KARNATAK UNIVERSITY, DHARWAD

Regulations and Syllabus
for
P.G. Studies in

MASTER OF COMPUTER SCIENCE

(M.Sc. (CS))

(I-IV Semester)

Revised Syllabus

Under

Choice Based Credit System (CBCS)

From

2021-22 onwards

Regulations Governing Post-Graduate Programmes in the Faculty of Science & Technology under Choice Based Credit System

(Framed under Section 44(1))(c) Of the K.S.U.Act.2000)

1.0 Title

These Regulations shall be called "Regulations Governing the Post-Graduate Programmes in the Faculty of Science & Technology under Choice Based Credit System" in Karnatak University, Dharwad

2.0 Commencement

These Regulations shall come into force with effect from the academic year 2021-22.

3.0 Definitions

a In these Regulations, unless otherwise provided;

"Academic Council" means Academic Council of the University constituted according to the *Karnataka State Universities Act, 2000.*

b "Board of studies means P. G. Board of studies of the University, Adhoc/Combined and Steering Committees of International Diploma programmes in the discipline/subjects concerned.

c Compulsory Course" means fundamental paper, which the student admitted to a particular Post-Graduate Programme, should successfully complete to receive the Post Graduate Degree in the concerned subject.

d Course Weightage "means number of credits assigned to a particular course.

e "Credit" means the unit by which the course work is measured. One Credit means one hour of teaching work or two hours of practical work per week. As regard the marks for the courses, 1 Credit is equal to 25 marks, 2 credits are equal to 50 marks, 3 credits are equal to 75 marks and 4 credits are equal to 100 marks.

f "Cumulative Grade Point Average(CGPA)"refers to the cumulative Grade Point Averages weighted across all the semesters and is carried forward from first semester to subsequent semesters.

g "Degree" means Post-Graduate Degree.

h "Grade" is an index to indicate the performance of a student in the selected course. These Grades are arrived at by converting marks scored in each course by the candidate in both Internal Assessment and Semester-end Examinations.

i "Grade Point Average"(GPA)" refers to an indication of the performance of the student in a given semester.GPA is the weighted average of all Grades a student gets in a given semester.

j "Open Elective Course "means a paper offered by a Department to the students of other Departments.

k "Post Graduate Programme" means semesterised Master's Degree Programmes excluding P. G. Diploma.

l "Specialization course" means advanced paper offered by a Department that a student of that Department can opt a special course.

m "Student" means the student admitted to programmes under (k).

n "University "means Karnatak University, Dharwad.

4.0 Minimum Eligibility for Admission

A candidate who has successfully completed Bachelor's Degree programme in Science or any other Degree programme of this University or of any other University recognized as equivalent there to by this university, shall be eligible for admission to the Post Graduate Programmes in science provided the candidate also satisfies the conditions like the minimum percentage of marks and other eligibility conditions as prescribed by the university from time to time.

Admission shall be as per Government of Karnataka reservation policy and the directions issued in this regard from time to time.

5.0 Duration of the programme

The duration of the study for the Post-Graduate Degree programme shall extend over a period of two consecutive academic years, each academic year comprising two semesters, and each semester comprising sixteen weeks with a minimum of ninety working days.

However the student, who discontinue the programme after one or more semesters due to extraordinary circumstances, are allowed to continue and complete the programmer with due approval from the Registrar. Candidates shall no register for any other regular course other than diploma and certificate courses being offered on the campus during the duration of P.G. Programme.

6.0 Medium of Instruction and Evaluation

The medium of instruction shall be English.

7.0 Programme Structure

7.1 The student of Post –Graduate programme shall study the courses as may be approved by the concerned Board of Studies, Faculty and the Academic Council of the University from time to time minimum and maximum credits as outlined in these regulations.

7.2 There shall be three categories of courses namely, compulsory courses, specialization Courses and Open Elective Courses.

7.3 Each programme shall have a set of Compulsory Courses, as stipulated in the regulations governing the concerned programme that a student must complete to get the concerned programme that a student must complete to get the concerned degree.

7.4 In those programmes that offer specialization courses, the student shall choose the prescribed number of specialization courses offered within the Department

7.5 Each Department shall offer Open Elective courses for students of other Departments, The students of a Department shall choose Open Elective courses from among those prescribed by the university and selected by the Department from time to time. P.G. Centers and affiliated colleges can offer those open Elective Course, which are approved or prescribed by their Parent Department of the University. Such open Elective courses shall be taught by qualified teachers approved by the University.

7.6 The credits for each of the Compulsory Courses may vary from 2 to 4; for Specialization Course, from 2 to 4; and for Open Elective Course, from 2 to 4, wherever project work/field work/practical are involved in the course, the credits may extend to 6 or as otherwise provided by concerned programme.

7.7 The minimum credits for P.G. Programme shall be 96. In the case of MCA, the minimum number of credits shall be 158 and in case of M Sc. Computer Science the minimum credits are 116.

7.8 The student shall undertake project/field work during the programme as a compulsory course or in lieu of Specialization Course or open Elective Course if so specified by the concerned Board of Studies.

7.9 The ratio between Compulsory, Specialization and Open Elective may differ from department to department.

7.10 The detailed programme structure for Faculty of Science & Technology shall be as prescribed and shown in Annexure-I,Annexure-IA,Annexure-Ib.

7.11 The Open Elective courses generally will have practical component, unless otherwise specified by the respective Board of Studies .The number of students admitted to the course shall commensurate with the availability of infrastructure.

8.0 Attendance

8.1 Each course shall be taken as a unit for the purpose of calculating the attendance.

8.2 Each student shall sign the attendance register maintained by the Department for each course for every hour/unit of teaching /practical. The course teachers shall submit the monthly attendance report to the Chairperson of the Department who shall notify the same on the notice board of the Department during the second week of the subsequent month.

8.3 Marks shall be awarded to the student for attendance as specified in the regulations concerning evaluation.

8.4 A student shall be considered to have satisfied the required attendance for each course if he/she has attended not less than 75% of the number of instructional hours during the semester.

8.5 There is no provision for condoning shortage of attendance.

8.6 The students who do not satisfy the prescribed requirement of attendance shall not be eligible for the ensuring examination. Such candidates may seek admission afresh to the given semester.

8.7 Such of the candidates who have participated in State/National level Sports, NSS, NCC, Cultural activities and other related activities as stipulated under the existing regulations shall be considered for giving attendance for actual number of days utilized in such activities (including travel days) subject to the production of certificates from the relevant authorities within two weeks after the event.

