning Quality Improvement is shown in **Fig.1.1.** The Academic Calendar of the Faculty of Information Technology is based on Syllabus prescribed by the University. The calendar of events of the academic calendar incorporates various industrial visits, guest lectures, technical competitions and short-term courses. The calendar of events is incorporated in framing the Timetable.

3.2 Teaching Learning Process- Flowchart

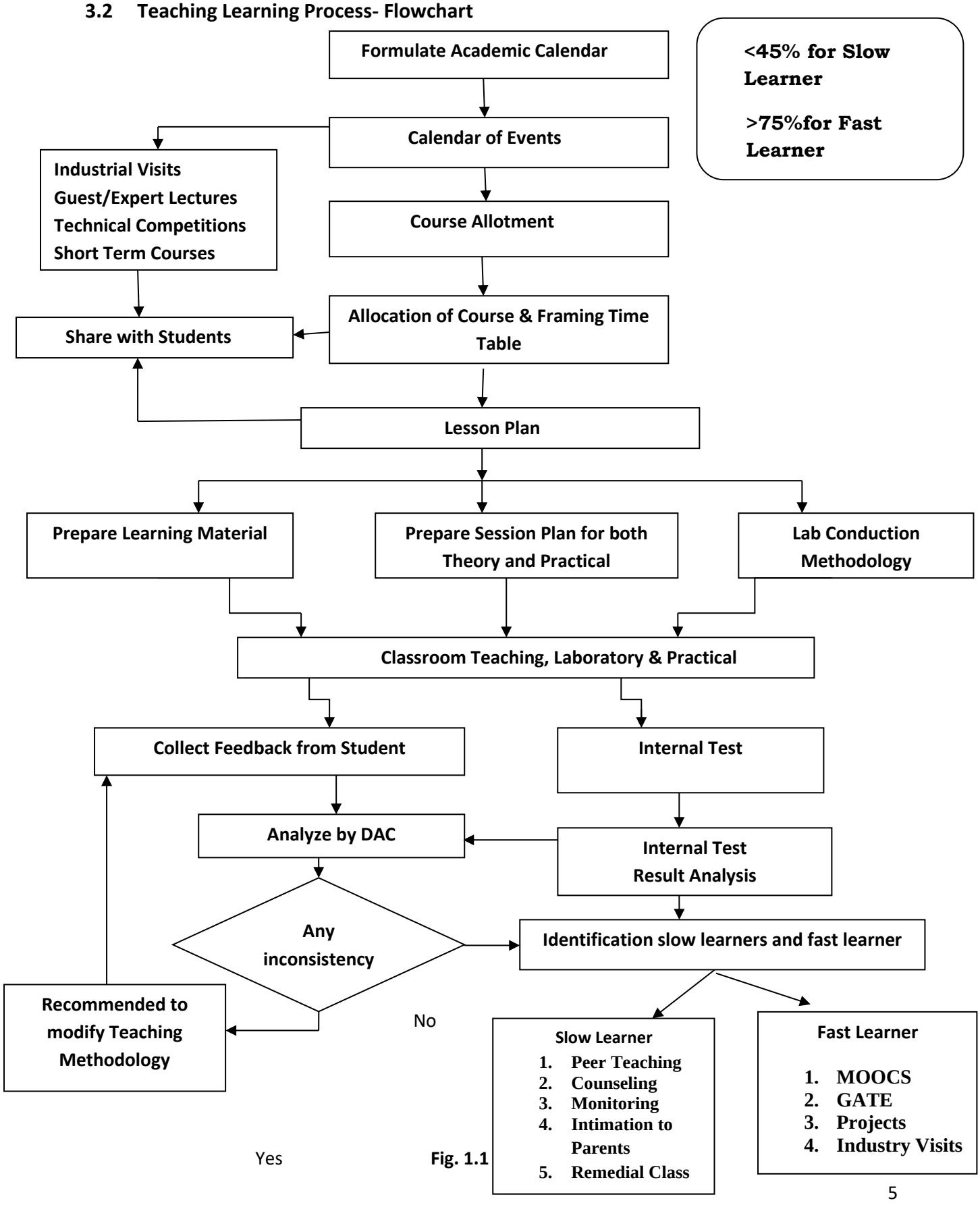

Fig. 1.1

	The academic calendar events and time table are shared with the students. The faculty prepares the lesson plan for the allotted subject. For better delivery of teaching learning process, the faculty prepares the course plan and learning methodology for the allotted subject. The faculty conducts the classes as per the lecture and course plan. Online feedback from the students are collected and analysed by the **Departmental Academic committee** (**DAC**). If any inconsistencies are found by DAC in the teaching learning process, the concerned faculty are advised to modify the teaching methodology and also attend Faculty development programmes. Two internal assessments are conducted for a particular subject per semester. The attainment of COs are analysed for taking remedial actions. **Remedial actions** include identification of **slow, and fast learners.** For the **slow learners (≤45% marks in class test)** the following methods of improvement are adopted- Peer teaching, Counselling, mentoring, intimation to parents and conducting extra classes. **Fast learners (>75% marks in class test)** are motivated to continue the achieve excellency and they are encouraged to participate in co-curricular and extra-curricular activities.
4.	**Gopal Narayan Singh University MCA Admission Rule regulation**
	Admission in MCA. 1st -Semester programme of study shall be made on merit in the Entrance Test conducted by University/Any National or State level Testing Body announced for thepurpose.
	The Faculty shall have an Admission Committee for MCA Postgraduate admission, constituted under the provisions of Ordinances and consisting of the Dean/Director or his nominee and two senior-most members of the teaching staff of the Faculty. Admission shall be made in accordance with these ordinances and the rules which are made under them.
	Admission cannot, however, be claimed by any candidate as a matter of right. The admission or re-admission of a candidate shall be entirely at the discretion of the Admission Committeewhich may refuse to admit any student without assigning any reason there for.
	On his/her selection for admission to the MCA. Semester- I programme, the candidate shall, within the time fixed by the Dean/Director, deposit the fees prescribed for the programme. If the candidate fails to deposit fees within the stipulated time, his/her selection shall automatically stand cancelled.
	Reservation in admission will be made as Govt. of Bihar rules.
	Post Graduate Program Master of Computer Applications
	Eligibility Criteria 1. 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

2. **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.
3. Obtained at least 50% marks (45% marks in case of candidates belonging to reserved category) in the qualifying examination.

(for students having no Mathematics/Computer Science background or not in Critera-1 compulsory bridge course in **Mathematics** and **"Foundations of Computer Science"** will be framed by the University as per the norms).

Admission of NRI and their Reservations

Reservations and admissions to **NRI / Foreign Students / Persons of Indian Origin (PIO) / Children of Indian Workers in the Gulf Countries and Management / InstitutePreference** Quota shall as per the policy laid down by Central government / State government of Bihar. The reservations for SC / ST / OBC (excluding creamy layer) /Minority communities shall be as per the policy laid down by Central government / State government of Bihar.

Intake

Post Graduate	Intake
Master of Computer Applications	60

Documents Required

- Scanned copies of academic details.
- Scanned passport size photograph of the candidate in JPG/JPEG format
- Scanned clear signature of the candidate in JPG/JPEG format
- A valid e-mail ID.
- Scanned copies of Category certificate, PwD certificate, if applicable.
- Migration certificate
- Transfer certificate
- Character certificate

**Other documents if any

Academic Calendar - Each academic session is divided into two semesters of approximately an Odd semester (July- December) and Even semester (January-May).

5. General Course Structure and Theme-

5.1. Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (P) per week	1 Credit

5.2. Range of Credits: **Gopal Narayan Singh University** : The total number of credits proposed for the two year MCA program is **100**.

5.3. Course level coding scheme: Three-digit number (odd numbers are for the odd semester courses and even numbers are for even semester courses) used as suffix withthe Course Code for identifying the level of the course. Digit at hundred's place signifiesthe year in which course is offered.

e.g. 101, 102 … etc. for first year. 201, 202 …. Etc. for second year.301, 302 … for third year.

Sessional (Project, Seminar, etc) e.g. **MC23-281**..i.e 2-Second Sem,8-Sessional, 1- sequence.
Laboratory- **MC23-291**.. ..i.e 2-Second Sem,9-Laboratory, 1- sequence

5.3.Structure of MCA Program: The structure of MCA programme

SEM	THEORY		PRACTICAL		SESSIONAL		Semester Credits [A+B+C]
	Courses	Credits [A]	Courses	Credits [B]	Courses	Credits [C]	
I	4(C) + 1(E)	19	3	6	-	-	25
II	4(C) + 1(E)	19	3	6	-	-	25
III	3(C) + 2(E)	18	1	2	1	5	25
IV	1(O)	3	-	-	2	22	25
(C-Compulsory courses, E-Elective courses, O-Open Elective)					**TOTAL CREDIT→**		**100**

5.4 Course Code and Definition:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
C	Credits
MC	Mandatory courses

5.5.Mandatory Induction Program: The Essence and Details of Induction program can also be understood from the 'Detailed Guide on Student Induction program', as available on AICTE Portal, (Link: https://www.aicteindia.org/sites/default/files/Detailed%20Guide%20on%20Student%20Induction%20program.pdf).

Induction program (mandatory)	**Three-week duration**
Induction program for students to be offered right at the start ofthe first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

6

PART – I

COURSE STRUCTURE

Semester – I

THEORY

Sl. No	Paper Code	Paper Name	Contact Hours / Week				Credit
			L	T	P	Total	
1	MC23-101	Programming Concept with Python	3	1	-	4	4
2	MC23-102	Relational Database Management System	3	1	-	4	4
3	MC23-103	Computer Organization and Architecture	3	1	-	4	4
4	MC23-104	Discrete Mathematics	3	1	-	4	4
5	**Elective I**		3	-	-	3	3
	MC23-E105A/B/C/D/E/F	Environment and Ecology, Management Accounting, Constitution of India, Stress Management through Yoga, Ethics in Business Profession, Managerial Economics					

PRACTICAL

1	MC23-190	Soft Skill and Interpersonal Communication	-	-	4	4	2
2	MC23-191	Python Programming Lab	-	-	4	4	2
3	MC23-192	Relational Database Management System Lab	-	-	4	4	2
Total Weekly Contact Hours and Credit						**31**	**25**

BRIDGE COURSE
[Only for Students of Category "B" stated in the "Eligibility" Section]

A minimum 8-week Online Course on Fundamentals of 'Computer Science' or 'ComputerApplication' or 'Information Technology' or so

Semester - II							
THEORY							
Sl. No.	**Paper Code**	**Paper Name**	**Contact Hours / Week**				**Credit**
			L	T	P	Total	
1	MC23-201	Data Structure using C	3	1	-	4	4
2	MC23-202	Operating System	3	1	-	4	4
3	MC23-203	Object Oriented Programming with JAVA	3	1	-	4	4
4	MC23-204	Networking	3	1	-	4	4
5	**Elective II**		3	-	-	3	3
	MC23-E205A	Numerical and Statistical Analysis					
	MC23-E205B	Computer Graphics					
	MC23-E205C	Probability and Statistics					
	MC23-E205D	Introduction to Cyber Security					
	MC23-E205E	Introduction to IoT					
	MC23-E205F	Automata Theory and Computational Complexity					
PRACTICAL							
1	MC23-291	Data Structure Lab using C	0	1	2	3	2
2	MC23-292	Operating System Lab (Unix)	-	-	4	4	2
3	MC23-293	Object Oriented Programming Lab using JAVA	-	-	4	4	2
Total Weekly Contact Hours and Credit						**30**	**25**
BRIDGE COURSE **[Only for Students of Category "B" stated in the "Eligibility" Section]**							
A minimum 8-week Online Course on Fundamentals of 'Software Engineering' or 'Systems Analysis and Design' or 'Business Systems Applications' or so							

Semester – III

THEORY

Sl. No.	Paper Code	Paper Name	Contact Hours / Week				Credit
			L	T	P	Total	
1	MC23-301	Software Engineering using UML	3	1	-	4	4
2	MC23-302	Artificial Intelligence	3	1	-	4	4
3	MC23-303	Design and Analysis of Algorithm	3	1	-	4	4
4	**Elective III**		3	-	-	3	3
	MC23-E304A	Image Processing					
	MC23-E304B	Web Enabled JAVA Programming					
	MC23-E304C	Cloud Computing					
	MC23-E304D	Web Technology using PHP					
	MC23-E304E	Android Application Development					
	MC23-E304F	Basic Data Science using R					
5	**Elective IV**		3	-	-	3	3
	MC23-E305A	Information Retrieval					
	MC23-E305B	Data Warehousing and Data Mining					
	MCAN-E305C	Introduction to Big Data Analytics					
	MC23-E305D	Graph Theory					
	MC23-E305E	Operation Research and Optimization Techniques					
	MC23-E305F	Pattern Recognition					
	MC23-E305G	Machine Learning					

PRACTICAL

1	MC23-E394 (A/B/C/D/E/F)	Elective III Lab	-	-	4	4	2

SESSIONAL

1	MC23-381	Minor Project and Viva-voce	-	-	8	8	5
	Total Weekly Contact Hours and Credit					**30**	**25**

Semester - IV

THEORY

Sl. No.	Paper Code	Paper Name	Contact Hours / Week				Credit
			L	T	P	Total	
1	**Open Elective**						
	MC23-OE401	Open Elective • Open Electives preferably be opted from the NPTEL/SWAYAM Platform. • While opting for a course for pursuing the Open Elective, a student needs to ensure that: i) The duration of the course must minimum of 12-Weeks. ii) The course must not be covered in previous semesters of the program. iii) Date of Exam and publication of result should be within the tenure of the MCA 4th Semester i.e. January to June of every Year. • Student must submit the course details atthe time of 4th semester enrollment MOOCs basket will be declared at the start of the semester	-	-	-	-	3
SESSIONAL							
1	MC23-481	Comprehensive Viva-voce	-	-	-	-	2
2	MC23-482	Major Project and Viva-voce	-	-	40	40	20
	Total Weekly Contact Hours and Credit					**40**	**25**

7. Evaluation Scheme :

It is advised to refer page numbers 48-51 of the document "Examination Reform Policy November 2018" published by AICTE to get some examples of assessment rubrics (https://www.aicte-india.org/sites/default/files/ExaminationReforms.pdf). There are several good examples of assessment rubrics available on the web when searching with the string "examples of assessment rubrics". There are many good videos available on YouTube on examples and strategies for preparing assessment rubrics.

Since assessment rubrics are not generic in nature and depend on courses, topics, assessment strategies of individual faculties etc., it is suggested that Faculty of Information Technology will follow the following rubrics for Theory, Laboratory and Sessional evaluation.

a. Rubrics for Theory Courses:

The internal assessment will be of 30 marks and end semester examinations will be of 70 marks. For passing the subject the students should obtain at least 40 marks out of 100 (Internal assessment and end semester assessment).

Suggestive rubrics for Internal Assessment: Calculation of Internal assessment number will be Average of Best of three CA plus 5 marks of Attendance.

Continuous Assessment	Activities
CA1	Quiz/ Assignment
CA2	Internal test (Pen and paper)
CA3	PPT presentation/ Group Discussion
CA4	Internal test(Pen and paper)

b. Rubrics for Practical Courses:

The internal assessment will be of 40 marks and end semester laboratory examinations will be of 60 marks. For passing the subject the students should obtain at least 50 marks out of 100 (Internal assessment and end semester assessment).

Sessional Exams- (Project, Seminar, Group Discussion, Internship, Training etc.) end semester examinations will be held for 100 marks. For passing the subject the students should obtain at least 50 marks out of 100 . Evaluation will be based on work done, quality of report, performance in viva-voice, presentation etc. for which rubrics may be designed based on course outcomes. The Project Viva and practical examinations will preferably have external examiners as per rules of the University.

c. Mapping of Marks to Grades

Each course (Theory/Practical)is to be assigned 100 marks, irrespective of the number of credits, and the mapping of marks to grades may be done as per the following table:

Classification	Letter Grade	Score on 100 percentage point	Points
Outstanding	O	100 to 90	10
Excellent	E	89 to 80	9
Very Good	A	79 to 70	8
Good	B	69 to 60	7
Fair	C	59 to 50	6
Below Average	D	49 to 40	5
Failed	F	Below 40	2
Incomplete	I	------	2

d. Promotional Policy: Candidates will be eligible for promotion to the next semester without clearing all end semester theory courses of earlier semesters if,

a. Candidate has minimum attendance percentage of 75% in the previous semester
b. Candidates must have appeared for all internal examinations and has secured marks in Continuous Assessments, Sessional Examinations, Practical Examinations
c. Candidates must have applied for appearing in the end semester examinations and have valid admit card in previous semester

Candidates failed to achieve the minimum benchmarks as mentioned in (a), (b), (c) for promotion will not be eligible for promotion to the next higher semester.

Candidates will appear in the end semester theory examinations as back log candidate in corresponding semester, of subsequent academic year. Marks scored in Continuous Assessments, Sessional Examinations, Practical Examinations during attending regular semester with minimum qualifying attendance would be carried all through. Backlog candidates would be allowed to appear in the end semester examinations only to achieve qualifying marks of the paper concerned. For 7^{th} and 8^{th}Semester backlog students, backlog examinations may be conducted after two months from the date of result publication.

If any candidate fails to secure minimum qualifying marks (pass marks) in sessional or practical examinations would suffer year lag and they have to continue the semester concerned afresh in the

next academic year. In the internal examination of 30 marks -Cumulative Assessment 25 plus 5 marks for attendance.

The marks of a back log paper will be determined from the marks obtained in theory examination and marks of the continuous evaluation of the regular semester. No up-gradation of internal/continuous assessment marks would be allowed.

If any candidates fail to achieve any of the three conditions above (a, b & c) in any semester (say, 1st semester), they would not be allowed to continue their study in the next semester (i.e., 2nd semester) and they have to fulfill the academic regulations by enrolling them in the next academic year from the discontinued semester (i.e. 1st semester) and so on.

However, there would not be any limit of number of back papers to continue their study in subsequent semester as regular candidate.

e. Calculation of DGPA, CGPA for one, two, three and four year programmes.

- Result Status: X=Not eligible for Semester Promotion/Degree; XP=Eligible for Promotion with Backlogs; P=Passed and Promoted.
- The method of calculation of Grade Point Average is as follows
- **SGPA (Semester Grade Point Average)** = $\frac{Credit\ Index}{\sum \text{Credits}}$
- **YGPA (Yearly Grade Point Average)** = $\frac{\text{Credit Index Odd Semester} + \text{Credit Index Even Semester}}{\sum \text{Credits Odd Semester} + \sum \text{Credits Even Semester}}$
- For final **Degree Grade Point Average (DGPA)** the calculation is as under

DGPA = $\frac{\text{YGPA 1} + \text{YGPA2} + 1.5 * \text{YGPA3} + 1.5 * \text{YGPA4}}{5}$

(For 4 Year Course)

DGPA = $\frac{\text{YGPA2} + 1.5 * \text{YGPA3} + 1.5 * \text{YGPA4}}{4}$

(For Lateral Entry Students)

DGPA = $\frac{\text{YGPA 1} + \text{YGPA2} + \text{YGPA3}}{3}$

(For 3 Year Course)

DGPA = $\frac{\text{YGPA 1} + \text{YGPA2}}{2}$

(For 2 Year Course)

DGPA = YGPA1

(For 1 Year Course)

CUMULATIVE GRADE POINT AVARAGE (CGPA)

CGPA = $\frac{\sum_{K=1}^{K=n} Credit\ Index\ of\ k^{th}\ semester}{\sum_{k=1}^{k=n} Credit\ of\ k^{th}\ Semester}$

Where

n = 4 for 2 years programme

n=6 for 3 years programme

n = 8 for 4 years programme

n = 10 for 5 years programme

8.

Student Roll No..... **Student Name: .....**

Academic year: 2023-24
Internal Examinations-I
M.C.A. (Branch), 2023 Batch
1st Semester

Subject Code: **Subject Name**

Time: 1 hours **Max. Marks: 25**

This template is recommended for courses with 4 COs and two In-Sem Tests. Can also be followed for courses with five COs. The COs can be altered in the template depending on the test being conducted.

(Assume any missing data suitably and design adequate hypothesis, if required)

Part-A	**(3X 1M=3M)**
Answer Any Three Questions	
Q. No. 1, 2 from CO1 Preferred to be at lower BTL than the Max BTL of CO1	
Q. No 3, 4 from CO2 Preferred to be at lower BTL than the Max BTL of CO2	
1.	
2.	
3.	
4.	
Part-B	**(2 X 4M=8M)**
Answer Any Two Questions	
Q. No. 5, 6 from CO1 Preferred to be at lower BTL than the Max BTL of CO1	
Q. No 7, 8 from CO2 Preferred to be at lower BTL than the Max BTL of CO2	
5.	
6.	
7.	
8.	
Part-C	**(2 X 7M=14M)**
Answer ALL Questions	
Q. No. 9,10 from CO1 and have an internal choice between Q.No.9 and Q.No.10	
Q. No. 11,12 from CO2 and have an internal choice between Q.No.11 and Q.No.12	
9.	Q. No. 9 from CO1 Preferred to be at lower BTL than the Max BTL of CO1, at least one sub question must be of Max. BTL of the CO1, max 2 sub questions.
(Or)	
10.	Q. No.10 from CO1 Preferred to be at lower BTL than the Max BTL of CO1, at least one sub question must be of Max. BTL of the CO1, max 2 sub questions.
11.	Q. No.11 from CO2 Preferred to be at lower BTL than the Max BTL of CO2, at least one sub question must be of Max. BTL of the CO1, max 2 sub questions.
(Or)	
12.	Q. No.12 from CO2 Preferred to be at lower BTL than the Max BTL of CO2, at least one sub question must be of Max. BTL of the CO1, max 2 sub questions.

Student Roll No..... **Student Name.....**

Academic year: 2023-24
Internal Examinations-II
M.C.A (Branch), 2023 Batch
1st Semester

Subject Code: **Subject Name**

Time: 1 hours **Max. Marks: 25**

This template is recommended for courses with 4 COs and two In-Sem Tests. Can also be followed for courses with five COs. The COs can be altered in the template depending on the test being conducted.

(Assume any missing data suitably and design adequate hypothesis, if required)

Part-A	**(3X 1M=3M)**
Answer Any Three Questions	
Q. No. 1, 2 from CO3 Preferred to be at lower BTL than the Max BTL of CO3	
Q. No 3, 4 from CO4 Preferred to be at lower BTL than the Max BTL of CO4	
1.	
2.	
3.	
4.	
Part-B	**(2 X 4M=8M)**
Answer Any Two Questions	
Q. No. 5, 6 from CO3 Preferred to be at lower BTL than the Max BTL of CO3	
Q. No 7, 8 from CO4 Preferred to be at lower BTL than the Max BTL of CO4	
5.	
6.	
7.	
8.	
Part-C	**(2 X 7M=14M)**
Answer ALL Questions	
Q. No. 9,10 from CO3 and have an internal choice between Q.No.9 and Q.No.10	
Q. No. 11,12 from CO4 and have an internal choice between Q.No.11 and Q.No.12	
9.	Q. No. 9 from CO3 Preferred to be at lower BTL than the Max BTL of CO3, at least one sub question must be of Max. BTL of the CO3, max 2 sub questions.
(Or)	
10.	Q. No.10 from CO3 Preferred to be at lower BTL than the Max BTL of CO3, at least one sub question must be of Max. BTL of the CO3, max 2 sub questions.
11.	Q. No.11 from CO4 Preferred to be at lower BTL than the Max BTL of CO4, at least one sub question must be of Max. BTL of the CO4, max 2 sub questions.
(Or)	
12.	Q. No.12 from CO4 Preferred to be at lower BTL than the Max BTL of CO4, at least one sub question must be of Max. BTL of the CO4, max 2 sub questions.

Student Roll No…….. **Student Name……..**

Academic year: 2023-24
Sem-End Examinations, Nov-Dec 2023
M.C.A (Branch), 2023 Batch
1st Semester

Subject Code: **Name of the Course:**

Time: 3 hours **Max. Marks: 70**

(Assume any missing data suitably and design adequate hypothesis, if required)

	Part-A	**(8 X 4M=32M)**
	Answer ALL Questions	
	Q. No.1.a to 1.h Preferred to be at lower BTL than the Max BTL, No sub questions	
1 a.	Q. No. 1.a from CO1 with Lower BTL Level	
1 b.	Q. No. 1.b from CO1 with Lower BTL Level	
1 c.	Q. No. 1.c from CO2 with Lower BTL Level	
1 d.	Q. No. 1.d from CO2 with Lower BTL Level	
1 e.	Q. No. 1.e from CO3 with Lower BTL Level	
1 f.	Q. No. 1 f. from CO3 with Lower BTL Level	
1 g.	Q. No. 1.g from CO4 with Lower BTL Level	
1 h.	Q. No. 1.h from CO4 with Lower BTL Level	
	Part-B	**(4 X 7M=28M)**
	Answer ALL Questions	
	Q. No. 2 to 4 Preferred to be at lower BTL than the Max BTL, No sub questions and have a internal choice	
2.a	Q. No. 2.a from CO1 with BTL Level	
	(OR)	
2.b	Q. No. 2.b from CO1 with BTL Level	
3.a	Q. No. 3.a from CO2 with BTL Level	
	(OR)	
3.b	Q. No. 3.b from CO2 with BTL Level	
4.a	Q. No. 4.a from CO3 with BTL Level	
	(OR)	
4.b	Q. No. 4.b from CO3 with BTL Level	
5.a	Q. No. 5.a from CO4 with BTL Level	
	(OR)	
5.b	Q. No. 5.b from CO4 with BTL Level	
	Part-C	**(1 X 10M=10M)**
	Answer ANY ONE Question	
	Q. No.6 and 7 preferably be Max BTL and maximum four sub questions with equal marks and may have a link between those questions. *(Question must be based on comprehensive knowledge of course and interconnection of courses)*	
6	Combination of all CO's	
7	Combination of all CO's	

First Year: Semester-I

Code: MC23-101 Paper: Programming Concept with Python
Contacts Hours / Week: 4 **Credit: 4**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Learn, understand and comprehend the concept of programming.
- ✓ Design algorithm to solve simple programming problem.
- ✓ Understand and remember syntax and semantics of Python.
- ✓ Create application using secondary storage.
- ✓ Understand and apply library for data analysis.
- ✓ Apply Python to implement different solutions for the same problem and analyze why one solution is better than theother.
- ✓ To write program for real life problem.

UNIT	COURSE CONTENT
1	**Fundamentals of Computer** History of Computers, Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input& Output devices. Basic Concepts of Assembly language, High level language, Compiler and Assembler. Number systems (decimal, octal and hexadecimal) with signed and unsigned numbers (using 1's and 2'scomplement) - their representation, conversion and arithmetic operations. Packed and unpacked BCD system, ASCII. IEEE-754 floating point representation (half- 16 bit, full- 32 bit, double-64 bit).
2	**Programming Basics** Problem analysis, Flowchart, algorithms, Pseudo codes, structured programming, Example of Flowchart andAlgorithm representation
3	**Variable and Expression** Variables as names for values; expressions (arithmetic and logical) and their evaluation (operators, associativity, precedence). Assignment operation; difference between left hand side and right hand side of assignment, Consoleinput/output: taking input from user and printing user information.
4	**Control Statement and Iteration** If statement, else-if statement, multiple statements within if, multiple if statement. While Loop, For Loop, NestingLoops, Controlling Loops using Break and Continue, Else Statement, Range Statement and Pass Statement in Loop.
5	**Collections** Strings, List, Tuples, Dictionary, Set, Selection sort, Bubble sort
6	**Function** Built in function, user defined function, function passing values, function returning values, default parameter values,Recursive function
7	**File Management** Operations on files (opening, modes, attributes, encoding, closing), read() & write() methods, tell() & seek()methods, renaming & deleting files and directories
8	**Errors and Exception Handling** Dealing with syntax errors, Exceptions, Handling exceptions with try/except, Cleaning up with finally
9	**Classes and Objects** Create a Class, Create Object,_Init_() Function, Methods, Self-Parameter, Modification and Deletion of Object Parameter, Deletion of Object, Pass Statement, Inheritance and Polymorphism, Scope, Module, Built-In MathFunction, Math Module, Module datetime and Date Objects, RegEx Module andRegEx Functions, Exception Handling.
10	**Modules& Packages** Importing a module, Creating module, Function aliases, packages
11	**Numpy** ndArray, Pandas: reading files, exploratory data analysis, data preparation and processing, , Matplolib: Scatterplot,Line plot, Bar plot, Histogram, Box plot, Pair plot

Reference Books:

- N.S. Gill, Handbook of Computer Fundamentals, Khanna Publishing House
- Dr.Jeeva Jose-Taming Python by Programming, Khanna Publishing
- Martin C. Brown – The Complete Reference Python, Mc Graw Hill
- A. Martelli, A. Ravenscroft, S. Holden, Python in a Nutshell,OREILLY.
- Jason Rees-Python Programming:Practical introduction to Python Programming for total beginners,
- Anthony Brun - Python Programming: A Step By Step Guide From Beginner To Expert (Beginner,Intermediate & Advanced)
- Mark Pilgrim-Diva into Python, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG
- Summerfield Mark- Programming in Python 3,Pearson Education India

Code: MC23-102 **Paper: Relational Database Management System**
Contacts Hours / Week: 4 **Credit: 4**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Identify the need for a database over the file system.
- ✓ Understand and implement the process of data insertion, retrieval, and manipulation.
- ✓ Understand and analyze the functional dependencies among attributes of the entity set and normalization betweenthe relations.
- ✓ Implement SQL concept for a database transaction.
- ✓ Understand and Implement the Transaction control and concurrency control management.
- ✓ Evaluate the relational tables, PL/SQL programs, triggers, database files, indexing of RDBMS.

UNITS	COURSE CONTENT
1	**Basic Concept** Database Management System , File based system, Advantages of DBMS over file based system, Database Approach, Logical DBMS Architecture, Three level architecture of DBMS or logical DBMS architecture, Need for three level architecture, Physical DBMS Architecture, Database Administrator (DBA) Functions & Role, Data files indices and Data Dictionary Types of Database, Relational and ER Models: Data Models , Relational Model, Domains, Tuple and Relation, Super keys, Candidate keys , Primary keys and foreign key for the Relations, Relational Constraints, Domain Constraint, Key Constraint , Integrity Constraint,- Update Operations and Dealing with Constraint Violations, Relational Operations **Entity Relationship (ER) Model:** Entities, Attributes, Relationships,More about Entities and Relationships, Conversion of E-R Diagram to Relational Database.
2	**Database Integrity And Normalization** Relational Database Integrity, The Keys, Referential Integrity, Entity Integrity, Redundancy and Associated Problems, Single Valued Dependencies, Normalization, Rules of Data Normalization, The First Normal Form, The Second Normal Form, The Third Normal Form, Boyce CODD Normal Form, The Fourth Normal Form, The Fifth Normal Form, Multi-valued Functional Dependency, Attribute Preservation,Losslessjoin Decomposition, Dependency Preservation.

3	**File Organization** Physical Database Design Issues, Storage of Database on Hard Disks, File Organization and Its Types, Heap files (Unordered files), Sequential File Organization, Indexed (Indexed Sequential) File Organization, Hashed File Organization, Types of Indexes, Index and Tree Structure, Multi-key File Organization, Need for Multiple Access Paths, Multi-list File Organization, Inverted File Organization.
4	**Structured Query Language (SQL)** Meaning, SQL commands, Data Definition Language, Data Manipulation Language, Data Control Language, Transaction Control Language, Queries using Order by, Where, Group by, Nested Queries. Joins, Views, Sequences, Indexes and Synonyms, Table Handling.
5	**Transaction and Concurrency Management** Transactions, Concurrent Transactions, Locking Protocol,Serializable Schedules, Locks Two Phase Locking(2PL), Deadlock and its Prevention, Optimistic& Pessimistic Concurrency Control. Database Recovery and Security: Database Recovery meaning, Kinds of failures, Failure controlling methods, Database errors, Backup& Recovery Techniques, Security & Integrity, Database Security Authorization.
6	**PL/SQL** Introduction to PL/SQL, Variables & Data types, Basic blocks, Conditional & branching statement, Handlingof Cursor, Trigger, Function, Procedure, Package and Exception.