9.0 Examination

9.1 There shall be an examination at the end of each semester. The odd semester examinations shall be conducted by the respective Department/P.G. Centers/Colleges. The even semester examination shall be conducted by the University.

9.1.1 Unless otherwise provided, there shall be semester-end examination of 3 hours duration for 75/100 marks; 1.5 hours for 50 marks and 2/4 hours for 35/75 marks practical examination.

9.1.2 Every student shall register for each semester-end examination as per the University Notification by submitting duly completed application from through the proper channel and shall also pay the fees prescribed.

9.1.3 The office of the Registrar (Evaluation) shall allot the Register Number to the candidate at the 1st semester-end examination. That will be the Register Number to the candidate for all subsequent appearance at semester-end examinations.

9.1.4 The answer scripts shall be in the safe custody of the University for a maximum period of six months from the date of announcement of results. These shall be disposed off after six months.

9.1.5 The programme under CBCS is a fully carry-over system. A candidate reappearing for either the odd or even semester examinations shall be permitted to take examinations as and when they are conducted (even semester examination in even semester and odd semester examination in odd semester)

9.1.6 Candidate who have failed, remained absent or opted for improvement in any course/courses shall appear for such course/courses in the two immediate successive examinations that are conducted. However, in the case of the candidates appearing for improvement of their marks, the marks secured in the previous examination shall be retained, if the same is higher.

9.1.7 Candidates who desire to challenge the marks awarded to them, in the even semester-end examinations, may do so by submitting an application along with the prescribed fees to the Registrar (Evaluation) within 15 day from the announcement of results.

9.2 Odd Semester Examination

9.2.1 There shall be a Board of Examiners to set, scrutinise and approve question papers.

9.2.2 The BOE shall scrutinise and approve question papers submitted in two sets by the paper setters and submit the same to the office of the Registrar (Evaluation).

9.2.3 The office of the Registrar Evaluation shall dispatch the question papers to the Department/P.G. Center/Colleges who shall conduct the Examinations according to the Schedule announced by the University.

9.2.4 The Chairperson of the Department/Administrator of the P.G. Center/Principal of the College shall appoint one of their full time courses teachers as Post Graduate Programme (PGP) Coordinator who shall conduct the examinations and arrange for evaluation of answer scripts.

9.2.5 Answer scripts shall be valued by the examiners appointed by the University. However, in those centers where an examiner for a particular course is not available, then the answer scripts of that course shall be dispatched to the officer of the Registrar (Evaluation) who shall arrange for valuation of the same.

9.2.6 There shall be single valuation. The examiners (Internal or External) shall value the answer scripts and shall indicate the marks awarded to each question on the answer script.

9.2.7 The Marks List, a copy of the Examination Attendance Sheet and the sealed bundles of the answer scripts shall be dispatched by the PGP Coordinator to the Registrar (Evaluation)'s Officer at the conclusion of the valuation at the respective centers.

9.2.8 The Office of the Registrar Evaluation shall process and announce the results.

9.3 Even Semester

9.3.1 There shall be a Board of Examiners to set, scrutinise and approve question papers.

9.3.2 As for as practicable, it will be ensured that 50% o the paper setters and examiners are from other University/Research Institutes.

9.3.3 Each answer script of the semester-end examination (theory and project report) shall be assessed by two examiners (one internal and another external). The Marks awarded to that answer script shall be the average of these two evaluations. If the difference in marks between two evaluations exceeds 20% of the maximum marks, such a script shall be assessed by a third examiner. The marks allotted by the third examiner shall be averaged with nearer award of the two evaluations.

Provided that in case the number of answer scripts to be referred to the third examiner in a course exceeds minimum of 5 or 20% of the total number of scripts, at the even semester-end examinations, such answer scripts shall be valued by the Board of Examiners on the date to be notified by the Chairperson of the Board of Examiners and the marks awarded by the Board shall be final.

9.3.4 Wherever dissertation/project work is prescribed in the even semesters of the programme, the same shall be evaluated by both internal and external examiners. The valuation shall be as prescribed by the concerned Board of Studies.

9.3.5 In case of programmes with practical examination details of maximum marks, credits or duration may vary from Department to Department as specified by the concerned Board of Studies.

9.4 Evaluation

9.4.1 Each Course shall have two evaluation components – Internal Assessment (IA) and the Semester End Exams.

9.4.2 The IA component in a course shall carry 25% / 30% / 50% and the Semester End Examination shall carry 75% / 70% /50% respectively, as the case may be. Courses have 25% & 30%/50% marks as internal assessment shall have 3/5 marks allotted to attendance. However, in case of project work, the distribution of marks for Internal Assessment and Examination shall be left to the discretion of the concerned BOS.

9.4.3 Marks for attendance shall be awarded to the students according to the following table

For courses carrying 25% of marks for IA, the attendance marks shall be

Attendance (in Percentage)	**Marks**
Above 90	3
Above 80 and up to 90	2
Above 75 and up to 80	1

Internal Assessment (IA) shall be based on written tests, practical and seminars.

9.4.4 However, the number of IA components per course per semester shall not be less than two.

9.4.5 The IA marks list shall be notified on the Department Notice Board as and when the individual IA components are completed and the consolidated list shall be submitted to the Office of the Registrar Evaluation before the commencement of semester-end examination, or as directed by the University.

9.4.6 The test shall be written in a separately designated book supplied by the University which shall be open for inspection by the students after evaluation.

9.4.7 There is no provision for seeking improvement of Internal Assessment marks.

9.4.8 The IA records, pertaining to Semester Examination, shall be preserved by the department/Centers/Colleges for a period of one year from the date of semester examination. These records may be called by the University or a body constituted by the University as and when deemed necessary.

9.4.9 The dissertation/project work viva-voce shall be conducted by an internal and external examiner.

10.0 Maximum duration for completion of the Programme

10.1 A candidate admitted to a post graduate programme shall complete it within a period, which is double the duration of the programme form the date of admission.

10.2 Whenever the syllabus is revised, the candidate reappearing shall be allowed for the examinations only according to the new syllabus.

11.0. Declaration of Results

11.1 The minimum for a pass in each course shall be 40% of the total marks including both the IA and the semester-end examinations. Further, the candidate shall obtain at least 40% of the marks in the semester-end examination. There is no minimum for the IA marks.

11.2 Candidates shall secure a minimum of 50% in aggregate in all courses of a program in eachsemester to successfully complete the program.

11.3 Candidates shall earn the prescribed number of credits for the program to qualify for the PG Degree.

11.4 For the purpose of announcing the results, the aggregate of the marks secured by a candidate in all the semester examinations shall be taken into account. However, Ranks shall not be awarded in case the candidate has not successfully completed each *of* the semesters in first attempt or has not completed the program in the stipulated time (vide Regulation 5) or had applied for improvement of results.