Reference Books:

- Silverchatz, Korth&Sudarshan-Data Base System Concepts, MH.
- Elmasri, Navathe- Fundamentals of Database Systems, Pearson
- C J date-An Introduction to Database, Addison-Wesley Publishing Company
- Majumder& Bhattacharyya-Data Base Management Systems, TMH
- Feuerstein-Oracle PL/SQL Programming,SPD/O'REILLY
- Leon-Data Base Management Systems, VIKAS
- Kroenke-Data Base Processing:Fundamentals, Design &Implementation,PHI
- P.S Deshpande-SQL PL/SQL for Oracle 8 & 8i, Wiley Dreamtech
- P. Bhatia, S. Bhatia, G. Singh- Concepts of Database Management System, Kalyani Publishers
- R.P. Mahapatra, Database Management Systems, Khanna Publishing House (AICTE Recommended)

Code: MC23-103 **Paper: Computer Organization and Architecture**

Contacts Hours / Week: 4 **Credit: 4**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Describe the merits and pitfalls in computer performance measurements and analyze the impact of instruction setarchitecture on cost-performance of computer design
- ✓ Explain Digital Logic Circuits, Data Representation, Register and Processor level Design and Instruction Setarchitecture
- ✓ Solve problems related to computer arithmetic and Determine which hardware blocks and control lines are used forspecific instructions
- ✓ Design a pipeline for consistent execution of instructions with minimum hazards
- ✓ Explain memory organization, I/O organization and its impact on computer cost/performance.

UNITS	COURSE CONTENT
1	**INTRODUCTION** **Digital Logic Design:** Axioms and laws of Boolean algebra, Reduction of Boolean expressions, conversion between canonical forms, Karnaugh map (4 variable), Half Adder, full adder, 4-bitparallel parity bit generator, checker circuit, Decoder, Encoder, Multiplexer, IC RAM, ROM, Memory Organization, Sequential Circuits, Statetransistors, Flip-flop, RS, JK, D-Latch, Master-slave.
2	**INSTRUCTION SET ARCHITECTURE:** **Memory Locations and Addresses:** Byte Addressability, Big-Endian and Little-Endian Assignments, Word Alignment, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Subroutines, Additional Instructions, dealing with 32-Bit Immediate Values.

3	**BASIC PROCESSING UNIT & PIPELINING** **Basic Processing Unit:** Some Fundamental Concepts, Instruction Execution, Hardware Components, Instruction Fetch and Execution Steps, Control Signals, Hardwired Control, CISC-Style Processors. **Pipelining:** Basic Concept, Pipeline Organization, Pipelining Issues, Data Dependencies, Memory Delays, Branch Delays, Pipeline Performance Evaluation.
4	**MEMORY ORGANIZATION** Basic Concepts, Semiconductor RAM Memories, Read-only Memories, Direct Memory Access, MemoryHierarchy, Cache Memories, Performance Considerations, Virtual Memory, Memory Management Requirements, Secondary Storage.
5	**INPUT OUTPUT & PARALLEL PROCESSING** **Basic Input Output:** Accessing I/O Devices, Interrupts, Input Output Organization: Bus Structure, BusOperation, Arbitration, Interface, Interconnection Standards. Parallel Processing: Hardware Multithreading, Vector (SIMD) Processing, Shared-Memory Multiprocessors, Cache Coherence, Message-PassingMulticomputer, Parallel Programming for Multiprocessors, Performance Modeling.

Reference Books:

- Computer Organization and Embedded Systems, 6thEdition, Hamacher Carl, et. al, Tata McGrawHill, New Delhi, 2011.
- Computer Organization and Design: The Hardware Software / Interface, 5thEdition, 1994, Patterson David A.
- Computer System Architecture, Revised 3rdEdition, Mano M. Morris,Pearson Education,

Code: MC23-104 **Paper: Discrete Mathematics**
Contacts Hours / Week: 4 **Credit: 4**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Interpret the problems that can be formulated in terms of graphs and trees.
- ✓ Explain network phenomena by using the concepts of connectivity, independent sets, cliques, matching, graph coloringetc.
- ✓ Achieve the ability to think and reason abstract mathematical definitions and ideas relating to integers throughconcepts of well-ordering principle, division algorithm, greatest common divisors and congruence.
- ✓ Apply counting techniques and the crucial concept of recurrence to comprehend the combinatorial aspects ofalgorithms.
- ✓ Analyze the logical fundamentals of basic computational concepts.
- ✓ Compare the notions of converse, contrapositive, inverse etc. in order to consolidate the comprehension of the logicalsubtleties involved in computational mathematics.

UNITS	COURSE CONTENT
1	**Logic and Proofs** Propositional logic, Propositional equivalences, Predicates and quantifiers, Nested quantifiers, Rules of inference.
2	**Principles of Mathematical Induction** The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest CommonDivisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.
3	**Sets and Sequence** Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Fuzzy set, Basic properties of fuzzy set.
4	**Counting and Combinatorics** Counting, Sum and product rule, Principle of Inclusion Exclusion. Pigeon Hole Principle, Counting by Bijections. Double Counting. Linear Recurrence relations - methods of solutions. Generating Functions. Permutations and Combination.

5	**Algebraic Structure** Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form
6	**Graph and Tree** Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and HamiltonianWalks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.

Reference Books:

- S.B. Singh, Discrete Structures, Khanna Book Publishing, Delhi
- Kandel& Baker- Discrete Mathematics for Comp. Scientists & Mathematicians, Mott, PHI
- C.L.Liu- Discrete Mathematical Structure, C.L.Liu,TMH
- G.S.RAO- Discrete Mathematical Structure, New Age International
- DeoNarsingh - Graph Theory With Applications To Engineering And Computer Science, PHI Learning
- Arumugam, Ramachandran- Invitation to Graph Theory, Scitech Publications (India)

Code: MC23-E105A **Paper: Environment and Ecology**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Be able to understand the natural environment and its relationships with human activities.
- ✓ Be able to apply the fundamental knowledge of science and engineering to assess environmental and health risk.
- ✓ Be able to understand environmental laws and regulations to develop guidelines and procedures for health andsafety issues
- ✓ Be able to solve scientific problem-solving to air, water, noise and land pollutions.

UNITS	COURSE CONTENT
1	**Introduction** Basic ideas of environment and interrelationship among man society and environment. Environmental problems and issues, Segments of environments, Natural Cycles of environmentsMathematics of population growth and its associated problems, Logistic population growth
2	**Elements of Ecology** Open and closed system ecology, species, population, community, definition of ecosystem-components typesand functions, Environmental perspectives, Montreal protocol
3	**Pollutants and Contaminants** Definition of primary and secondary pollutants and contaminants. Source and effects of different air pollutantssuspended particulate matter, oxides of carbon, nitrogen, sulphur particulate
4	**Air Pollution** Structures of the atmosphere, global temperature models, Greenhouse effect, global warming; acid rain: causes,effects and control. Lapse rate and atmospheric stability; pollutants and contaminants; smog; depletion of ozone layer; standards and control measures of air pollution.
5	**Water Pollution** Hydrosphere; pollutants of water: origin and effects; oxygen demanding waste; thermal pollution; pesticides; salts. Biochemical effects of heavy metals; eutrophication: source, effect and control. Water quality parameters:DO, BOD, COD. Water treatment: surface water and wastewater.
6	**Land Pollution** Land pollution: sources and control; solid waste: classification, recovery, recycling, treatment and disposal.
7	**Noise Pollution** Noise: definition and classification; noise frequency, noise pressure, noise intensity, loudness of noise, noisethreshold limit value; noise pollution effects and control.

Reference Books:

- Environmental Studies, M.P. Poonia & S.C. Sharma, Khanna Publishing House.
- Basic Environmental Engineering and Elementary Biology, GourKrishna Das Mahapatra, VikasPublishing House P. Ltd.
- Environmental Chemistry, A. K. De, New Age International.
- Environmental Engineering, G.M.Masters, Tata Mc Graw Hills
- Environmental Chemistry with Green Chemistry, A. K. Das, Books and Allied P. Ltd.
- Fundamentals of Environment & Ecology, D. De, D. De, S. Chand & Company Ltd.

Code: MC23-E105B **Paper: Management Accounting** **Contacts Hours / Week: 3** **Credit: 3**	
Course Outcome: After successful completion of this course, students will be able to: ✓ Understand the basic concepts related to Business. ✓ Demonstrate the roles, skills and functions of different discipline of business management. ✓ To disseminate knowledge among the students inculcate with theoretical structures about banking system ✓ Record basic accounting transactions and prepare annual financial statements; and analyse, interpret and communicatethe information contained in basic financial statements ✓ Analyse and provide recommendations to improve the operations of Organisations through the application of Cost andManagement accounting techniques ✓ Equip students with in-depth and expert knowledge of Tally ERP with GST.	
UNITS	**COURSE CONTENT**
1	**Introduction** Basics of management; Planning, scheduling, organizing, staffing, directing, controlling
2	**Management** Marketing Management, Financial management, Operation management,Human resource management, Management information System
3	**Strategy** Firm and its environment, strategies and resources, industry structure and analysis, corporate strategies and itsevaluation, strategies for growth and diversification, strategic planning
4	**Business Trade and Banking (3L)** Business: Types of business, Sole Proprietorship, Partnership, Limited company and cooperative society – theircharacteristics. Banking: role of commercial banks; credit creation and its importance in industrial functioning. Role of centralbank: Reserve Bank of India. International Business or Trade Environment.
5	**Financial Accounting** Journals, Ledgers, Trial Balance, Profit & Loss Account, Balance Sheet, Financial ReportingFinancial Statement Analysis and Interpretation (Financial Ratio and Cash Flow analysis)
6	**Cost Accounting** Concepts and Classification of costs, Cost Sheet Break Even Analysis, Variance Analysis, Cost-volume profit (CVP) relationship, Cash Budgeting
7	**Packages** Financial accounting computer package (Tally ERP with GST)
Reference Books: • Financial Accounting- A Managerial Perspective, R. Narayanswami, Prentice-Hall of India Private Limited. NewDelhi • Fundamentals of Financial Management, Horne, James C Van, Prentice-Hall of India Private Limited, New Delhi • Modern Economic Theory, H. L. Ahuja., S. Chand. New Delhi. • Management Accounting, Khan & Jain, TMH • Management Accounting,M.E.ThukaramRao,New Age International	

Code: MC23-E105C **Paper: Constitution of India**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- ✓ To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement tocivil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- ✓ To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impacton the initial drafting of the Indian Constitution.

UNITS	COURSE CONTENT
1	**History of Making of the Indian Constitution** History Drafting Committee, (Composition & Working)
2	**Philosophy of the Indian Constitution** Preamble Salient Features
3	**Contours of Constitutional Rights & Duties** Fundamental Rights, Right to Equality, Right to Freedom ,Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.
4	**Organs of Governance** Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President,Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions
5	**Local Administration** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy
6	**Election Commission** Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission:Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Reference Books:

- The Constitution of India, 1950 (Bare Act), Government Publication.
- Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
- M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Code: MC23-E105D **Paper: Stress Management through Yoga**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ To achieve overall health of body and mind
- ✓ To overcome stress

UNITS	COURSE CONTENT
1	**Astanga** Definitions of Eight parts of Yoga (Ashtanga)
2	**Yam and Niyam** Do`s and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan
3	**Asan and Pranayam** i) Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects-Typesof pranayama
4	**Meditation Techniques**

Reference Books:

- Janardan Swami Yogabhyasi Mandal- Yogic Asanas for Group Tarining-Part-I, Nagpur
- Swami Vivekananda- Rajayoga or conquering the Internal Nature, AdvaitaAshrama (Publication Department),Kolkata

Code: MC23-E105E **Paper: Ethics in Business Profession**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Earn about morals, values & work ethics, Learn to respect others and develop civic virtue.
- ✓ Learn about the ethical responsibilities of the engineers, create awareness about the customs and religions, InstallMoral and Social Values and Loyalty and to appreciate the rights of others.
- ✓ Demonstrate knowledge to become a social experimenter, Provide depth knowledge on framing of the problem anddetermining the facts.
- ✓ Create awareness about safety, risk & risk benefit analysis, Provide knowledge on Intellectual Property Rights.
- ✓ Develop knowledge about global issues, Create awareness on computer and environmental ethics, Analyze ethicalproblems in research.

UNITS	COURSE CONTENT
1	**Human Values** Morals, Values and Ethics-Integrity-Work Ethic-Service learning, Civic Virtue, Respect for others, Living Peacefully, Caring, Sharing, Honesty, Courage-Cooperation, Commitment, Empathy, Self Confidence Character.
2	**Professional Ethics** Senses of 'Professional Ethics-Variety of moral issued, Types of inquiry, Moral dilemmas, Moral autonomy, Kohlberg's theory-Gilligan's theory, Consensus and controversy, Models of professional roles, Theories aboutright action, Self-interest, Customs and religion.
3	**Professional As Social Experimentation** Profession As Social Experimentation, Framing the problem, Determining the facts, Codes of Ethics, ClarifyingConcepts, Application issues, Common Ground, General Principles, Utilitarian thinking respect for persons.
4	**Safety, Responsibilities And Rights in Profession** Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect forAuthority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination
5	**Global Issues** Globalization, Cross culture issues-Environmental Ethics, Computer Ethics –Computers as the instrument ofUnethical behavior, Computers as the object of Unethical acts, Autonomous Computers, Computer codes of Ethics, Moral Leadership, Code of Conduct, Corporate Social Responsibility. Ethics and Research, AnalyzingEthical Problems in research.

Reference Books:

- Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi.
- A. R. Aryasri, DharanikotaSuyodhana "Professional Ethics and Morals" Maruthi Publications.
- Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi.
- John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi.

Code: MC23-E105F	**Paper: Managerial Economics**
Contacts Hours / Week: 3	**Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ To understand applications of managerial economics.
- ✓ To understand and interpret demand function,
- ✓ To assess the relationships between short-run and long-run costs.
- ✓ To analyze perfectly competitive markets including substitution.
- ✓ To explain uniform pricing and how it relates to price discrimination and total revenue.
- ✓ To analyze the causes and consequences of different market conditions.
- ✓ To integrate the concept of price and output decisions of firms under various market structure.

UNITS	COURSE CONTENT
1	**Introduction** Introduction to Managerial Economics, Basic problems of an economic system; Goals of managerial decisionmaking; Resource allocation using PPC
2	**Demand Analysis** A. Demand Functions - Law of Demand, Explaining the law of demand, Violations of theLaw of Demand, Shifts in Demand; Elasticity of Demand: Price Elasticity (at a point andover and interval), Factors affecting price elasticity, Price elasticity and Change in TotalRevenue, AR, MR and Price elasticity, Range of Values of Price Elasticity; IncomeElasticity, Inferior, Superior and Normal goods, Income Elasticity and Share in TotalExpenditure; Cross- Price Elasticity, Substitutes and ComplementsIndifference curves, budget line and consumerequilibrium Introduction to methods of demand estimation (concepts only)
3	**Production and Cost Analysis** Production Function, Short Run and Long Run, Production with One Variable Input,Total Product, Average and Marginal Products, Law of Variable proportions,Relationship between TP, AP and MP. Short Run Costs of Production, Fixed and Variable Costs, Short Run Total, Average andMarginal Cost and Relationship between them, Short Run Cost Curves, Relationshipbetween AVC, MC, AP and MP; Long run cost curves, Relationship between LAC andSAC, Economies of Scale and Scope. Production with Two Variable Inputs, Isoquants – Characteristics, Margina Rate of Technical Substitution, Laws of Returns to Scale, Isocost Curves, * # Finding the Optimal Combination of Inputs, Production of a given output at Minimum Cost, Production of Maximum Output with a given level of Cost, Expansion Path, Finding the Long Run Cost Schedules from the Production Function,
4	**Alternate Goals of Managerial Firms** Profit maximization; Revenue maximization; Managerial utility maximization
5	**Managerial Decision Making under Alternative Market Structures** . Characteristics of Perfect Competition, #Profit Maximization in Competitive Markets, Output Decision in the ShortRun, Shut Down Point, Short Run Supply for the Firm and Industry; Output Decision in the Long Run, Break Even Point, Long Run Supply for the Perfectly Competitive Industry. Price and output decision under different market structure – Monopoly, MonopolisticCompetition, Oligopoly – cartel, price leadership.
6	**Pricing Decisions** Price Discrimination under Monopoly, Transfer Pricing.Market Failure Game theory &Asymmetric information

Reference Books:

- Sociology & Economics for Engineers, Khanna Publishing, Delhi,
- Damodaran, Suma – Managerial Economics – Oxford University Press
- Lipsey & Chrystal – Economics – Oxford University Press
- Peterson & Lewis – Managerial Economics – Pearson Education.
- Pindyck and Rubenfeld - Micro Economics – Pearson Education
- H.L. Ahuza- Managerial Economics, S. Chand
- D.N. Dwivedi- Managerial Economics, Prentice Hall.

Code: MC23-190 **Paper: Soft Skill and Interpersonal Communication**
Contacts Hours / Week: 4 **Credit: 2**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Effectively communicate through verbal/oral communication and improve the listening skills
- ✓ Able to be self-confident with positive vibes
- ✓ Actively participate in group discussion / meetings / interviews and prepare & deliver presentations
- ✓ Become more effective individual through goal/target setting, self-motivation and practicing creative thinking.
- ✓ Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality.

UNITS	COURSE CONTENT
1	**Soft Skills& Interpersonal Communication** An Introduction – Definition and Significance of Soft Skills; Process, Importance and Measurement of Soft Skill Development. Inter personal relations; communication models, process and barriers; team communication; developing interpersonal relationships through effective communication; listening skills; essential formal writing skills; corporate communication styles –assertion, persuasion, negotiation.
2	**SWOT & Creative Thinking** Discovering the Self; Setting Goals; Beliefs, Values, Attitude, Virtue. Developing Positive Thinking and Attitude; Driving out Negativity; Meaning and Theories of Motivation;Enhancing Motivation Levels.
3	**Corporate Communication** **Public Speaking:** Skills, Methods, Strategies and Essential tips for effective public speaking. **Group Discussion:** Importance, Planning, Elements, Skills assessed; Effectively disagreeing, Initiating,Summarizing and Attaining the Objective. **Interview& Presentation Skills:** Interviewer and Interviewee– in-depth perspectives. Before, During and After theInterview. Tips for Success: Types, Content, Audience Analysis, Essential Tips – Before, During and After, OvercomingNervousness.
4	**Non-Verbal Communication & Personality Development** Importance and Elements;Body Language. Concept, Essentials, Tipsc Meaning, Nature, Features, Stages, Models; Learning Skills; Adaptability Skills.
5	**Business Etiquette & Team Work** Concept of Teams; Building effective teams; Concept of Leadership and honing Leadership skills.Meaning, Nature, Features, Stages, Models; Learning Skills; Adaptability Skills.

Reference Books:

- Managing Soft Skills for Personality Development – edited by B.N.Ghosh,McGraw Hill India, 2012.
- Effective Communication and Soft Skills, Nitin Bhatnagar, Pearson Education India, 2011
- English and Soft Skills – S.P.Dhanavel, Orient Blackswan India, 2010.
- Effective Business Communication, Kulbhushan Kumar, Khanna Publishing House, 2021.

Code: MC23-191	**Paper: Python Programming Lab**
Contacts Hours / Week: 4	**Credit: 2**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ To write simple programs relating to different logical problems.
- ✓ To be able to interpret, understand and debug syntax errors reported by the compiler.
- ✓ Understand and implement the native data types (Python in this course)
- ✓ To implement conditional branching, iteration.
- ✓ To decompose a problem intofunctions.
- ✓ To be able to create, read from and write into simple text files.
- ✓ To understand the basic concept of OOPs
- ✓ To understand and implement Python NumpyArrray operations

UNITS	COURSE CONTENT
1	**Python Basics:** Installing Python, Setting up Path and Environment Variables, Running Python, First Python Program
2	**Python Data Types & Input/output:** Keywords, Identifiers, Python Statement, Indentation, Documentation,Variables, Multiple Assignment, Understanding Data Type, Data Type Conversion, Python Input and Output Functions, Import command.
3	**Operators and Expressions:** Operators in Python, Expressions, Precedence, Associativity of Operators, Non Associative Operators.
4	**Control Structures:** Decision making statements, Python loops, Python control statements.
5	**Python Native Data Types:** Numbers, Lists, Tuples, Sets, Dictionary, Functions & Methods of Dictionary, Strings(in detail with their methods and operations).
6	**Python Functions:** Built-in Functions, User defined functions, Anonymous functions, Pass by value,Pass by Reference, Recursion
7	**Exception Handling:** Exceptions, Built-in exceptions, Exception handling, User defined exceptions in Python.
8	**File Management in Python:** Operations on files (opening, modes, attributes, encoding, closing), read() & write() methods, tell() & seek() methods, renaming & deleting files in Python, directories in Python.
9	**Python OOPs** Python OOPs Concepts, Object Class, Constructors, Inheritance
10	**Python Numpy** Numpy data types, Operations on Numpy Array (indexing,slicing, shape/reshape, iteration, join, split, search, sort,filter)

Code: MC23-192 **Paper: Relational Database Management System Lab**
Contacts Hours / Week: 4 **Credit: 2**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Learn to use Entity Relationship Diagram (ERD) model as a blueprint to develop the corresponding relational model ina RDBMS system like Oracle DBMS.
- ✓ Apply DDL component of Structured query language (SQL) to create a relational database from scratch throughimplementation of various constraints in Oracle RDBMS system.
- ✓ Apply DML component of Structured query language (SQL) for storing and modification of data in Oracle RDBMSsystem.
- ✓ Apply DQL component of Structured query language (SQL) to construct complex queries for efficient retrieval of datafrom existing database as per the user requirement specifications.
- ✓ Conceptualize and apply various P/L SQL concepts like cursor, trigger in creating database programs.
- ✓ Develop a fully-fledged database backend system using SQL and P/L SQL programming to establish overall integrityof the database system.
- ✓ Implement PL/SQL function, Procedure and Package and Apply Exception.

UNITS	COURSE CONTENT
1	**Creation of a database based on given ERD Model:** SQL Data Definition Language (DDL) Create (and Alter) table structure, Apply (and Alter) constraints on columns/tables viz., primary key, foreign key, unique, not null, check. Verify/ Review the table structure (along with applied constraints) using appropriate data dictionary tables like user_constraints, user_cons_columns, etc. Create view, materialized view using one or more table. SQL Data Manipulation Language (DML) Insert into rows (once at a time/ and in bulk) from a table, Update existing rows of a table, Delete rows (a few or all rows) from a table.
2	**Data Query Language (DQL)** Basic select-from-where structure - Usage of Top, Distinct, Null keywords in query, Using String and Arithmetic Expressions, Exploring Where Clause with various Operators and logical combination of various conditions,Sorting data using Order By clause. Usage of IN, LIKE, ALL keywords. Introduction to Joins, Natural Joins, equi-join, non-equi-join, Self-Join, Inner Join, Outer (left, right) Join.Set operations: Unions, Intersect, minus set operations on table data using SQL.Using single row functions in Queries NVL function (to handle ambiguity of null data), upper, lower, to_date, to_char functions, etc. Using group/multiple row functions in Queries like Count, Sum, Min, Max, Avg, etc, using Group By and HavingClause, Using Group By with Rollup and Cube. Sub-query - Working with various nested structure of Sub Queries - use in from or where clause with more than onelevel of nesting, correlated sub-query- Ranking table data using correlated sub-query.
3	**PL/SQL** Stored Procedures and Functions- Basic programming constructs of PL / SQL like if, else, else-if, loop, while, for structure Populate stored procedure variables with the data fetched from table using SQL command. Working with Cursors - Creating Cursors, parameterized cursor, Locks on cursors, Exploring advantages of cursors.Introduction to triggers - Constraints Vs Triggers, Creating, Altering, Dropping triggers, use of for/ after/ instead of triggers, Using trigger to validate/ rollback a Transaction, Automatically populate integer data based primary key columns (e.g., Id.) using trigger. Handling Function, Procedure & Package – Create Function, Create Procedure and Create Package.Exception Handling.

First Year: Semester-II

Code: MC23-201	**Paper: Data Structure using C**
Contacts Hours / Week: 4	**Credit: 4**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Understand the concept of abstract data type such as stack, queue, linked list, and trees
- ✓ Chose appropriate data structure to design algorithm to solve the problem.
- ✓ Analyze the algorithms in the context of efficiency.
- ✓ Apply the knowledge of stack and queue to design algorithm
- ✓ Design application using sorting, searching and the concept of tree.

UNITS	COURSE CONTENT
1	**Introduction** Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.;Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity
2	**Stacks and Queues** ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: ExpressionConversion and evaluation – corresponding algorithms and complexity analysis. ADT, queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queue:Algorithms and their analysis.
3	**Linked Lists** Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertioninto, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.
4	**Trees** Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVLTree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.
5	**Graph** Graph Terminology, Representation of graphs, Path Matrix, Graph Traversal, BFS, DFS, Minimum Spanning Tree,Kruskal's Algorithm and Prim's Algorithm.
6	**Sorting** Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort,Merge Sort, Heap Sort; Performance and Comparison among all the methods.
7	**Hashing** Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, OpenAddressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Code: MC23-202	**Paper: Operating System**
Contacts Hours / Week: 4	**Credit: 4**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Describe the main components of OS and their working
- ✓ Explain the concepts of process and thread and their scheduling policies
- ✓ Explain the various memory management techniques
- ✓ Compare the different techniques for managing memory, I/O, disk and files
- ✓ Explains the security and protection features of an Operating System

UNITS	COURSE CONTENT
1	**Introduction** Generations Concept of Operating systems, Systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Real Time Operating Systems, Distributed Operating Systems, Multiprocessor Operating System. **Case Study:** Architecture of Unix and Windows Operating Systems
2	**Process Management** **Processes and Threads**: 7 state process model, Process scheduling, Operations on processes, Inter-processcommunication, Threads overview, Benefits of threads, User and kernel threads. **CPU Scheduling:** Scheduling criteria, Preemptive & non-preemptive scheduling, Scheduling algorithms (FCFS, SJF, RR, Priority, Multi-level queue, Multi-level feedback queue), Comparative study of the algorithms, Multi- processor scheduling. **Process Synchronization**: Background, Critical section problem, Software solution – Peterson and Bakery algorithm, Synchronization hardware, Semaphores, Classical problems of synchronization. **Deadlocks:** System model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock. **Case Study:** Scheduling on Unix and Windows Operating Systems
3	**Memory Management** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation– Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation Hardware support for paging, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms(Optimal, FIFO, SC, NRU and LRU), Thrashing **Case Study:** Unix Virtual Memory, Windows Virtual Memory
4	**File Systems and I/O Management** File concept, Fundamental File System Organization and Access Methods, Directory structure, File system structure, Allocation methods (Contiguous, Linked, Indexed), Free-space management (Bit vector, Linked list, Grouping), Directory Implementation (Linear list, Hash table), Efficiency and Performance. PC Bus Structure, I/O connections, Data transfer techniques (Programmed, Interrupt driven, DMA), Bus arbitration (Daisy chain, Polling, Independent request), Blocking and non-blocking I/O, Kernel I/O subsystem (Scheduling, Buffering, Caching, Spooling and device reservation, Error handling). **Case Study:** UnixFile System, Windows File System
5	**Security and Protection:** Overview of Security and Protection, Goals of Security and Protection, Security Attacks, Formal and Practical aspects of Security, Encryption, Authentication and Password Security, Access Descriptors and the Access Control Matrix, Protection Structures, Capabilities, **Case Study:** Unix Security, Windows Security.

Reference Books:

- Operating System Concepts Essentials, 10th Edition by Avi Silberschatz, Peter Galvin, Greg Gagne, WileyAsia Student Edition.
- Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
- Operating System Concepts, Ekta Walia, Khanna Publishing House (AICTE Recommended Textbook – 2018)
- Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
- Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison- Wesley
- Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
- Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

Code: MC23-203 **Paper: Object Oriented Programming with JAVA**
Contacts Hours / Week: 4 **Credit: 4**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Use the characteristics of Java language in a program. Use variables and data types in program development.
- ✓ Identify and implement arrays, String and Selection Statements.
- ✓ Write Java programs using object-oriented programming techniques including classes, objects, methods, instancevariables, interface.
- ✓ Design and implementation programs of Exception handling, Packages, Multithreading Programming, Window basedprograms.

UNITS	COURSE CONTENT
1	**Object-Oriented Languages** Java's History, Creation of Java, Internet & Java, Byte-code, Its Features, Java Program Structure and Java's Class Library, Data Types, Variables, and Operators, Operator Precedence; Selection Statements, Scope of Variable, Iterative Statement; Defining Classes & Methods, Creating Objects of a Class, Defining and Using a Class, Automatic Garbage Collection. **Arrays and Strings:** Arrays, Arrays of Characters, String Handling Using String Class, Operations on String Handling Using, String Buffer Class.
2	**Classes and Inheritance** Using Existing Classes, Class Inheritance, Choosing Base Class, Multiple Levels of Inheritance, Abstraction through Abstract Classes, Using Final Modifier, Packages: Understanding Packages, Defining a Package, Packaging up Your Classes, Adding Classes from a Package to Your Program, Understanding CLASSPATH, Standard Packages, Access Protection in Packages, Concept of Interface. **Exception Handling:** The concept of Exceptions, Types of Exceptions, Dealing with Exceptions, Exception Objects, Defining Your Own Exceptions.
3	**Multithreading Programming** The Java Thread Model, Understanding Threads, The Main Thread, creating a Thread, Creating MultipleThreads, Thread Priorities, Synchronization. **Input / Output in Java:** I/O Basic, Byte and Character Structures, I/O Classes, Reading Console Input, Writing Console Output, Reading and Writing on Files, Random Access Files, Storing and Retrieving Objects from File, Stream Benefits. **Creating Applets in Java:** Applet Basics, Applet Architecture, Applet Life Cycle, Simple Applet Display Methods, The HTML Applet Tag Passing Parameters to Applets.
4	**Working with Windows** AWT Classes, Window Fundamentals, Working with Frame, Creating a Frame Window in an Applet; Displaying Information within a Window. **Working with Graphics and Texts**: Working with Graphics, Working with Color, Setting the Paint Mode, Working with Fonts, Managing Text Output; Using Font Metrics, Exploring Text and Graphics, Working with AWT Controls, Layout Managers and Menus.

Reference Books:

- The Complete Reference JAVA, Herbert Schildt, TMH Publication.
- JAVA and Object-Oriented Programming Paradigm, Debasish Jana, Prentice Hall of India
- Beginning JAVA, Ivor Horton, WROX Publication.
- Core JAVA, Tanweer Alam, AICTE Recommended (Khanna Publishing)
- JAVA 2 UNLEASHED, Tech Media Publications.
  JAVA 2 (1.3) API Documentations.

Code: MC23-204 **Paper: Networking**
Contacts Hours / Week: 4 **Credit: 4**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Understand the purpose of network layered models, network communication using the layered concept and able tocompare and contrast OSI and TCP/IP model.
- ✓ Differentiate among and discuss the four level of address (physical, logical, port and url) used by the internet TCP/IPprotocols.
- ✓ Understand the routing principals and algorithm such as distance vector routing and link state.
- ✓ Judge the efficiency of the connection oriented and connectionless protocol.
- ✓ Familiar with the routing techniques, protocols and quality of service.
- ✓ Explain the concept of network security and cryptography.

UNITS	COURSE CONTENT
1	**Introduction** Direction of data flow (simplex, half duplex, full duplex), Network topology, categories of network (LAN, MAN,WAN).
2	**Protocol and Standard** Layered Task, The OSI model, TCP/IP protocol suite, Addressing
3	**Networking** Networking concept, IPv4 and IPv6 Addressing, IPv4 protocol, IPv6 protocol, transition from IPV4 to(1IP0LV)6 , transition from IPv4 to IPv6, Address Mapping, Error Reporting, Multicasting, Unicast Routing Protocols, Distance Vector routing, Link state routing, Path vector routing, Multicasting Routing Protocols, Transmission Control Protocol(TCP), User Datagram Protocol(UDP)
4	**Quality of Service** Data traffic, Congestion, congestion control, Quality of service, Techniques to improve QoS, Integrated services,Differentiated service, QoS in Frame Relay, QoS in ATM
5	**DNS and Web** Name Space, Domain Name System, Distribution of Name Space, Remote Logging, Electronic Mail and File Transfer, WWW, Web document and HTTP, Network Management, Simple Network Management Protocol (SNMP)
5	**Network Security** Symmetric Key Cryptography, DES, AES, Asymmetric Key Cryptography, RSA, Diffie-Hellman, Security Services,Digital Signature, Key Management, IP Security, SSL/TLS, PGP, Firewalls

Reference Books:

- Computer Networks, Andrew S. Tanenbaum, Pearson Education, Fourth edition.
- Data and Computer Communication, William Stallings, Prentice hall, Seventh edition.
- An Integrated Approach to Computer Networks, Bhavneet Sidhu, Khanna Publishing House.
- High speed Networks and Internets, William Stallings, Pearson education, Second edition.
- Behrouz A Forouzan, - Data communication & Networking , TMH
- Behrouz A Forouzan, - TCP/IP Protocol Suite , TMH
- Kelvin R Fall, W. Richard Stevens- TCP/IP Illustrated Volume 1, Addison Wesley

Code: MC23-E205A **Paper: Numerical and Statistical Analysis** **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ To understand approximation and propagation error.
- ✓ To understand and implement different interpolation techniques.
- ✓ To understand and implement integration techniques.
- ✓ To understand and implement solutions for linear and algebraic and differential equations.