12.0 Marks, Credit Points, Grade Points, Grades and Grade Point Average

12.1 The grade points and the grade letters to candidates in each course shall be awarded as follows:

Percentage of marks	Grade Points	Grade Letter
75 and above, up to 100.00 %	7.50 to 10.00	A
60 and above but less than 75 %	6.00 and above but less than 07.5	**B**
50 and above but less than 60 %	5.00 and above but less than 6.0	C
40 and above but less than 50 %	4.00 and above but less than 05.00	**D**
less than 40.00 %	Less than 4.00	F

12.2 Credit Point (CP): The Credit Point for each course shall be calculated by multiplying the grade point obtained by the credit of the course.

12.3 The award of Grade Point Average (GPA) for any student is based on the performance in the whole semester. The student is awarded Grade Point Average for each semester based on the Total Credit Points obtained and the total number of credits opted for. The GPA is calculated by dividing the total credit points earned by the student in all the courses by the total number of credits of those courses of the semester.

12.4 The Cumulative Grade Point Average (CGPA) shall be calculated by dividing the total number of credit points in all the semesters by the total number of credits in all the semesters. The CGPA to date shall be calculated by dividing the total number of credit points in all the semesters to date by the total number of credits in all the semesters to date.

CGPA for the **I**Semester= Sum of the CP of the **I** Semester / Sum of the credits of the I Semester

CGPA for the **II** Semester =Sum of the CP of the **I**Semester+ Sum of the CP of **II** Semester./ Sum of the credits of the I Semester + **II** Semester

CGPA for the III and IV Semesters shall be computed accordingly**.**

12.5 The Grade Card at each semester examination shall indicate the courses opted by the student, the credit for the course chosen by the student, the credit points obtained in each course, the grade letter and the grade point average. No class shall be awarded for each semester and the same would only be awarded at the end of all the semesters based on Cumulative Grade Point Average.

12.6 Class shall be awarded to the successful candidates based on the Cumulative Grade Point Average (CGPA) as specified below:

Cumulative Grade Point Average (CGPA)	Class To Be Awarded
7.5 to 10.0	First Class With Distinction
6.0 and above but below 7.5	First Class
5.0 and above but below 6.0	Second Class

13. Miscellaneous:

a. Notwithstanding anything contained in these regulations, the semester system at Post-Graduate level is hereby repealed.

b. The provisions of any order, Rules or Regulations in force shall be inapplicable to theextent of its inconsistency with these Regulations.

c. The University shall issue such orders, instructions, procedures and prescribe suchformat as it may deem fit to implement the provisions of this Regulations.

d. The procedural details may be given by the University from time to time.

e. Any unforeseen problems/ difficulties may be resolved by the Vice Chancellor, whose decision in the matter shall be final.

Annexure-I

The Program structure of the Master of Science Degree shall be as follows:

Semester	No.of compulsory& Specialization courses (credits/course)	Total credits for compulsory &Specialization courses	No. of open elective course (credits/course)	Total credits of open elective course	Total credits for the semester
Sem. I	Th :03 (04) =12 Pra/Th*:03 (02)=06	18	Th :01 (04) =04 Pra/Th*:01(02)=02	06	24
Sem. II	Th :03 (04) =12 Pra/Th*:03 (02)=06	18	Th :01 (04) =04 Pra/Th*:01(02)=02	06	24
Sem. III	Th:03(04)=12 Pra/Th*:03 (02)=06	18	Th :01 (04) =04 Pra/Th*:01(02)=02	06	24
Sem. IV	Th :03/04** (04) =12/16 Pra/Th: 03/04* *(02)=06/08 Pj# 01 (06) =06	24		-	24
Total	Th 12/13 (4) =48/52 Pra/Th 12/13(02)= 24/26 Pj:1 (06)=06	78	03 (04)=12 Pra/Th*:03(02)=06	18	96

Note: Except for IV semester, the concerned Department shall offer one each of open elective theory and practical course**or**two * open elective Theory courses for students of other science departments**.*** Only for Mathematics; ** for Mathematics and Statistics; # except Mathematics & Statistics Abbreviations: Th = Theory; Pra = Practical; Pj = Project

GRADE CARD

Program: M.Sc. (……..)

Name of the candidate: **Semester:IV**

Seat No: **Month &Year:**

Course	Course Code	Credit	IA Marks		Theory/ Practical		Max	Marks Obtained	Semester Grade Point	Credit Point
Compulsory Courses			**Max**	**Obt**	**Max**	**Obt**				
Course - **I**	XX CT 4.1	**04**	**25**	**15**	75	45	100	60	6.00	24.00
Course - II	XX CT 4.2	04	25	15	75	59	100	74	7.40	29.60
Course - III	XX CT 4.3	04	25	15	**75**	28	100	43	4.30	17.20
Course - IV	XX CP 4.4	02	15	06	35	34	50	40	8.00	16.00
Total		**14**					**350**			

XX refers to course abbreviations. 4.1 refers to IV semester course 1; e.g. CHI CT 1.1= Chemistry Inorganic compulsory theory 1.1

except for Mathematics and Statistics;* For Statistics and mathematics; +Only for Statistics;^only for Mathematics

GPA for IV Semester = CP (IV Sem) / Credits (IV Sem) = 200 /24.00 = 8.33

GPA for I Semester = CP (I Sem) / Credits (I Sem)

CGPA for I Semester = GPA for I Semester CP (ISem) + CP (IISem)

CGPA for II Semester= CP(I SEM)+CP(II SEM)

———————————

Credit(I Sem)+ Credit(II Sem)

CGPA for III Semester= CP(I SEM)+CP(II SEM)+CP(III SEM)

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Credit(I Sem)+ Credit(II Sem) +Credit(III Sem)

CGPA for the program = CP(I SEM)+CP(II SEM)+CP(III SEM)+CP(IV Sem)

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Credit(I Sem)+ Credit(II Sem) +Credit(III Sem)+ Credit(IV Sem)

(*CP:Credit Points)

Annexure-1a

The program structure of the **M.Sc. (Computer Science)** shall be as follows:

Semester	No.of compulsory& Specialization courses (credits/course)	Total credits for compulsory &Specialization courses	No. of open elective course (credits/course)	Total credits of open Elective course	Total credits for the semester
Sem. I	Th :05 (04) =20Pra:01(04)=04	24	Th :01 (04) =04 Pra:01(02)=02	06	30
Sem. II	Th :05 (04) =20Pra:01(04)=04	24	Th :01 (04) =04 Pra:01(02)=02	06	30
Sem. III	Th :05 (04) =20Pra:01(04)=04	24	Th :01 (04) =04 Pra: 01(02)=02	06	30
Sem. IV	Th :05 (04) =20Pra:01(06)=06	26	----------	----------	26
Total	Th 20 (04) =80 Pra 03(04)=12 Pj:1 (06)=06	98	Th:03 (04)=12 Pra:03(02)=06	18	116