UNITS	COURSE CONTENT
1	**Approximation in numerical computation** Truncation and rounding errors, Fixed and floating point arithmetic, Propagation of errors.
2	**Interpolation** Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation
3	**Numerical integration** Trapezoidal rule, Simpson's1/3 rule, Romberg's Integration, Expression for corresponding error terms.
4	**Numerical solution of Linear equations** Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method.
5	**Numerical solution of Algebraic equation** Bisection method, Regula-Falsi method, Newton-Raphson method, Iteration Method, Secant Method.
6	**Numerical solution of ordinary differential equation** Euler's method, Runge-Kutta methods, Taylor's series, method, Predictor Corrector methods and Finite Difference method.
7	**Least Square Curve fitting** Linear & non-linear curve fitting
8	**Introduction to Statistics& Probability** Basic Statistics-measure of central tendency, dispersion. Probability, distribution introduction to mass function, density function, distribution function (Binomial, Poisson,Normal).

Reference Books:

- R.S. Salaria: Computer Oriented Numerical Methods, Khanna Publishing House (AICTE)
- C.Xavier: C Language and Numerical Methods.
- Dutta & Jana: Introductory Numerical Analysis.
- J.B.Scarborough: Numerical Mathematical Analysis.
- Jain, Iyengar, & Jain: Numerical Methods (Problems and Solution).
- Balagurusamy: Numerical Methods, Scitech.
- Baburam: Numerical Methods, Pearson Education.
- N. Dutta: Computer Programming & Numerical Analysis, Universities Press

Code: MC23-E205B **Paper: Computer Graphics**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Identify the basic terminologies of Computer Graphics and interpret the mathematical foundation of the concepts ofcomputer graphics.
- ✓ Apply mathematics to draw basic primitives.
- ✓ Illustrate the concepts of windowing and clipping and apply various algorithms to fill and clip polygons.
- ✓ Understand and apply the core concepts of computer graphics, including transformation in two and three dimensions,viewing and projection.
- ✓ Create effective programs using concepts of curves.
- ✓ Understand the concepts of color models, lighting, shading models and hidden surface elimination.

UNITS	COURSE CONTENT
1	**Introduction** Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.
2	**Graphics Primitives:** Points, Lines andCircles as primitives, Scan conversion algorithms for primitives, Fill area primitives includingscan-line polygon filling, inside-outside test, Boundary and Flood-fill, Character generation, line attributes, area-fill attributes, character attributers.
3	**2D Transformation and Viewing:** Transformations (translation, rotation, scaling), matrix representation, homogeneous coordinates, composite transformations, reflection and shearing, viewing pipeline and coordinates system, window-to-viewport transformation, clipping including point clipping, line clipping (Cohen-Sutherland, Liang-Bersky), Polygon clipping
4	**3D Transformations:** Translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space, Reflection throughan arbitrary plane; General parallel projection transformation; clipping, viewport clipping, 3D viewing.
5	**Curve:** Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-splinecurves, rational B-spline curves.
6	**Hidden surfaces** Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, The Painter's algorithm, scan-linealgorithm; Hidden line elimination.
7	**Color & shading models** Light &Color Model; Interpolative Shading Models; Texture;

Reference Books:

- D. Hearn and M.P. Baker, Computer Graphics, Pearson Eduction.
- D.P. Mukherjee, D. *Jana*, Computer Graphics: Algorithms and Implementations, Pentice Hall of India.
- J. Foley, V. Dam, S. Feiner, J. Hughes, "Computer Graphics Principles and Practice", Pearson Education.
- D. Rogers, Procedural Elements for Computer Graphics, TataMcGraw-Hill Publications.
- D.Rogers,J.Adams,MathematicalElementsforComputerGraphics,TataMcGraw Hill Publication.
- R. Anand, Computer Graphics, Khanna Publishing House.

Code: MC23-E205C **Paper: Probability and Statistics**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Explain the concept of probability and its feature in terms of random event, sample space, favorable event.
- ✓ Describe the idea of random variable and the probability distribution.
- ✓ Calculate the expectation, standard deviation and moments.
- ✓ Critically evaluate the underlying assumptions of analysis tools.
- ✓ Carry out basic statistical analysis of data.

UNITS	COURSE CONTENT
1	**Probability** Sample Space, Probability Axioms, Combinatorics: probability of finite sample space, Conditionalprobability and Bayes Theorem, Independence of Events,
2	**Random Variables** Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, probability and moment generating function, median and quantiles, Markov inequality, Chebyshev's inequality, problems
3	**Special Distributions** Discrete uniform, binomial, geometric, negative binomial, hypergeometric, Poisson, continuous uniform, exponential, gamma, Pareto, beta, normal
4	**Joint Distributions** Joint, marginal and conditional distributions, product moments, correlation and regression, independenceof random variables, bivariate normal distribution, problems.
5	**Sampling Distributions** The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions, problems.
6	**Descriptive Statistics** Graphical representation, measures of locations and variability.
7	**Estimation** Unbiasedness, consistency, the method of moments and the method of maximum likelihood estimation,confidence intervals for parameters in one sample and two sample problems of normal populations,confidence intervals for proportions, problems.
8	**Testing of Hypotheses** Null and alternative hypotheses, the critical and acceptance regions, two types of error, power of the test, the most powerful test and Neyman-Pearson Fundamental Lemma, tests for one sample and two sample problems for normal populations, tests for proportions, Chi-square goodness of fit test and its applications, problems.

Reference Books:

- Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh- An Introduction To probability And statistics, John Wiley &Sons
- V.K.Rohatgi& A.K. Md. E. Saleh - An Introduction to Probability and Statistics
- J.S. Milton &J.C. Arnold- Introduction to Probability and Statistics
- H.J. Larson -Introduction to Probability Theory and Statistical Inference.
- S.M. Ross - Introduction to Probability and Statistics for Engineers and Scientists
- The Practice of Business Statistics, Gupta & Gupta, Khanna Book Publishing.

Code:MC23-E205D Paper: Introduction to Cyber Security
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Know Fundamental knowledge in Cyber Security
- ✓ Understand the security challenges as well as the best practices that are essential to protect one from becoming thevictims of cybercrimes.
- ✓ Understand the current status of cyber world.
- ✓ To safe-guard the individual, society, organization and the government from the dangers of cyber frauds, scams,threats and attacks.
- ✓ Able to further exploration in Cyber Security Domain.

UNITS	COURSE CONTENT
1	**Introduction** Introduction to Cyber Space, Information Systems, Need for Cyber Security
2	**Cyber Attacks**: Introduction to Cyber Attacks, Classification of Cyber Attacks, Classification of Malware, Threats
3	**Intrusion Detection and Prevention** Vulnerability Assessment Intrusion Detection Systems,Intrusion Prevention Systems
4	Authentication Methods: Introduction to User Authentication Methods Biometric Authentication Methods, Biometric Systems
5	**Security Models:** Different Security Models and Security Mechanisms Information Security and Network Security Operating System Security
6	**Online Security** Web Security Email Security Mobile Device Security, Cloud Security
7	**IoT & Social Media Security** IoT SecurityCyber Physical System Security Social Media Security
8	**Security and Virtual Currency** Virtual Currency, Block Chain Technology,Security Auditing
9	**Cyber Crimes** Introduction, Different Types of Cyber Crimes, Scams and Frauds, Analysis of Crimes, Human Behavior, Stylometry, Incident Handling, Investigation Methods, Criminal Profiling, Cyber Trails
10	**Digital Forensics** Digital Forensics, History, Challenges, Branches of Digital Forensics, Digital Forensic Investigation Methods,Reporting, Management of Evidence
11	**Cyber Law** Cyber laws, Cyber terrorism, Information Technology Act 2000 and Amendments,Evidentiary value of Email/SMS, Cybercrimes and Offenses dealt with IPC, RBI Act and IPR Act in India, Jurisdiction of CyberCrime, Cyber Security Awareness Tips

Reference Books:

- Fundamentals of Cyber Security By MayankBhushan, BPB Publications
- https://heimdalsecurity.com/pdf/cyber_security_for_beginners_ebook.pdf
- Information Security & Cyber Laws, Gupta & Gupta, Khanna Publishing House
- Certified Ethical Hacker Certification Exam by William Manning
- Data communication and Networking by Behrouz A. Forouzan, McGraw Hill Education (India) Pvt. Ltd.
- http://larose.staff.ub.ac.id/files/2011/12/Cyber-Criminology-Exploring-Internet-Crimes-and-Criminal-Behavior.pdf

Code:MC23-E205E **Paper: Introduction to IoT**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Explain what Internet of Thins is
- ✓ Describe key technologies in Internet of Things.
- ✓ Understand wireless sensor network architecture and its framework along with WSN applications.
- ✓ Explain resource management in the Internet of Things.
- ✓ Understand business models for the Internet of Things.

UNTS	COURSE CONTENT
1	**Introduction:** What is the Internet of Things? : History of IoT, About IoT, Overview and Motivations, Examples of Applications, Internet of Things Definitions and Frameworks : IoT Definitions, IoT Architecture, GeneralObservations, ITU-T Views, Working Definition, IoT Frameworks, Basic Nodal Capabilities
2	**Fundamental IoT Mechanisms And Key Technologies** Identification of IoT Objects and Services, Structural Aspects of the IoT, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy, Open Architecture, Key IoT Technologies, Device Intelligence, Communication Capabilities, Mobility Support, Device Power, Sensor Technology, RFID Technology, Satellite Technology,
3	**Radio Frequency Identification Technology** RFID: Introduction, Principle of RFID, Components of an RFID system, Issues EPCGlobal Architecture Framework: EPCIS & ONS, Design issues, Technological challenges, Security challenges, IP for IoT, Web of Things. Wireless Sensor Networks: History and context, WSN Architecture, the node, Connecting nodes, Networking Nodes, Securing Communication WSN specific IoT applications, challenges: Security, QoS, Configuration, Various integration approaches, Data link layer protocols, routing protocols and infrastructure establishment.
4	**Resource Management In The Internet Of Things:**Clustering, Software Agents, Clustering Principles in an Internet of Things, Architecture, Design Guidelines, and Software Agents for Object Representation, Data Synchronization. Identity portrayal, Identity management, various identity management models: Local, Network, Federated and global web identity, user- centric identity management, device centric identity management and hybrid-identity management, Identity and trust.
5	**Internet Of Things Privacy, Security And Governance** Vulnerabilities of IoT, Security requirements, Threat analysis, Use cases and misuse cases, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Non-repudiation and availability, Security model for IoT.

Reference Books:

- Jeeva Jose, Internet of Things, Khanna Book Publishing House, (AICTE Recommended).
- Pethuru Raj and Anupama C Raman, The Internet of Things – Enabling Technologies, Platforms, and use cases,CRC Press, Taylor and Francis
- Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press.
- Yasuura, H., Kyung, C.M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing.
- David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 1stEdition, Pearson Education (Cisco Press Indian Reprint).
- Srinivasa K G, Internet of Things,CENGAGE Leaning India.

Code: MC23-E205F **Paper: Automata Theory & Computational Complexity**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Understand the formal notation for strings, languages and machines.
- ✓ Design and Implement Finite automata to accept a string of a language.
- ✓ For a given language determine whether the given language is regular or not.
- ✓ Design context free grammars to generate strings of context free language.
- ✓ Determine equivalence of languages accepted by Push Down Automata and languages generated by context freegrammars
- ✓ Understand and analyze the hierarchy of formal languages, grammars and machines.
- ✓ Distinguish between computability and non-computability and Decidability and un-decidability.

UNITS	COURSE CONTENT
1	**Introduction** Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.
2	**Regular languages and finite automata:** Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regularexpressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemmafor regular languages, minimization of finite automata)
3	**Context-free languages and pushdown automata:** Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministicpushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic push down automata, closure properties of CFLs.
4	**Turing machines:** The basic model for Turing machines (TM), Turing recognizable(recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMsand equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMsasenumerators.Context Sensitive Language, The model of Linear Bounded Automaton, relation between LBA and context sensitive language
5	**Decidability:** Decidability, decidable language and undecidable language, Halting problem of TM, Halting problem of TM
6	**Complexity** Growth rate of functions, The classes P and NP, Polynomial time reduction and NP completeness, SAT is NPcomplete, Cook's theorem, Church-Turing Thesis

Reference Books:

- Introduction to Automata Theory, Languages, and Computation, John E. Hopcroft, Rajeev Motwani and Jeffrey D.Ullman, Pearson Education Asia.
- Theory of Computation, R.B. Patel & Prem Nath, Khanna Publishing House.
- Elements of the Theory of Computation, Harry R. Lewis and Christos H. Papadimitriou, Pearson Education Asia.
- Theory of Computer Science, Automata Languages and computation, Mishra and Chandra shekaran, 2nd edition, PHI.
- Automata and Computability, Dexter C. Kozen, Undergraduate Texts in Computer Science, Springer.
- Introduction to the Theory of Computation, Michael Sipser, PWS Publishing.
- Introduction to Languages and The Theory of Computation, John Martin, Tata Mc Graw Hill.,PEARSON.

Code: MC23-291 **Paper: Data Structure Lab using C**
Contacts Hours / Week: 3 **Credit: 2**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ To understand linear and non-linear data structures.
- ✓ To understand different types of sorting and searching techniques.
- ✓ To know how to create an application specific data structure.
- ✓ To solve the faults / errors that may appear due to wrong choice of data structure.
- ✓ To analyze reliability of different data structures in solving different problems.

UNITS	COURSE CONTENT
1	Implementation of data structure operations (Insertion, deletion, traversing, searching) on array. Linear search,Binary search.
2	Implementation of stack, queue operation using array. Pop, Push, Insertion, deletion, Implementation of circular queue. Infix to postfix conversion, postfix expression evaluation
3	Implementation of linked lists: Single linked list, circular linked list, double linked list, doubly circular linked list. Implementation of stack and queue using linked list. Merging two linked list, Linked list representation of apolynomial, polynomial addition, polynomial multiplication.
4	Tree: creating Binary Search tree, recursive and non-recursive traversal of BST, deletion in BST, calculating height of a BST, building AVL tree.
5	Implementation of sorting techniques: selection, bubble, quick sort, insertion sort, merge sort, heap sort, implementation of priority queue. Hash table implementation.
6	Implementation of Graph: representation, searching, BFS, DFS

Code: MC23-292 **Paper: Operating System Lab (Unix)**
Contacts Hours / Week: 4 **Credit: 2**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Do the use of basic UNIX Commands from the command line, and create Shell Scripts to customize their UNIXWorking Environment.
- ✓ Organize and manage their processes within UNIX through system calls.
- ✓ Organize and manage their files within the UNIX through system calls.
- ✓ Provide a mechanism for handling asynchronous events through signals (Software Interrupt).
- ✓ Implement the Inter-process communication using FIFOs, Message Queues, Semaphores, and Shared Memory.
- ✓ Explain Socket programming to design Client-Server Environment.
- ✓ Understand and implement Multithreaded Programming Environment.

UNITS	COURSE CONTENT
1	**Shell programming** Creating a script, making a script executable, shell syntax (variables, Conditions, control structures, functions andcommands).

2	**Process** Starting new process, replacing a process image, duplicating a process image, waiting for a process, Zombie Process,Orphan Process
3	**File Handling** Programming on files (use create(), open(), read(), write(), close(), lseek(), dup()).
4	**Signal** Signal Handling, Blocking, Suspending, Delivering Signals, Various Signal Related Functions.
5	**Inter-process communication** Pipes (use functions pipe(), popen(), pclose()),Named Pipes (FIFOs, accessing FIFO), Message Queues (use functions msgget(), msgsnd(), msgrcv(), msgctl()),Semaphores (use functions semctl(), semget(), semop()) Shared Memory (use functions shmget(), shmat(), shmdt(), shmctl())
6	**Sockets:** TCP Sockets, UDP Sockets, Socket Options, Cliient /Server Example, Name and Address Conversions
7	**POSIX Threads** Programming with pthread functions (viz. pthread_create(), pthread_join(), pthread_exit(), pthread_attr_init(),pthread_cancel())

Code: MC23-293 **Paper: Object Oriented Programming Lab using JAVA**
Contacts Hours / Week: 4 **Credit: 2**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Apply object-oriented principles or features in software design process to develop Java programs for real life applications.
- ✓ Reduce the complexity of procedural language by employing different OOP technologies for developing robust andreusable software.
- ✓ Develop programs using stream classes for various I/O operations and design concurrent.
- ✓ Design graphical user interface to develop user interactive applications.