Note: Except for I and IV semester, the concerned Department shall offer one each of open elective theory and practical for students of other science departments**.**

Abbreviations: Th = Theory; Pra = Practical; Pj = Project;

GRADE CARD

Program: M.Sc. (Computer Science)

Name of the candidate: **Semester: I/II/III**

Seat No: **Month &Year:**

Courses	Course Code	Credit	IA Marks		Theory/ Practical		Max Marks	Marks Obtained	Semester Grade Point	Credit Point
Compulsory Courses			**Max**	**Obt**	**Max**	**Obt**				
Course - I	CT X.1	04	25	15	75	45	100	60	6.00	24.00
Course - II	CT X.2	04	25	15	75	59	100	74	7.40	29.60
Course - III	CT X.3	04	25	15	75	50	100	65	6.50	26.00
Course - IV	CT X.4	04	25	15	75	45	100	60	6.00	24.00
Course - V	CT X.5	04	25	15	75	50	100	65	6.50	26.00
Course - VI	CT X.6	04	25	15	75	45	100	60	6.00	24.00
Open elective courses:										
Course - VII	ET X.7	04	25	15	75	50	100	65	6.50	26.00
Course - VIII	ET X.8	02	10	05	40	35	50	40	8.00	16.00
Total		**30**					**750**			**195.60**

CT: Core Theory

CP: Core Practical

X:Semester

GRADE CARD

Program: M.Sc. (Computer Science)

Name of the candidate: **Semester:IV**

Seat No: **Month &Year:**

Course	Course Code	Credit	IA Marks		Viva-voce		Theory/ Practical		Max Marks	Marks Obtained	Semester Grade Point	Credit Point
Compulsory Courses			**Max**	**Obt**	**Max**	**Obt**	**Max**	**Obt**				
Course - **I**	CT 4.1	**04**	**25**	**15**			75	45	100	60	6.00	24.00
Course - II	CT 4.2	04	25	**15**			75	59	100	74	7.40	29.60
Course - III	CT 4.3	04	25	**15**			75	50	100	65	6.50	26.00
Course - IV	**CPR 4.4**	**06**	**25**	**15**	**50**	**40**	75	**45**	**150**	**120**	**8.00**	**48.00**
Course - V	CT 4.5	04	**25**	**15**			75	50	100	65	6.50	26.00
Course - VI	CT 4.6	04	**25**	**15**			75	***45***	100	60	6.00	24.00
Total		**26**							**650**			**177.60**

CT: Core Theory

CP: Core Project

CGPA for I Semester = 195.60/30=6.52
CGPA for I Semester=GPA=6.52

$$\text{CGPA for II Semester} = \frac{\text{CP(I SEM)+CP(II SEM)}}{\text{Credit(I Sem)+ Credit(II Sem)}}$$

$$\text{CGPA for III Semester} = \frac{\text{CP(I SEM)+CP(II SEM)+CP(III SEM)}}{\text{Credit(I Sem)+ Credit(II Sem) +Credit(III Sem)}}$$

$$\text{CGPA for the program} = \frac{\text{CP(I SEM)+CP(II SEM)+CP(III SEM)+CP(IV Sem)}}{\text{Credit(I Sem)+ Credit(II Sem) +Credit(III Sem)+ Credit(IV Sem)}}$$

(*CP:Credit Points)

Annexure-1b

The program structure of the **M.Sc.(Computer Science)** shall be as follows:

Semester	No.of compulsory& Specialization courses (credits/course)	Total credits for compulsory &Specialization courses	No. of open elective course (credits/course)	Total credits of open elective course	Total credits for the semester
Sem.I	Th :05 (04) =20 Pra:01(04)=04	24	Th :01 (04) =04 Pra:01(02)=02	06	30
Sem.II	Th :05 (04) =20 Pra:01(04)=04	24	Th :01 (04) =04 Pra:01(02)=02	06	30
Sem.III	Th :05 (04) =20 Pra:01(04)=04	24	Th :01 (04) =04 Pra:01(02)=02	06	30
Sem.IV	Th :05 (04) =20 Pra:01(04)=04 SR:01(02)=02	26	----------	----------	26
Total	Th:20 (04) =80 Pra:05(04)=020 SR:02(02)=004 Pj:1 (16)=016	98	Th:03 (04)=12 Pra:03(02)=06	18	116

Note: Except for I and IV semester, the concerned Department shall offer one each of open elective theory and practical for students of other science departments**.**

Abbreviations: Th = Theory; Pra = Practical; Pj = Project;

GRADE CARD

Program: M.Sc.(Computer Science)

Name of the candidate: **Semester: I/II/III**

Seat No: **Month &Year:**

Courses	Course Code	Credit	IA Marks		Theory/ Practical		Max Marks	Marks Obtained	Semester Grade Point	Credit Point
Compulsory Courses			**Max**	**Obt**	**Max**	**Obt**				
Course - I	CT X.1	04	25	15	75	45	100	60	6.00	24.00
Course - II	CT X.2	04	25	15	75	59	100	74	7.40	29.60
Course - III	CT X.3	04	25	15	75	50	100	65	6.50	26.00
Course - IV	CT X.4	04	25	15	75	45	100	60	6.00	24.00
Course - V	CT X.5	04	25	15	75	50	100	65	6.50	26.00
Course - VI	CT X.6	04	25	15	75	45	100	60	6.00	24.00
Open elective courses:										
Course - VII	ET X.7	04	25	15	75	50	100	65	6.50	26.00
Course - VIII	ET X.8	02	10	05	40	35	50	40	8.00	16.00
Total		**30**					**750**			**195.60**

CT: Core Theory

CP: Core Practical

CSR: Core Seminar

X:Semester

GRADE CARD

Program: M.Sc.(Computer Science)

Name of the candidate: **Semester: IV**

Seat No: **Month &Year:**

Courses	**Course Code**	**Credit**	**IA Marks**		**Theory/ Practical**		**Max Marks**	**Marks Obtained**	**Semester Grade Point**	**Credit Point**
Compulsory Courses			**Max**	**Obt**	**Max**	**Obt**				
Course - I	CT X.1	04	25	15	75	45	100	60	6.00	24.00
Course - II	CT X.2	04	25	15	75	59	100	74	7.40	29.60
Course - III	CT X.3	04	25	15	75	50	100	65	6.50	26.00
Course - IV	CT X.4	04	25	15	75	45	100	60	6.00	24.00
Course - V	CT X.5	04	25	15	75	50	100	65	6.50	26.00
Course - VI	CP X.6	04	25	15	75	45	100	60	6.00	24.00
Course - VII	CSR X.7	02	---	---	---	---	50	40	8.00	16.00
Total		**26**					**650**			**169.60**

CT: Core Theory

CP: Core Practical

CSR: Core Seminar

X:Semester

SEMESTER – I

Sem. No.	Paper Code	Paper Title	Credits	No. of Hrs/Week Theory/ Practical	Duration of exam In Hrs Theory/ Practical	Internal Assessment Marks Theory/ Practical	Marks at the Exams	Total Marks
I	M.Sc.1.1	Computer Organizations and Architecture	4	4	3	25	75	100
	M.Sc.1.2	Theory of Computation	4	4	3	25	75	100
	M.Sc.1.3	Data Structures using C	4	4	3	25	75	100
	M.Sc.1.4	Probability and Statistics	4	4	3	25	75	100
	M.Sc.1.5	Data Structures using C Lab	4	4	3	25	75	100
	M.Sc.1.6	Probability and Statistics Lab	4	4	3	25	75	100
		Total	**24**	**24**	**18**	**150**	**450**	**600**

SEMESTER – II

Sem. No.	Paper Code	Paper Title	Credits	No. of Hrs/Week Theory/ Practical	Duration of exam In Hrs Theory/ Practical	Internal Assessment Marks Theory/ Practical	Marks at the Exams	Total Marks
II	M.Sc.2.1	Computer Networks	4	4	3	25	75	100
	M.Sc.2.2	Linear Algebra	4	4	3	25	75	100
	M.Sc.2.3	Database Management System	4	4	3	25	75	100
	M.Sc.2.4	Python Programming	4	4	3	25	75	100
	M.Sc.2.5	DBMS Lab (using My SQL)	4	4	3	25	75	100
	M.Sc.2.6	Python Programming Lab	4	4	3	25	75	100
	Open Elective							
	OEC 2.7	Computer Concepts and Office Automation	4	4	3	25	75	100
		Total	**28**	**28**	**21**	**175**	**525**	**700**

SEMESTER - III

Sem. No.	Paper Code	Paper Title	Credits	No. of Hrs/Week Theory/ Practical	Duration of exam In Hrs Theory/ Practical	Internal Assessment Marks Theory/ Practical	Marks at the Exams	Total Marks
III	M.Sc.3.1	Design and Analysis of Algorithms	4	4	3	25	75	100
	M.Sc.3.2	Core Theory Electives-I	4	4	3	25	75	100
	M.Sc.3.3	Web Technologies	4	4	3	25	75	100
	M.Sc.3.4	Artificial Intelligence and Machine Learning	4	4	3	25	75	100
	M.Sc.3.5	Web Tech. Lab	4	4	3	25	75	100
	M.Sc.3.6	Artificial Intelligence and Machine Learning Lab	4	4	3	25	75	100
	Open Elective							
	OEC 3.7	SPSS Software	4	4	3	25	75	100
		Total	**28**	**28**	**21**	**175**	**525**	**700**

Core Theory Electives-I:

Subject Code	Elective Title
M.Sc.3.2 A	Operating System Concepts
M.Sc.3.2 B	Computer Vision
M.Sc.3.2 C	Mobile Computing
M.Sc.3.2 D	Business Intelligence Systems
M.Sc.3.2 E	Computer Graphics

SEMESTER - IV

Sem. No.	Paper Code	Paper Title	Credits	No. of Hrs/Week Theory/ Practical	Duration of exam In Hrs Theory/ Practical	Internal Assessment Marks Theory/ Practical	Marks at the Exams	Total Marks
IV	M.Sc.4.1	Software Engineering	4	4	3	25	75	100
	M.Sc.4.2	**Core Theory Electives-II**	4	4	3	25	75	100
	M.Sc.4.3	Data Mining	4	4	3	25	75	100
	M.Sc.4.4	Operation Research	4	4	3	25	75	100
	M.Sc.4.5	Data Mining Lab	4	4	3	25	75	100
	M.Sc.4.6	Project	4	4	3	25	75	100
		Total	**24**	**24**	**18**	**150**	**450**	**600**

Core Theory Electives-II:

Subject Code	Elective Title
M.Sc.4.2 A	Cloud Computing
M.Sc.4.2 B	Internet of Things (IoT)
M.Sc.4.2 C	Mobile Communications
M.Sc.4.2 D	Deep learning
M.Sc.4.2 E	Information Security and Cryptography
M.Sc.4.2 F	Soft Computing

M.Sc.1.1: COMPUTER ORGANIZATIONS AND ARCHITECTURE

Total Hours: 48

Upon Completion of the course, the students will be able to

- Explain the concepts of binary numbers, computer instructions and peripheral devices.
- Able to solve number conversions and Boolean expressions.
- Analyze the functions of combinational logic, instruction formats and basics of memory.
- Evaluate the importance of logic gates, flip-flops and addressing modes.
- Capable of design the digital circuits using logic gates.
- Build combinational and sequential logic circuit.
- Identify the components of register, input/output and memory organizations.

Unit-I **10 Hrs**

Number Systems: binary, octal hexadecimal, number base conversion, addition, subtraction of binary numbers, one's and two's complements, positive and negative numbers, character codes ASCH, EBCDIC.

Boolean algebra and Logic gates: Axiomatic definition of Boolean algebra, Basic theorems and properties, Boolean functions, canonical and standard forms, logic functions using gates and design of combinational circuits.

Unit-II **10 Hrs**

Simplification of Boolean functions: Karnaugh maps, product of sums, sum of products, simplification, NAND and NOR implementation, don't care condition.

Combinational and Sequential logic: Adders, subtractors, code, converters, decoder multiplexer, flip-flops, shift registers, counters.

Unit-III **10 Hrs**

Processor Logic Design: Processor organization, arithmetic logic unit, design of arithmetic and logic circuits, design of arithmetic logic unit, status registers, design of shifter, processor unit, design of accumulator.

Control Logic Design: Processor Organization, Hardware control micro program control, control of processor unit, PLA control, micro program sequencer, computer design.

Unit- IV **10 Hrs**

Micro – computer System Design: Microcomputer organization, microprocessor organization, instructions and addressing modes, subroutines and interrupts, memory organization, input-output interface, programmed input-output, input – output processor, input – output device characteristics, direct memory access (DMA).