UNITS	COURSE CONTENT
1	Assignments on class, constructor, overloading, inheritance, overriding.
2	Assignments on wrapper class, arrays.
3	Assignments on developing interfaces- multiple inheritance, extending interfaces.
4	Assignments on creating and accessing packages.
5	Assignments on multithreaded programming
6	Assignments on applet programming

Second Year– III Semester

Code: MC23-301 **Paper: Software Engineering using UML**
Contacts Hours / Week: 4 **Credit: 4**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Analyze the problem scenario and identify classes/ objects and their properties, relationship in class model.
- ✓ Demonstrate the conceptual modeling techniques of UML for solving Real-World problem.
- ✓ To learn software development life cycle for Object-Oriented solutions for Real-World Problems.
- ✓ Ability to apply the concepts of object oriented methodologies to analyze requirements and design to the point where itis ready for implementation.
- ✓ Demonstrate the concept of Testing to measure quality of software.

UNITS	COURSE CONTENT
1	**Introduction to Software Engineering:** What is Software Engineering? Software Engineering Concepts, Software Engineering Development Activities,Managing Software Development.
2	**Object Oriented Concept and Modelling:** **Object-Oriented Principals and Concepts:** Classes and Object, Modularity, Abstraction and Encapsulation; Object Relationship like Association, Aggregation and Composition; Inheritance, Polymorphism and Dynamic Binding Interfaces **Model:** Importance of Modeling, Object Oriented Modeling **Identifying the Elements of an Object Model:** Identifying classes and objects, Specifying the attributesDefining operations, Finalizing the object definition.
3	**Introduction to UML:** Overview of UML, Conceptual Model of UML, Architecture, S/W Development Life Cycle.
4	**Basic and Advanced Structural Modeling:** Classes Relationship, Common mechanism, Diagrams, Class Diagram,Advanced classes, Advanced Relationship, Interface, Types and Roles, Packages, Object Diagram.
5	**Basic and Advanced Behavioral Modeling:** Interactions, Use cases, Use Case Diagram, Sequence Diagram, Collaboration Diagram, Interaction Diagram,Activity Diagram, State Chart Diagram.
6	**Architectural Modeling:** Artifacts, Artifact Diagram, Implementation Diagram, Deployment Diagram.
7	**Object-Oriented Design:** Generic components of Object-Oriented Design model, System Design process, Partitioning the Analysis Model,Concurrency and subsystem Allocation, Task Management component, Data Management Component, Resource Management Component, Inter Sub-system Communication.
8	**Object Oriented Analysis:** Iterative Development, Unified process & its Phases: Inception, Elaboration, Construction, Transition, Understanding requirements.
9	**Object Oriented Testing:** Overview of Testing and object oriented Testing, Types of Testing, Object oriented Testing strategies, Test casedesign for Object-Oriented software, Inter class test case design.

Reference Books:

- Software Engineering, N.S. Gill, Khanna Publishing House
- The Unified Modeling Language User Guide, Grady Booch, James Raumbaugh, Ivar Jacobson.
- Object Oriented Software Engineering, Ivar Jacobson, ACM Press
- Applying UML and Patterns, Craig Larman Motilal Uk Books of India
- Object-Oriented Software Engineering: Using UML, Patterns, and Java, Bernd Bruegge, Allen Dutoit, Pearson.
- Software Engineering – A Practitioner's Approach, Roger. S. Pressman and Bruce R. Maxim, McGraw Hill

Code: MC23–302 **Paper: Artificial Intelligence**

Contacts Hours / Week: 4 **Credit: 4**

Course Outcome:

- ✓ After successful completion of this course, students will be able to understand the underlying assumption of philosophy of the logical sequences of real life problem by applying State Space Search behind the limitation of non-solving methodof conventional computational approach.
- ✓ Incorporating heuristic search technique on Game Playing.
- ✓ Various strategies of representing knowledge with decision making algorithms. Creation of substantial domain knowledge base with meta data. Application of knowledge representation issues using Prolog/LISP.
- ✓ To recognize the adoption of new system through learning by an Intelligent System and processing of Natural Language.
- ✓ Ability to apply machine learning techniques to solve real world problems and how Expert Systems can be carried out by the help of learning, analyzing by applying various search techniques and resolute to provide solutions.

UNITS	COURSE CONTENT

1	**Introduction to Intelligent Systems:** Overview of Artificial intelligence- Problems of AI, AI technique, Tic – Tac – To problem.
2	**Search Techniques:** Problems, Problem Space & search.Heuristic Search Techniques, Game planning –Minimax search procedure, adding alpha beta cut-off's, Iterative Deepening.
3	**Knowledge Representation Issues:** Representing knowledge using rules.Weak slot & filler structures. Strong slot & filler structures. Implementation of Knowledge with Prolog Programs. Basic knowledge of programming language like Prolog & Lisp.
4	**Adoption of New Knowledge:** Deep Learning: Introduction to Neural Networks, Convolution of New KnowledgeNatural language processing, Understanding. Learning – induction & explanation based learning.
5	**Expert systems:** Expert system shells, knowledge acquisition.

Reference Books:

- A Classical Approach to Artificial Intelligence, Munesh Trivedi, Khanna Book Publishing.
- Artificial Intelligence: A Modern Approach, Stuart Russell & Peter Norvig, Pearson Education.
- Artificial Intelligence, Rich & Knight, TMH.Reference Books
- Artificial Intelligence & Intelligent Systems, N.P Padhy, Oxford University Press.
- Introduction to Artificial Intelligence & Expert Systems, Dan W. Patterson, PHI.
- Artificial Intelligence: A new Synthesis, Nils J. Nilsson, Morgan Kaufmann Publishers, Inc.

Code: MC23-303 Paper: Design and Analysis of Algorithm Contacts Hours / Week: 4 **Credit: 4**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Understand and analyze the running times of algorithms based on asymptotic analysis and justify the correctness ofalgorithms.
- ✓ Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it.
- ✓ Understand and implement the greedy paradigm for a given problem.
- ✓ Design the dynamic-programming paradigm and implement it.
- ✓ Understand and implement the Back Tracking and Branch-&-Bound problem.
- ✓ For a given model engineering problem model it using graph and write the corresponding algorithm to solve theproblems.
- ✓ Explain the ways to analyze randomized algorithms (expected running time, probability of error).

UNITS	COURSE CONTENT
1	**Introduction:** Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best,average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method andMasters' theorem.

2	**Divide-&-Conquer and Greedy Method:** ***Divide & Conquer***: General Method - Finding maximum and minimum – Merge sort, Quick sort, Selection,Strassen's matrix multiplication. ***Greedy Method***: General Method –knapsack problem - Tree vertex splitting - Job sequencing with deadlines –optimal storage on tapes.
3	**Dynamic Programming:** Assembly-line programming, Matrix Chain Multiplication, 0-1 knapsack problem
4	**Graph Algorithms:** Introduction to Spanning tree, growing a minimum spanning tree, Prims and Kruskal Algorithm
5	**Back Tracking and Branch-&-Bound:** ***Back Tracking***: General Method – 8-queens - Sum of subsets - Graph Coloring –Hamiltonian cycles. ***Branchand Bound***: General Method - Traveling Salesperson problem.
6	**Lower Bound Theory:** Comparison trees - Oracles and advisory arguments – Lower bounds through reduction - Basic Concepts of NP-Hard and NP-Complete problems.

Reference Books:

- Design and Analysis of Algorithms, Gajendra Sharma, Khanan Publishing House.
- E. Horowitz, S. Sahni and S. Rajasekaran, 2008, Computer Algorithms, 2ndEdition, Universities Press, India.
- Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, 4THEdition, MIT Press/McGraw-Hill.
- A.V. Aho, J.E. Hopcroft, J.D. Ullmann, 1974, The Design and Analysis of Computer Algorithms, Addison Wesley,Boston.

Code: MC23-E304A	**Paper: Image Processing**
Contacts Hours / Week: 3	**Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Describe the fundamental concept of the digital image processing system.
- ✓ Experiment the images in the frequency domain and spatial domain using various transforms.
- ✓ Evaluate the techniques for image enhancement and restoration.
- ✓ Explain different feature extraction techniques for image analysis and recognition.
- ✓ Categorize various compression techniques.
- ✓ Develop any image processing application.

UNITS	COURSE CONTENT
1	**Introduction** Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.
2	**Digital Image Formation** A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), PerspectiveProjection, Sampling & Quantization - Uniform & Non uniform.

3	**Mathematical Preliminaries** Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform,Discrete Fourier Transform, Discrete Cosine & Sine Transform
4	**Image Enhancement** Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching,Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High- pass Filtering, High-boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequencydomain - Low pass filtering, High pass filtering.
5	**Image Restoration** Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained & Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation – Spatial Transformation, Gray Level Interpolation.
6	**Image Segmentation** Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection – Local Processing, Global Processing via The Hough Transform; Thresholding - Foundation, Simple Global Thresholding, Optimal Thresholding; Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging.

Reference Books:

- Digital Image Processing, Rafael C.Gonzalez & Richard E.Woods, Pearson
- Fundamentals of Digital Image Processing, Anil K. Jain, Pearson Education-2003.
- Digital Image Processing, Jahne, Springer India
- Digital Image Processing & Analysis, Chanda &Majumder, PHI
- Fundamentals of Digital Image Processing, Jain, PHI
- Digital Image Processing, Munesh Trivedi, Khanna Publishing House, Delhi.

Code: MC23-E304B	**Paper: Web Enabled JAVA Programming**
Contacts Hours / Week: 3	**Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Understand the basic working methodology of JSP, servlet and JSF Frameworks
- ✓ Create dynamic web application using JSP and servlet and database.
- ✓ Design and develop a Web site using AJAX.
- ✓ Debug the Programs by applying concepts and error handling techniques.

UNITS	COURSE CONTENT
1	**Core Java Overview:** Object oriented concepts, Exception Handling, Multi Threading Introduction to JDBC: Overview of JDBC API, The Java.sql package, JDBC Drivers, Executing SQL commands using JDBC Drivers, static and dynamic Execution of SQL statements, Execution of Stored Procedures using JDBC. Introduction to Transactions and Transaction Methods. Introduction to JNDI, Introduction to Data Source and Connection pooling, Introduction to Web Applications, Web Servers Overview of J2EE Technologies.
2	**Introduction to Java Servlets:** Static and Dynamic contents, Servlet life Cycle and Life cycle methods, Servlet Request and Response Model,Deploying a Servlet, Servlet State Transitions, Servlet Config and Servlet Context, Servlet Redirection and Request Dispatch, Servlet Synchronization and Thread Model. Maintaining Client State: Cookies, URL

	rewriting,Hidden form fields, Session Tracking.
3	**Introduction to JSP :** JSP & Servlet as Web Components, Servlets vs. JSP, JSP Lifecycle, JSP Page Lifecycle Phases, General Rules of Syntax, JSP syntactic elements, JSP element syntax, Template content. JSP elements-directives, declarations, expressions, scriptlets, actions. JSP Standard Actions: jsp:useBean, jsp:getPreoperty, jsp:setProperty, jsp:include, jsp:forward, jsp:plugin, jsp:param,java Server Pages Standard Tag Library(JSTL).
4	**Introduction to JSF Frameworks:** Getting started: A Simple Example, Sample Application Analysis, Development Environments for JSF. Managed Beans: A Sample Application, Bean Scopes Configuring Beans, Navigation, Static Navigation, Dynamic Navigation, Standard JSF tags, Data tables, conversion and validation Overview of the Conversion and Validation Process, Using Standard Converters. Event Handling: Life Cycle Events, Value Change Events, Action Events, Event Listener Tags, Immediate Components, Passing Data from the UI to the Server, Custom Components, Converters and Validators: Classes for Implementing Custom components, Tags and Components, The Custom Component Developer's Toolbox, Encoding: Generating Markup, Decoding: Processing Request Values, Using Converters, Implementing Custom Component Tags, The TLD File, The Tag Handler Class, Defining Tag Handlers in JSF 1.1.
5	**AJAX:** Ajax Fundamentals, JavaScript Libraries, The Prototype Library, The Fade Anything Technique Library, Form Completion. Realtime Validation, Propagating Client-Side View State Direct Web Remoting, Ajax Components, Hybrid Components, Keeping JavaScript Out of Renderers, Transmitting JSP Tag Attributes to JavaScript Code,Ajax4jsf,Implementing Form Completion with Ajax4jsf,Implementing Realtime Validation with Ajax4jsf.Introduction to Java Web Services.

Reference Books

- Core JAVA, Tanweer Alam, Khanna Publishing House.
- Professional Java Server Programming- J2EE 1.3 Edition- SubrahmanyamAllamaraju and Cedric Buest- Apresspublication, 2007.
- Core JavaServer Faces-Second Edition-David Geary,CayHorstmann-Prentice Hall-2007

Code: MC23-E304C Paper: Cloud Computing
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Understandand identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, publiccloud, private cloud,hybrid cloud.
- ✓ Describe the core issues of cloud computing such as security, privacy, and interoperability to choose the appropriatetechnologies, algorithms, and approaches for the identified problems.
- ✓ Analyze various cloud computing solutions.
- ✓ Understand cloud Storage systems and Cloud security, the risks involved, its impact.
- ✓ Apply knowledge for solving real life cloud computing problem scenario and illustrate solutions.

UNITS	COURSE CONTENT
1	**Basics of Cloud Computing** Defining a Cloud, Cloud Types – NIST Cloud Reference Model, Cloud Cube Model, Deployment Models (Public, Private, Hybrid and Community Clouds), Service Models – IaaS, PaaS, SaaS, Benefits and Advantages of Cloud Computing
2	**Concepts of Abstraction and Virtualization** Taxonomy of Virtualization, Reference model for Virtualization

3	**Services and Applications by Type** IaaS – Basic Concept, Workload, Partitioning of Virtual Private Server Instances, Pods, Aggregations, SilosPaaS – Basic Concept, Tools and Development Environment with examples SaaS - Basic Concept and Characteristics, Open SaaS, examples of SaaS Platform Identity as a Service (IDaaS), Compliance as a Service (CaaS)
4	**Concepts of Service Oriented Architecture (SOA) and Web Service (WS)** Service Oriented Architecture – Basics, Terminologies, Components, Standards and Technologies, Benefits and Challenges Web Services – Basics, Characteristics, Terminologies, Characteristics and Scope, Business Models
5	**Cloud-based Storage** Cloud File Systems, including GFS and HDFS
6	**Cloud Security** Cloud security concerns, security boundary, security service boundaryOverview of security mapping Security of data: cloud storage access, storage location, tenancy, encryption, auditing, complianceIdentity management (awareness of identity protocol standards) Risk Management and Compliance
7	**Introduction to Various Web Services** Amazon Web Services, Google Web Services, Microsoft Cloud Services
8	**Cloud Federation** Definition, different scenario description, replace ability and negotiation mechanism

Reference Books:

- Mastering Cloud Computing by RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, McGraw Hill Education
- Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd
- Cloud Computing: A Practical Approach by Anthony T. Velte, Tata Mcgraw-Hill
- Building Applications in Cloud: Concept, Patterns and Projects by Moyer, Pearson.
- Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India

Code: MC23-E304D **Paper: Web Technology using PHP**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

- ✓ After successful completion of this course, students will be able to understand the underlying assumption of definingvariables, constants, operators, expressions, HTML Form creation and submissions. POST & GET Method.
- ✓ Incorporating HTML form with PHP
- ✓ Implementation of Decision, Loops, Functions, Array and Exception Handling concepts using PHP server concept.
- ✓ Strategy to connect with MYSQL Server.
- ✓ Ability to check validation using JavaScript & JQuery.
- ✓ Connecting Forms using AJAX Concept.

UNITS	COURSE CONTENT
1	**Introduction to Web Technology & implementation of PHP Programs:** Evaluation of PHP. Basic Syntax. Defining variables and constants. PHP Data type Operator and Expression. Basics of HTML: Form Creation, Handling of Forms, Submission of Forms. POST& GET method.
2	**Handling Html Form with PHP** Capturing Form. Data Dealing with Multi-value files. Generating File uploaded form. Redirecting a form aftersubmission.