Unit-V **8 Hrs**

Memory Organization: Serial access, random access memories (RAM), read only memories (ROM), virtual memory, cache memory.

Introduction to 8085Assembly Language Programming: The 8085 Programming model, Instruction classification, Instruction format, How to write, Assemble and Execute a simple program, Overview of the 8085 Instruction set.

References:

1. Digital Logic and Computer Design, Morris Mano, PHI
2. Digital Computer Fundamentals, Bartee, T.C., MC Graw Hill
3. Computer Architecture and Organization, Tanenbaum A.S., Mc Graw Hill
4. Computer Architecture and Organization, hayes, J.P., Mc Graw Hill
5. Introduction to Microprocessors, Gaonkar, Tata Mc Graw Hill
6. Digital Computer Electronics Malvino & Brown Shird Education, TMH.

M.Sc.1.2: THEORY OF COMPUTATION

Total Hours: 48

Upon Completion of the course, the students will be able to

- Discuss key notions of computation, such as algorithm, computability, decidability, reducibility, and complexity, through problem solving.
- Explain the models of computation, including formal languages, grammars and automata, and their connections.
- Analyze and design finite automata, pushdown automata, Turing machines, formal languages, and grammars.
- Solve computational problems regarding their computability and complexity and prove the basic results of the theory of computation.

Unit-I **10Hrs**

Introduction To Finite Automata: Introduction to Finite Automata, the central concepts of Automata theory, deterministic finite automata, non-deterministic finite automata, an application. Finite automata with Epsilon-transitions.

Unit-II **10 Hrs**

Regular Expressions and Languages, Properties Of Regular Languages: Regular expression, Finite Automata and Regular Expressions, Applications of Regular Expressions, Proving languages not to be regular, Closure properties of Regular languages, Decision properties of Regular languages. Equivalence and minimization of automata.

Unit-III **10 Hrs**

Context-Free Grammars And Languages: Context-free grammars. Parse trees, Applications, Ambiguity in grammars and languages.

Pushdown Automata: Definition of the Pushdown automata, The languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata.

Unit-IV **10Hrs**

Properties Of Context-Free Languages: Normal forms for CFGs, The pumping lemma for CFGs, Closure properties of CFLs.

Introduction To Turing Machines: Problems that computers cannot solve. The Turing Machine, Programming techniques for Turing Machines, Extensions to the basic Turing Machine, Restricted Turing Machines, Turing Machine and Computers.

Unit-V **08 Hrs**

Un decidability: A Language that is not recursively enumerable, An Undecidable problem that is RE, Post's Correspondence problem. Other un decidable problems.

References:

1. J.P. Hopcroft, Rajeev Motwani, J.D. Ullman, Introduction to automata Theory, Languages and Computation, II edition, Pearson Education, 2001.
2. Introduction to Formal Languages and Automata, Peter Linz, Narosa Publ.
3. Languages & Machine An Introduction to Computer Science, Thomds A Sud Kamp, Addison Wesley.
4. Elements of theory of Computation, H.R. Lewis, Shistor H, Papadimitroce, Prentice Hall, New Delhi 199
5. Introduction to Language and Theory of Computation, John Mastin TMH New Delhi, 1998.
6. Theory Of Computation, Rajesh K Shukla,Cengage \ Delmar Learning India Pvt, 1, 2009

MSc 1.3: DATA STRUCTURES USING C

Total Hours: 48

Upon Completion of the course, the students will be able to

- Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms.
- Describe common applications for arrays, records, linked structures, stacks, queues, trees, and graphs.
- Write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs.
- Demonstrate different methods for traversing trees.
- Compare alternative implementations of data structures with respect to performance.
- Compare and contrast the benefits of dynamic and static data structures implementations.
- Describe the concept of recursion, give examples of its use, describe how it can be implemented using a stack.
- Design and implement an appropriate hashing function for an application.
- Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing.

Unit- I INTRODUCTION TO DATA STRUCTURES 08Hrs

Basic concepts: Introduction to data structures, classification of data structures, operations on data structures; Searching techniques: Linear search and Binary search; Sorting techniques: Bubble sort, selection sort, insertion sort and comparison of sorting techniques.

Unit - II LINEAR DATA STRUCTURES 10 Hrs

Stacks: Primitive operations, implementation of stacks using Arrays, applications of stacks, arithmetic expression conversion and evaluation; Queues: Primitive operations; Implementation of queues using Arrays, applications of linear queue, circular queue and double ended queue (deque).

Unit - III LINKED LISTS 12 Hrs

Linked lists: Introduction, singly linked list, representation of a linked list in memory, Types of linked lists: Single linked lists Circular linked lists, doubly linked lists; operations on a single linked list; Applications of linked lists: Polynomial representation and sparse matrix manipulation.

Unit - IV NON LINEAR DATA STRUCTURES 10 Hrs

Trees: Basic concept, binary tree, binary tree representation, array and linked representations, binary tree traversal, binary tree variants, application of trees; Graphs: Basic concept, graph terminology, graph implementation, graph traversals, Application of graphs, Priority Queue.

Unit - V Binary search tree and HASHING 08Hrs

Binary search trees, properties and operations; Balanced search trees: AVL trees; Introduction to M-Way search trees, B trees; Hashing and collision: Introduction, hash tables, hash functions, collisions, applications of hashing.

References:

1. S. Lipschutz, “Data Structures”, Tata McGraw Hill Education, 1st Edition,2008.

2. D. Samanta, “Classic Data Structures”, PHI Learning, 2nd Edition,2004.

Web References:

1. https://www.tutorialspoint.com/data_structures_algorithms/algorithms_basics.htm
2. https://www.codechef.com/certification/data-structures-and-algorithms/prepare
3. https://www.cs.auckland.ac.nz/software/AlgAnim/dsToC.html
4. https://online-learning.harvard.edu/course/data-structures-and-algorithms

M.Sc. 1.4: PROBABILITY AND STATISTICS
Total Hours: 48

Upon Completion of the course, the students will be able to

- Able to understand the basic knowledge on fundamental probability concepts, including random variable, probability of an event, additive rules and conditional probability
- Able to understand the concept of Bayes' theorem
- Able to understand the basic statistical concepts and measures
- Able to develop the concept of the central limit theorem
- Able to understand several well-known distributions, including Binomial, Geometrical, Negative Binomial, Pascal, Normal and Exponential Distribution
- Able to understand the concepts of various parameter estimation methods.
- Able to perform hypotheses testing Skills
- Able to apply the central limit theorem to sampling distribution
- Able to use estimation technique to determine point estimates confidence interval and sample size.
- Able to apply the appropriate Chi-Squared test for independence and goodness of fit
- Able to perform and analyze hypotheses tests of means, proportions and variances using both one-and two-sample data sets.
- Able to solve problems independently
- Able to appreciate the diversity of the applications of central limit theorem
- Able to appreciate the diversity of the applications of hypothesis testing

Unit I: 8hrs.