3	**Decisions, Functions, String, Array & Exception Handling** Making Decisions. Doing Repetitive task with looping. Mixing Decisions and looping with HtmlWhat is a function? Cookies, Session and in-built functions. Creating and accessing String. Searching & Replacing String. Formatting String. String Related Libraryfunction. PHP Array. Creating index based and Associative array. Accessing array Element. Looping with Index basedarray. Looping with associative array using each () and foreach (). Some useful Library functions. Understanding Exception and error. Try, catch, throw.
4	**Database Connectivity with MySql** Introduction to RDBMS. Connection with MySQL Database. Performing basic database operation (DML) (Insert,Delete, Update, Select). Setting query parameter. Executing query Join (Cross joins, Inner joins, Outer Joins, Self joins.).
5	**Java Script & JQuery** Introduction to JavaScript. Three ways to use JavaScript. Working with events Client-side Validation.Introduction to jQuery. Validation using jQuery. jQuery Forms. jQuery Examples.
6	**Connecting Forms using AJAX Concept** Introduction to AJAX. PHP with AJAX. Working with database.

Reference Books:

- The Joy of PHP Programming: A Beginner's Guide to Programming Interactive Web Applications with PHP andMySQL**.** Alan Forbes, Fifth Edition, Plum Island
- Beginning Web Programming, Jon Duckett, WROX
- Open Source for the Enterprise: Managing Risks, Reaping Rewards,DanWoods and GautamGuliani, O'Reilly, ShroffPublishers and Distributors, 2005.
- Learning PHP, Ramesh Bangia, Khanna Publishing House.

Code: MC23-E304E **Paper: Android Application Development**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Understand mobile application development trends and Android platform
- ✓ Analyze the need of simple applications, game development, Location map based services
- ✓ Be familiar with SMS, email, service, binding and deploying APks
- ✓ To develop, deploy and maintain the Android Applications.

UNITS	COURSE CONTENT
1	**Android Fundamentals** Mobile Application development and trends – Android overview and Versions – Android open stack, features – Setting up Android environment (Eclipse, SDK, AVD)- Simple Android application development – Anatomy ofAndroid applications – Activity and Life cycle – Intents, services and Content Providers
2	**Android User Interface** Layouts: Linear, Absolute, Table, Relative, Frame, Scroll view, Resize and reposition - Screen orientation – Views:Text view, Edit Text, Button, Image Button, Checkbox, Toggle Button, Radio Button, Radio Group, Progress Bar, Auto complete Text, Picker, List views and Web view– Displaying pictures with views: Gallery and Image View, Image Switcher, Grid view – Displaying Menus: Helper methods, Option and Context
3	**Data Persistence** Shared User preferences – File Handling: File system, System partition, SD card partition, user partition, security,Internal and External Storage – Managing data using SQLite –User defined content providers

4	**Messaging, Networking and Services** SMS Messaging: Sending and Receiving – Sending email and networking – Downloading binary and text data files – Access Web services – Developing android services: create your own services, performing long running task in aservice-performing repeated task in a service
5	**Location Access And Publish Android Application** Location based services: Display map, zoom control, view and change, Marking, Geocoding, Get location - PublishAndroid applications and Deployment

Reference Books:

- Beginning Android Application Development, WeiMeng Lee,(2012) Wrox Publications (John Wiley, New York)
- Hello Android: Introducing Google's Mobile Development Platform, Ed Burnette (2010), The Pragmatic Publishers,3rd edition, North Carolina USA
- Professional Android 4 Application Development, Reto Meier (2012),Wrox Publications (John Wiley, New York).
- Programming Android: Java Programming for the New Generation of Mobile Devices,ZigurdMednieks, LairdDornin, Blake Meike G, Masumi Nakamura (2011), OReilly Media, USA
- Mastering Android, Khanna Publishing House.

Code: MC23-E304F **Paper: Basic Data Science using R**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Understand the fundamental knowledge of Data Science and the task of Data Science people.
- ✓ Understand fundamental of statistics.
- ✓ Calculate the correlation, covariance, central tendency.
- ✓ Estimate confidence interval.
- ✓ Perform hypothesis testing.
- ✓ Understand the mechanics of regression analysis.
- ✓ Carry out regression, classification using kNN, decision tree.
- ✓ Use clustering method to cluster records.

UNITS	COURSE CONTENT
1	**Introduction to Data Science** Define Data Science, why data science, data science in business
2	**Descriptive Statistics** Matrix, Matrix operations, Sample, Population, Descriptive statistics, Central tendency, outlier detection
3	**Inferential Statistics** Basics of probability, probability distribution, Central Limit theorem
4	**Hypothesis testing** Null and Alternate Hypothesis, Making a Decision, and Critical Value Method, p-Value Method and Types ofErrors, Two-Sample Mean and Proportion Test
5	**Regression Analysis** Fundamentals of Regression analysis, assumption of regression analysis, accuracy, validity, Dealing withcategorical data
6	**Classification** Introduction, Logistic regression, model building and evaluation
7	**Clustering** Introduction to clustering, k-means clustering, hierarchical clustering
8	**Decision tree and kNN** Introduction to decision tree, regression tree, truncation & pruning, random forest, kNN for regression,classification, weighted kNN

Reference Books:

- Data Sciences and Analytics, V.K. Jain, Khanna Publishing House.
- Introducing Data Science; Davy Cielen, Arno D Meysman and Mohamed Ali; Dreamtech Press
- Practical Statistics for Data Scientists; Peter Bruce and Andrew Bruce; O‟Reilly Media Inc.
- Doing Data Science; Cathy O‟Neil and Rachel Schutt; O‟Reilly Media Inc.
- Mining of Massive Datasets; Jure Leskovek, AnandRajaraman and Jeffrey Ullman; Cambridge University Press

Code: MC23-E305A **Paper: Information Retrieval**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Learn the information retrieval models.
- ✓ Be familiar with Web Search Engine.
- ✓ Be exposed to Link Analysis.
- ✓ Understand Hadoop and Map Reduce.
- ✓ Learn document text mining techniques.

UNITS	COURSE CONTENT
1	**Introduction** Introduction -History of IR- Components of IR - Issues –Open source Search engine Frameworks - The impact ofthe web on IR - The role of artificial intelligence (AI) in IR – IR Versus Web Search - Components of a Search engine- Characterizing the web.
2	**Information Retrieval** Boolean and vector-space retrieval models- Term weighting - TF-IDF weighting- cosine similarity – Preprocessing - Inverted indices - efficient processing with sparse vectors – Language Model based IR -Probabilistic IR –Latent Semantic Indexing - Relevance feedback and query expansion.
3	**Web Search Engine – Introduction And Crawling** Web search overview, web structure, the user, paid placement, search engine optimization/ spam. Web size measurement - search engine optimization/spam – Web Search Architectures - crawling - meta-crawlers- Focused Crawling - web indexes –- Near-duplicate detection - Index Compression - XML retrieval.
4	**Web Search – Link Analysis And Specialized Search** Link Analysis –hubs and authorities – Page Rank and HITS algorithms -Searching and Ranking – Relevance Scoring and ranking for Web – Similarity - Hadoop & Map Reduce - Evaluation - Personalized search - Collaborative filtering and content-based recommendation of documents and products – handling “invisible” Web - Snippet generation, Summarization, Question Answering, Cross- Lingual Retrieval.
5	**Document Text Mining** Information filtering; organization and relevance feedback – Text Mining -Text classification and clustering - Categorization algorithms: naive Bayes; decision trees; and nearest neighbor - Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM).

Reference Books:

- Manning, P. Raghavan, and H. Schütze, “Introduction to Information Retrieval”, Cambridge University Press.
- Ricardo Baeza -Yates and Berthier Ribeiro - Neto, “Modern Information Retrieval: The Concepts and Technologybehind Search”, ACM Press Books.
- Bruce Croft, Donald Metzler and Trevor Strohman, “Search Engines: Information Retrieval in Practice”, AddisonWesley.
- Mark Levene, “An Introduction to Search Engines and Web Navigation”, Edition Wiley.
- Stefan Buettcher, Charles L. A. Clarke, Gordon V. Cormack, “Information Retrieval: Implementing and EvaluatingSearch Engines”, The MIT Press.
- Ophir Frieder “Information Retrieval: Algorithms and Heuristics: The Information Retrieval Series“, Springer.

- Manu Konchady, “Building Search Applications: Lucene, Ling Pipe”, and First Edition, Gate Mustru Publishing.

Code: MC23-E305B **Paper: Data Warehousing and Data Mining**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Study of different sequential pattern algorithms
- ✓ Study the technique to extract patterns from time series data and it application in real world.
- ✓ Can extend the Graph mining algorithms to Web mining
- ✓ Help in identifying the computing framework for Big Data

UNITS	COURSE CONTENT
1	**Introduction to Data Warehousing:** The need for data warehousing, Operational and informational Data stores, Data warehouse definition and characteristics, Data warehouse architecture, Data warehouse Database, Sourcing, Acquisition, Cleanup andtransformation tools, Metadata, Access tools, Data marts, Data warehousing administration and management.
2	**Online analytical processing (OLAP)**: Need for OLAP, Multidimensional data model, OLAP guidelines, Multidimensional vs. Muilti-relational(OLAP), Categorization of OLAP tools, OLAP tools internet.
3	**Introduction to data mining:** The motivation, Learning from past mistake, Data mining, Measuring data mining effectiveness, Embedded data mining into business process, What is decision tree, Business score card, Where to use decision tree, The general idea, How the decision tree works.
4	**Classification and prediction:** Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; TransactionalPatterns and other temporal based frequent patterns
5	**Time Series Analysis:** Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis.
6	**Web Mining:** Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on theweb, Automatic classification of web documents and web usage mining; Distributed Data Mining.

Reference Books:

- Data warehousing, Data mining and OLAP by Alex Berson& Stephon J. Smith, Tata McGraw Hill.2003.
- Data Warehousing Fundamentals for IT Professionals, Second Edition by PaulrajPonniah, Wiley India.
- Principles and Implementation of Data Ware housing, Rajeev Parida Fire Wall Media, Lakshmi Publications.2006.
- Data Mining and Warehousing, Ikvinderpal Singh, Khanna Book Publishing 2017.

Code: MC23-E305C **Paper: Introduction to Big Data Analytics**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ To optimize business decisions and create competitive advantage with Big Data
- ✓ analytics
- ✓ Explore the fundamental concepts of big data analytics.
- ✓ Learn to analyze the big data using intelligent techniques.
- ✓ Understand the various search methods and visualization techniques.
- ✓ Learn to use various techniques for mining data stream.
- ✓ Understand the applications using Map Reduce Concepts.
- ✓ Introduce programming tools PIG & HIVE in Hadoop echo system.

UNITS	COURSE CONTENT
1	**Introduction to big data** Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature ofData - Analytic Processes and Tools - Analysis vs Reporting.
2	**Mining data streams** Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams –Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications – Case Studies - Real Time Sentiment Analysis- Stock Market Predictions.
3	**Hadoop** History of Hadoop, Hadoop Distributed File System, Components of Hadoop Analysing the Data with Hadoop, Scaling Out, Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics-Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats- Map Reduce FeaturesHadoop environment.
4	**Frameworks** Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL –Querying Data in Hive - fundamentals of HBase and ZooKeeper - IBM InfoSphere BigInsights and Streams.
5	**Predictive Analytics** Simple linear regression, Multiple linear regression, Interpretation of regression coefficients. Visualizations - Visual data analysis techniques- interaction techniques - Systems and applications.

Reference Books:

- Big Data and Hadoop, V.K. Jain, Khanna Publishing House 2021.
- Hadoop: The Definitive Guide, Tom White Third Edition, O'reilly Media, 2012.
- Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, Chris Eaton, Dirk DeRoos,Tom Deutsch, George Lapis, Paul Zikopoulos, McGrawHill Publishing, 2012.
- Mining of Massive Datasets, Anand Rajaraman and Jeffrey David Ullman, CUP,2012.
- Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, BillFranks, John Wiley& sons, 2012.
- Making Sense of Data, Glenn J. Myatt, John Wiley & Sons, 2007.

Code: MC23-E305D **Paper: Graph Theory**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Write precise and accurate mathematical definitions of objects in graph theory.
- ✓ Use mathematical definitions to identify and construct examples and to distinguish examples from non-examples.
- ✓ Validate and critically assess a mathematical proof.
- ✓ Use a combination of theoretical knowledge and independent mathematical thinking in creative investigation ofquestions in graph theory.
- ✓ Reason from definitions to construct mathematical proofs.

UNITS	COURSE CONTENT

1	**Introduction:** Graph, Application of Graph, Finite and Infinite Graph, Incidence & Degree, Isolated & Pendant Vertex, NullGraph, Isomorphism, Subgraphs, Walks, Paths, and Circuits, Connected Graphs, Disconnected Graphs, and Components, Euler Graphs, Operations On Graphs, Hamiltonian Paths and Circuits, The Traveling SalesmanProblem.
2	**Trees** Trees, Properties, Distance and Centres, Types of Trees, Tree Enumeration, Labeled Tree, Unlabeled Tree, Spanning Tree, Fundamental Circuits, Cut Sets, Properties, Fundamental Circuit and Cut-set, Connectivity, Separability, Related Theorems. Spanning trees, Fundamental circuits, Spanning trees in a weighted graph, cut sets,Properties of cut set, All cut sets, Fundamental circuits and cut sets, Connectivity and separability.
3	**Connectivity And Planarity** Network Flows, Planar Graph, Representation, Detection, Dual Graph, Geometric and Combinatorial Dual,Related Theorems, Digraph, Properties, Euler Digraph.
4	**Matrices, Colouring** Matrix Representation, Adjacency matrix, Incidence matrix, Circuit matrix, Cut-set matrix, Path Matrix, Properties – Related Theorems – Correlations. Graph Coloring, Chromatic Polynomial, Chromatic Partitioning, Matching,Covering, Related Theorems.
5	**Graph Theoretic Algorithm** Graph Algorithms- Connectedness and Components- Spanning Tree- Fundamental Circuits- Cut Vertices-Directed Circuits- Shortest Path – Applications overview.

Reference Books:

- NarsinghDeo, "Graph Theory: With Application to Engineering and Computer Science", Prentice Hall of India.
- Combinatorics and Graph Theory, S.B. Singh, Khanna Publishing House.
- Grimaldi R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", Addison Wesley.
- Clark J. and Holton D.A, "A First Look at Graph Theory", Allied Publishers.
- Mott J.L., Kandel A. and Baker T.P. "Discrete Mathematics for Computer Scientists and Mathematicians" , PrenticeHall of India.
- Liu C.L., "Elements of Discrete Mathematics", McGraw Hill.

Code: MC23-E305E **Paper: Operation Research and Optimization Techniques**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Describe the way of writing mathematical model for real-world optimization problems.
- ✓ Identify Linear Programming Problems and their solution techniques
- ✓ Categorize Transportation and Assignment problems
- ✓ Apply the way in which Game Theoretic Models can be useful to a variety of real-world scenarios in economics andin other areas.
- ✓ Convert practical situations into non-linear programming problems.
- ✓ Solve unconstrained and constrained programming problems using analytical techniques.

UNITS	COURSE CONTENT
1	**Linear Programming Problem (LPP)-I** Formulation of an LPP; Graphical Method of solution of an LPP; Convex Combination and Convex Set; ConvexHull and Convex Polyhedron; Canonical and Standard form of an LPP; Basic Solution of a system of linear equations; Simplex Method; Big-M Method; Concept of Duality; Mathematical formulation of duals.

2	**Linear Programming Problem (LPP)-II** Transportation Problems (TP) ; Representation of Transportation Problems as LPP; Methods of finding initial basicfeasible solution of TP: North-West Corner Rule, Matrix Minima Method, Vogel's Approximation Method; Optimality test of the basic feasible solution; Assignment Problems; Hungarian Method.
3	**Game Theory** Introduction; Strategies; The Minimax and Maximin Criterion; Existence of Saddle Point; Two person zero some Games; Games with saddle Point – Pure Strategies; Games without a Saddle Point – Mixed Strategies; Symmetric Games; Dominance Principle; Graphical Method of Solution; Algebraic Method of Solution.
4	**Non-Linear Programming Problem (NLPP)** Single-variable Optimization; Multivariate Optimization with no constraints: Semidefinite Case, Saddle Point; Multivariate Optimization with Equality Constraints: Method of Lagrange Multipliers; Multivariable Optimization with inequality constraints: Kuhn-Tucker Conditions.

Reference Books:

- Linear Programming and Game Theory by J. G. Chakraborty and P. R. Ghosh, Moulik Library.
- Operations Research by KantiSwarup, P. K. Gupta and Man Mohan, S. Chand and Sons.
- Engineering Optimization by S. S. Rao, New Age Techno Press.
- Operations Research by J K Sharma, Macmillan India Ltd

Code: MC23-E305F Paper: Pattern Recognition
Contacts Hours / Week: 3 Credit: 3

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Identify where, when and how pattern recognition can be applied.
- ✓ Equipped with basic mathematical and statistical techniques commonly used in pattern recognition
- ✓ Understand a variety of pattern recognition algorithms.
- ✓ Apply machine learning concepts in real life problems.
- ✓ Design and develop a pattern recognition system for the specific application
- ✓ Evaluate quality of solution of the pattern recognition system.