Probability: Sample space and Events - Probability -The Axioms of probability - some Elementary Theorems - Conditional probability -Baye's Theorem - Random variables – Discrete and continuous probability distributions.

Unit II: 10hrs.

Distributions Binomial, Poisson and normal Distributions, related properties. Sampling Distributions – Sampling Distribution of means.

UNIT III: 8 hrs.

Estimation Point Estimation - Interval Estimation – Introduction to student's t-distribution - Confidence interval for Single Mean and Single Proportion (Large and Small samples).

Unit IV: 14hrs.

Testing of Hypothesis-I : Testing of hypothesis-Introduction- Null hypothesis-Alternative hypothesis- Type I and Type II errors – Critical region. Test of hypotheses for Single Mean (Large and small samples) - Test of hypotheses for Single Proportion (Large and small samples). **Testing of Hypothesis-II:** Tests of hypotheses for difference of Means (Large and Small samples) - Tests of hypotheses for difference of proportions(Large samples) – Introduction to Chi-Square distribution and Goodness of Fit.

Unit V: 8hrs.

Correlation & Regression: Coefficient of correlation- Regression Coefficient- The lines of regression- The rank correlation.

References

1. Probability & Statistics, T.K.V.Iyengar, B. Krishna Gandhi & Others,3ed, S.Chand & Co,2011
2. Probability & Statistics, D. K. Murugesan, P. Guru Swamy, 1ed, Anuradha Publications,2011
3. Probability & Statistics for Engineers, G.S.S. Bhishma Rao, 2ed,Scitech Publications, 2005
4. Probability & Statistics for Engineers, Miller, John E. Freund, 8ed, Prentice Hall of India,2010
5. A first course in Probability & Statistics, B.L.S.Prakasa Rao, 1ed, World Scientific,2010
6. Fundamentals of Mathematical Statistics, S.C. Gupta, V.K.Kapoor,11 ed, S.Chand & Co.,2003

M.Sc. 2.1: COMPUTER NETWORKS

Total Hours: 48

Upon Completion of the course, the students will be able to

- Describe the functions of each layer in OSI and TCP/IP model.
- Explain the functions of Application layer and Presentation layer paradigms and Protocols.
- Describe the Session layer design issues and Transport layer services.
- Classify the routing protocols and analyze how to assign the IP addresses for the given network.
- Describe the functions of data link layer and explain the protocols.
- Explain the types of transmission media with real time applications

UNIT-I: 10hrs

Foundation- Building a Network**,** Applications**,** Requirements**,** Architecture**,** Software**,** Performance.

Direct Links- Connecting to a Network, Technology Landscape, Encoding, Framing, Error Detection, Reliable Transmission, Multi-Access Networks

UNIT-II: 10hrs

Internetworking: Switching Basics, Switched Ethernet, Spanning Tree Algorithm, Broadcast and Multicast, Virtual LANs (VLANs), What Is an Internetwork? Service Model, Global Addresses, Datagram Forwarding in IP, Subnetting and Classless Addressing, Address Translation (ARP), Host Configuration (DHCP), Error Reporting (ICMP), Virtual Networks and Tunnels, Routing- Network as a Graph, ,Distance-Vector (RIP), Link State (OSPF), Metrics

UNIT-III: 10hrs

Global Internet- Routing Areas, Inter-domain Routing (BGP)

IP Version 6- Historical Perspective, Addresses and Routing, Packet Format, Advanced Capabilities

Multicast- Multicast Addresses, Multicast Routing (DVMRP, PIM, MSDP)

Multiprotocol Label Switching-Destination-Based Forwarding, Explicit Routing, Virtual Private Networks and Tunnels

UNIT-IV: 10hrs

Simple Demultiplexor (UDP)

Reliable Byte Stream (TCP)- End-to-End Issues, Segment Format, Connection Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission

Remote Procedure Call- RPC Fundamentals

Transport for Real-Time (RTP)- Requirements, RTP Design, Control Protocol

Congestion Control- TCP Congestion Control

UNIT-V: 08hrs

Applications-Traditional Applications- Electronic Mail (SMTP, MIME, IMAP), World Wide Web (HTTP), Web Services
Multimedia Applications- Session Control and Call Control (SDP, SIP, H.323), Resource Allocation for Multimedia Applications

Reference books:

1. Larry Peterson, "Computer Networks- A system approach", 5th edition, Elsevier
2. Kurose and Rose, "Computer Networking- A top down approach", 6th edition, Pearson, 2013
3. Andrew Tanenbaum, "Computer Networks", Prentice Hall
4. Behrouz Forouzan, "Data Communications and Networking", 4th edition, McGraw Hill, 2017

M.Sc. 2.2: LINEAR ALGEBRA

Total Hours: 48

Upon Completion of the course, the students will be able to

- Solve systems of linear equations
- Analyze vectors in Rn geometrically and algebraically.
- Recognize the concepts of the terms span, linear independence, basis, and dimension, and apply these concepts to various vector spaces and subspaces,
- Use matrix algebra and the related.
- Matrices to linear transformations, Compute and use determinants, Compute and use eigenvectors and eigenvalues.
- Find the eigenvalues and eigenvectors of a square matrix using the characteristic polynomial and will know how to diagonalize a matrix when this is possible;
- Understand the basic ideas of vector algebra: linear dependence and independence and spanning;
- Familiar with the notion of a linear transformation and its matrix.
- Find the change-of-basis matrix with respect to two bases of a vector space.

Unit – I 12hrs.

Introduction to Vector: Vector and linear combination, Length and Dot products, Matrices.

Solving Linear Equations: Vectors and linear equations, the idea of elimination, Elimination using matrices, Rules for matrix, Inverse Matrices, Elimination=Factorization: A=LU, Transposes and permutations.

Unit-II 12hrs.

Vector Spaces and Subspaces: Spaces of Vectors, The Null space of A, The Complete Solution to Ax=b, Independence, Basis and Dimension, Dimension of the Four Subspaces.

Orthogonality: Orthogonality of the four subspaces, Projections, Least squares approximations, Orthogonal bases and Gram-Submidt.

Unit-III 10hrs.

Determinants: The properties of Determinants, Permutations and Cofactors, Cramer's Rule, Inverses, and Volumes.