UNITS	COURSE CONTENT
1	**Basics of Probability, Random Processes and Linear Algebra** Probability: independence of events, conditional and joint probability, Bayes theorem Random Processes: Stationaryand non-stationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra.
2	**Linear Algebra** Inner product, outer product, inverses, eigen values, eigen vectors, singular values, singular vectors.
3	**Bayes Decision Theory** Minimum-error-rate classification. Classifiers, Discriminant functions, Decision surfaces. Normal density anddiscriminant functions. Discrete features.
4	**Parameter Estimation Methods** Maximum-Likelihood estimation: Gaussian case. Maximum a Posteriori estimation. Bayesian estimation: Gaussian case. Unsupervised learning and clustering - Criterion functions for clustering. Algorithms for clustering: K-Means, Hierarchical and other methods. Cluster validation. Gaussian mixture models, Expectation-Maximization method for parameter estimation. Maximum entropy estimation. Sequential Pattern Recognition. Hidden Markov Models (HMMs). Discrete HMMs. Continuous HMMs. Nonparametric techniques for density estimation. K-Nearest Neighbour method.
5	**Dimensionality reduction** Principal component analysis - it relationship to eigen analysis. Fisher discriminant analysis - Generalised eigenanalysis. Eigen vectors/Singular vectors as dictionaries. Factor Analysis, Total variability space - a dictionary learning methods. Non negative matrix factorisation - a dictionary learning method.

6	**Linear discriminant functions** Gradient descent procedures, Perceptron, Support vector machines - a brief introduction.
7	**Artificial neural networks** Multilayer perceptron - feedforward neural network. A brief introduction to deep neural networks, convolutionalneural networks, recurrent neural networks.
8	**Non-metric methods for pattern classification** Non-numeric data or nominal data. Decision trees: Classification and Regression Trees (CART). K-Nearest Neighbour method

Reference Books:

- Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2/E, Wiley - Interscience, 2000.
- Christopher M. Bishop :, "Pattern Recognition And Machine Learning (Information Science and Statistics)" ,1/E,Springer, January 2008
- T. Hastie , R. Tibshirani, J. H. Friedman:, "The Elements of Statistical Learning",1/E ,Springer, Reprint 3/E, 2003
- Christopher M. Bishop ; "Pattern Recognition and Machine Learning", Springer, 2006
- Shigeo Abe, "Advances in Pattern Recognition", Springer, 2005

Code: MC23-305G **Paper: Machine Learning**
Contacts Hours / Week: 3 **Credit: 3**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Understand the concept of machine learning.
- ✓ Identify the regression and classification problem.
- ✓ Relate the supervised, unsupervised learning in the real life problem.
- ✓ Evaluate the machine learning models with respect to the performance parameters.
- ✓ Design and implement various machine learning algorithms in the range of real world problems.

UNITS	COURSE CONTENT
1	**Introduction to Machine Learning** Introduction to Artificial Intelligence, Machine Learning, Deep LearningTypes of Machine Learning, Application of Machine Learning
2	**Linear Algebra** Scalar, Vector, Matrix, Matrix Operation, Norms, Probability, Joint Distribution, Bayes Theorem, Expectation, Co-variance.
3	**Regression and Classification** Simple Linear Regression, Multiple Linear Regression, Least square gradient descent, Linear Classification,Logistic Regression
4	**Decision Tree Learning** Representing concepts as decision trees. Recursive induction of decision trees. Picking the best splitting attribute:entropy and information gain. Searching for simple trees and computational complexity. Overfitting, noisy data, and pruning.
5	**Ensemble Learning** Bagging, boosting, and DECORATE. Active learning with ensembles.
6	**Artificial Neural Networks** Neurons and biological motivation. Linear threshold units. Perceptrons: representational limitation and gradientdescent training. Multilayer networks and backpropagation. Hidden layers and constructing intermediate, distributed representations. Overfitting, learning network structure, recurrent networks.

7	**Support Vector Machines** Maximum margin linear separators. Quadratic programming solution to finding maximum margin separators.Kernels for learning non-linear functions.
8	**Bayesian Learning** Probability theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression. Bayes nets and Markov nets for representing dependencies.
9	**Clustering and Unsupervised Learning** Learning from unclassified data. Clustering. Hierarchical Agglomerative Clustering. k-means partitional clustering.Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labeled and unlabeleddata.
10	**Dimensionality Reduction** Principal component Analysis (PCA), Linear Discriminant Analysis (LDA), Feature selection, Feature manipulationand normalization

Reference Books:

- Machine Learning, Rajiv Chopra, Khanna Publishing House
- Introduction to Machine Learning, Jeeva Jose, AICTE Recommended.
- Machine Learning, V.K. Jain, Khanna Book Publishing, Delhi.
- Pattern Recognition and Machine Learning- Christopher M. Bishop, Springer
- The Elements of Statistical Learning: Data Mining, Inference, and Prediction - Trevor Hastie, Robert Tibshirani, andJerome Friedman, Springer
- Machine Learning for Absolute Beginners: A Plain English Introduction - Oliver Theobald, Scatterplot Press
- Machine Learning -Tom M. Mitchell, Mc Graw Hill

Datasets may be downloaded from the website "http://www1.aucegypt.edu/faculty/hadi/RABE5/"

Code: MC23-E394A **Paper: Image Processing Lab**
Contacts Hours / Week: 4 **Credit: 2**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Students will learn to convert one image form to another image form.
- ✓ Able to learn various kinds of image enhancement and image restoration techniques.
- ✓ They will learn various techniques of image compression, image segmentation etc.

UNIT	COURSE CONTENT
1	Display of Grayscale Images
2	Histogram Equalization
3	Non-linear Filtering
4	Edge detection using Operators
5	2-D DFT and DCT
6	Filtering in frequency domain
7	Filtering in spatial domain
8	Display of color images
9	Discrete Wavelet Transform (DWT) of images
10	Segmentation using watershed transform
11	Image Compression
12	Applications of image zooming and image shrinking etc

Code: MC23-E394B **Paper: Web Enabled JAVA Programming LAB**
Contacts Hours / Week: 4 **Credit: 2**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Create dynamic Website/ Web based Applications

UNIT	COURSE CONTENT
1	HTML to Servlet Applications

2	Applet to Servlet Communication
3	Designing online applications with JSP
4	Creating JSP program using JavaBeans
5	Working with Enterprise JavaBeans
6	Performing Java Database Connectivity.
7	Creating and Sending Email with Java
8	Building web applications

Code: MC23-E394C **Paper: Cloud Computing Lab**
Contacts Hours / Week: 4 **Credit: 2**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Adapt different types of virtualizations and increase resource utilization.
- ✓ Build a private cloud using open-source technologies.
- ✓ Analyze security issues on cloud.
- ✓ Develop real world web applications and deploy on commercial cloud.
- ✓ Demonstrate various service models.

UNIT	COURSE CONTENT
1	Study of NIST model of cloud computing
2	Understand different types of virtualizations, Host and bare metal hypervisors and implement horizontalscalability. **Technology:** XEN/ Vmwares EXSi
3	Implement IaaS using your resources. **Technology:** Open Stack / Eucalyptus
4	Simulate identity management in private cloud **Technology:** Open Stack
5	Explore Storage as a Service for remote file access using web interface. **Technology:** ownCloud
6	Understand security of web server and data directory **Technology:** ownCloud
7	Deploy Platform as a Service; web applications on commercial cloud . **Technology:** Google appEngine/ Windows Azure
8	To create and access VM instances and demonstrate various components such as EC2, S3, Simple DB,DynamoDB **Technology:** Amazon Web Services
9	Understand on demand application delivery and Virtual desktop infrastructure (Software as a Service) **Technology:** Ulteo
10	Understanding of implementation/applications of basic fog computing.

Code: MC23-E394D	**Paper: Web Technology using PHP Lab**
Contacts Hours / Week: 4	**Credit: 2**

Course Outcome:

- ✓ After successful completion of this course, students will be able to understand the underlying assumption of defining variables, constants, operators, expressions, HTML Form creation and submissions. POST & GET Method & Implementation of Decision, Loops, Functions, Array and Exception Handling concepts.
- ✓ How HTML forms are submitted with PHP Server.
- ✓ Strategy to connect with MYSQL Server.
- ✓ Ability to check validation using JavaScript & JQuery.
- ✓ Connecting Forms using AJAX Concept.

UNITS	COURSE CONTENT
1	**Fundamental of Web Design** **HTML:** Introduction, Editor(VS Code/ Sublime), Element, Attribute, Head, Heading, Paragraph, Style, Formatting, Quotation, Comment, Color, CSS, Link, Image, Table, List, Block & Inline, Class, ID, Iframe, Script,File path, Layout, Code, Entity, Symbol, Emoji, Charset, Forms, Form Attributes, Elements, Input types, Input Attributes. **CSS:** Introduction, Selector, External-Internal-Inline CSS, Comments, Color, Background, Border, Margin, Padding, Height, Width, Box model, Outline, Text, Font, Icon, Link, List, Table, Display, Max width, Position, Overflow, Float, Inline-bock, Align, Pseudo-class, Pseudo-element, Opacity, Navigation Bar, Dropdowns, Image gallery, Image sprites, Text Effect, Web Fonts, Transition, Animation, Tooltip, Style Image, Button etc.
2	**Advance Web Design** **CSS Responsive Design:** Introduction, Viewport, Grid view, Media queries, Responsive image, Responsivevideo. **Bootstrap:** Introduction, Container, Grid, Typography, Color, tables, Images, jumbotron, Alerts, Button, Buttongroup, Badges, Progress bar, Spinner, Pagination, List group, Card, Dropdown, Collapse, Navs, Navbar, Forms, Input, Input group, Carousel, Modal, Tooltip, Popover, Toast, Scrollspy, Flex, Media object**.**
3	**Introduction to Web Technology & implementation of PHP Programs &Knowing about ConnectionStrings and Functions.** Implementing basic PHP programs with Form, Loop, Functions Array and Strings.
5	**Handling Html Form With PHP:** Capturing Form. Data Dealing with Multi-value files. Generating File uploaded form. Redirecting a form aftersubmission.
6	**Database Connectivity with MySql:** Programs implementing displaying data from MYSQL to HTML forms using PHP.Programs implementing updating data from MYSQL to HTML forms using PHP. Programs implementing deleting data from MYSQL to HTML forms using PHP.
7	**Java Script & JQuery:** Validating forms using JAVASCRIPT.
8	**Connecting Forms using AJAX Concept:** Fetching data from one form to another form using AZAX.

Code: MC23-E394E **Paper: Android Application Development Lab**
Contacts Hours / Week: 4 **Credit: 2**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Learn to use Android Application development platform.
- ✓ To create simple android application
- ✓ To understand and implement various designing components of Android user interfaces
- ✓ To design application's main navigation screen
- ✓ To understand and designing Android Notification (including push notification)
- ✓ To connect android application to database for data insertion and retrieval

UNITS	COURSE CONTENT
1	**Writing First Application** Creating Android Project, Android Virtual Device Creation, Set up debugging environment, Workspace set up for development, Launching emulator, debugging on mobile devices.
2	**Basic UI design** Basics about Views, Layouts, Resources, Input controls, Input Events, Toasts.
3	**More UI Design** Layouts design GridView and ListView, Action bar, Adapters, Menus: Option menu, context menu, sub menu,Pickers - Date and Time, Spinners.
4	**Activity and Fragment** Activity, Fragment, Activity Lifecycle and Fragment Lifecycle.
5	**Intents** Implicit Intents, Explicit intents, communicating data among Activities.
6	**Navigation Drawer** Panel that displays the app's main navigation screens on the left edge of the screen
7	**Android Notifications** Toast, Dialogs (TimePicker, DatePicker, Progress, Alert), Notification Manager and Push Notification
8	**Introducing SQLite** SQLiteOpenHelper and creating a database - Opening and closing a database, Working with cursors Inserts, updates, and deletes

Code: MC23-E394F **Paper: Basic Data Science Lab using R**
Contacts Hours / Week: 4 **Credit: 2**

Course Outcome:

After successful completion of this course, students will be able to:

- ✓ Perform the quantitative and qualitative analysis of the data.
- ✓ Realized the basic trends in two variable plots of numerical data.
- ✓ Compute the mean, median, mode, standard deviation, and variance of grouped data
- ✓ Determine the equation of the trend line to forecast outcomes for time periods in the future, using alternate coding fortime periods if necessary.
- ✓ Use a computer to develop a regression analysis, and interpret the output that is associated with it.
- ✓ Construct machine learning models for providing business ideas.

UNITS	COURSE CONTENT
1	Read the datasets(.txt, .xlsx, .csv) from the local system
2	Make numerical summery(descriptive statistics) of data
3	Apply various measures- range, interquartile range, mean absolute deviation, variance, and standard deviation
4	Make graphical summery(histogram, scatterplot, pie plot, boxplot) of data
5	Detect the outliers(if exists), impute the outliers using suitable methods.
6	Implement simple linear regression with suitable datasets, observe the standard error, p-value, R-square values.

7	Implement the multivariate regression with suitable datasets and present the outputs (a) What percentage of variation in the response is explained by these predictors? (b) Which observation has the largest (positive) residual? Give the case number. (c) Compute the mean and median of the residuals. (d) Compute the correlation of the residuals with the fitted values. (e) Compute the correlation of the residuals with the target variable.
8	Implement the logistic regression using suitable datasets. Evaluate the performance of the model.
9	Implement kNN for classification and regression problem.
10	Implement weighted kNN for classification and regression problem.
11	Implement decision tree and regression tree and check the model performance.
	Datasets may be downloaded from the website "http://www1.aucegypt.edu/faculty/hadi/RABE5/"

Code: MC23-381

Paper: Minor Project and Viva-voce

Contacts Hours / Week: 8

Total Contact Hours: 120

Credit: 5

A student needs to pursue research/application-based project in his/her institution under the direct supervision/mentorship of assigned teacher(s) and on completion of the same an evaluation will be made on the basis of Project Report, Project Presentation and Viva-voce.

Second Year: Semester-IV

Code: MC23-OE401 **Paper: Open Elective**

Contacts Hours / Week: Not applicable **Total Contact Hours: Not applicable** **Credit: 3**

Open Elective: chosen from the MOOCs basket given by Faculty of Information Technology-may include

- Business Analytics
- Robotics
- Bioinformatics
- Information Theory &Coding
- Automation in VLSI Design
- Intelligent Control
- Design of Embedded Systems
- Machine Learning
- Soft Computing
- Information Retrieval
- Distributed System
- Digital Marketing

(While opting for a domain for pursuing the online course, a student needs to ensure that the domain was not covered inprevious semesters of the program.)

Student may opt for a minimum 12-week online course from Massive Open Online Courses (MOOCs) in one or any of theabove domains with prior approval form the Faculty of Information Technology of the University. In such case, student needs to submit a self-attested copy of the mark-sheet of this online course to Faculty of Information Technology of the University well before the end of Semester IV. Directly on the basis of the result obtained by a student, final marks will be allocated to him/her. In case a student pursues a non- evaluation based online course, **an in-house evaluation would be done by examiner appointed by the Dean Faculty of Information Technology.**

Code: MC23-481 **Paper: Comprehensive Viva-Voce**
Contacts Hours / Week: Not Applicable **Total Contact Hours: Not Applicable** **Credit: 2**

Course Objective

Objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of computer science and application acquired over 2 years of study in the MCA Program.

The viva shall normally cover the subjects taught in all the semesters of MCA Program. This will test the student's learning and understanding during the course. In doing so, the main objective of this course is to prepare the students to face interview both in the academic and the industrial sector.

Code: MC23-482 **Paper: Major Project & Viva-Voce**
Contacts Hours / Week: 40 **Total Contact Hours: 12-15 Weeks** **Credit: 20**

A student needs to pursue research/application-based project in any of the following modes:

[A] In his/her institution under the supervision/mentorship of assigned teacher(s) belonging to that institution.

[B] In his/her institution under the joint supervision/mentorship of assigned teacher(s) belonging to that institution and invitedexternal expert(s).

[C] In a research/software/hardware organization under the joint supervision/mentorship of assigned teacher(s) belonging tothat institution and external expert(s) belonging to that research/software/hardware organization.

On completion of the same, an evaluation will be made by the institution on the basis of Project Report, Project Presentation, Viva-voce and sufficient measures will be taken by the institution to understand that the project is an outcome-based work asa product of student's sole effort.