Unit-IV 7hrs.

Eigen values and Eigenvectors: Introduction to Eigenvalues, Diagonalizing a Matrix, Systems of Differential equations, Symmetric Matrices, Positive Definite Matrices.

Unit-V 7hrs.

Single Value Decomposition (SVD): Image processing by Linear Algebra, Bases and Matrices in the SVD, Principal Component Analysis (PCA by SVD), The Geometry of the SVD.

REFERENCES:

1) Introduction to Linear Algebra by Gilbert Strang (5^{th} edition), Wellesley – Cambridge press, 2016
2) Linear Algebra by Kenneth Hoffman and Ray Kunze (2^{nd} edition), Prentice-Hall, 1971
3) Introduction to Linear Algebra by Thomas A Whitelaw, (2^{nd} edition), Champman & Hall/ CRC, 2018
4) Introduction to Linear Algebra with applications by Jim De Franza & Daniel Gagliardi, Waveland Press.

M.Sc 2.3: DATA BASE MANAGEMENT SYSTEM

Upon Completion of the course, the students will be able to

- Explain the features of database management systems and Relational database.
- Design conceptual models of a database using ER modeling for real life applications and also construct queries in Relational Algebra.
- Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- Retrieve any type of information from a data base by formulating complex queries in SQL.
- Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- Build indexing mechanisms for efficient retrieval of information from a database.

UNIT-I INTRODUCTION TO DBMS 10Hrs

Introduction, characteristics of database, advantages of DBMS over file processing system, A Brief History of Database Applications. Database softwares (microsoft SQL server, oracle RDBMS, MySQL) Data Models, Schemas, and Instances;Three-Schema Architecture and Data Independence; Database Languages and Interfaces; Centralized and Client/Server Architectures for DBMS.

UNIT-II DATA MODELING 10 Hrs

Entity-Relationship Diagram, Relational Model - Constraints, Languages, Design, and Programming, Relational Database Schemas, Update Operations and Dealing with Constraint Violations; Relational Algebra and Relational Calculus; Cod Rules.

Unit-III: Enhanced Data Models 12 Hrs

Temporal Database Concepts, Multimedia Databases, Deductive Databases, XML and Internet Databases; Mobile Databases, Geographic Information Systems, Genome Data Management, Distributed Databases and Client-Server Architectures.

UNIT-IV SQL AND NOSQL 08 Hrs

Data Definition and Data Types; Constraints, Queries, Insert, Delete, and Update Statements; Views, Stored Procedures and Functions; Database Triggers, SQL Injection.

NOSQL: NOSQL and Query Optimization; Different NOSQL Products, Querying and Managing NOSQL; Indexing and Ordering Data Sets; NOSQL in Cloud.

UNIT -V NORMALIZATION FOR RELATIONAL DATABASES 08 Hrs

Functional Dependencies and Normalization; Algorithms for Query Processing and Optimization; Transaction Processing, Concurrency Control Techniques, Database Recovery Techniques, Object and Object-Relational Databases; Database Security and Authorization.

References:

1. "Database System Concepts" by Silberschatz, Korth, Sudarshan, 4th Edition, McGraw Hill Publication.

2. “Database Systems, Concepts, Design and Applications” by S.K.Singh, Pearson Education.
3. “Database Management Systems” by Raghu Ramakrishnan, Johannes Gehrke, McGraw Hill Publication.
4. “Fundamentals of Database Systems” by Elmsari, Navathe, 5th Edition, Pearson Education (2008).

M.Sc.2.4: PYTHON PROGRAMMING

Total 48hrs.

Upon successful completion of this course, the student will be able to:

- Define and demonstrate the use of built-in data structures “lists” and “dictionary”.
- Design and implement a program to solve a real world problem.
- Design and implement GUI application and how to handle exceptions and files.
- Make database connectivity in python programming language

Unit-I 12hrs.

INTRODUCTION TO PYTHON PROGRAMMING: Python interpreter and interactive mode; values and types variables, expressions, statements, tuple assignment, Order of operations, comments, debugging; modules and functions: function Calls, adding new functions, Definitions and Uses, flow of execution, parameters and arguments, Fruitful functions. Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, range, break, continue, pass; recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays.

Unit-II 12hrs.

LISTS, TUPLES, DICTIONARIES: Lists: Traversing a List, list operations, list slices, list methods, Map, Filter and Reduce, list loop, mutability, aliasing, cloning lists, list parameters; Dictionaries: operations and methods; advanced list processing - list comprehension; Tuples: tuple assignment, tuple as return value.

Unit-III 07hrs.

FILES, MODULES, PACKAGES: Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages: PANDAS, NUMPY, SCIKIT-LEARN;

Unit-IV 10hrs.

CLASSES AND OBJECTS: Introduction, Defining Classes, Creating Objects, Data Abstraction and Hiding through Classes, Class method and self argument, Class Constructor (init() Method), Data Members, Calling a Class Method from another Class Method, Class Methods and Static Methods, Inheritance, Types of Inheritance, Abstract Classes and Interfaces, Operator Overloading, Overriding Methods.

Unit-V 07hrs.

Multithreading, GUI Programming, Graphics, Plotting and Web Programming: Multithreading-Introduction, Threading Module (Creating a Thread, Synchronizing Threads) GUI Programming with tkinter Package, Simple Graphics using Turtle, Plotting Graphs in Python, Web Programming using Python.

REFERENCES:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist,,,,, 2nd edition, Updated for Python 3, Shroff/O,,Reilly Publishers, 2016
2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. John V Guttag, ―Introduction to Computation and Programming Using Python,,,,, Revised and expanded Edition, MIT Press , 2013
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

M.Sc. OEC 2.7: COMPUTER CONCEPTS AND OFFICE AUTOMATION

Total Hours: 48

Upon Completion of the course, the students will be able to

- Understanding the concepts of computers and the use of MS office packages.
- Identify the role of MS-word and its potential application in real-life context.
- Knowledge in the application of various menus and their uses in MS office packages.
- Having hands-on training on the use of MS-Excel and MS-Power Point
- Learnt to create simple database applications.

Unit-I **10 Hrs**

Basics: History and generations of Computer, Types of Computer, Organization of Computer System, Hardware and Software Components, Memory unit: Types of memory, ROM, RAM, types of RAM & ROM, Introduction to cache and virtual memory.

Unit-II **10 Hrs**

Number system: Binary Octal, Hexa-decimal, Number base conversion, Binary addition, Subtraction, One's and Two's compliment, Character codes – ASCII, EBCDIC.

Unit-III **10 Hrs**

Operating System: Types of operating system, Functions, Introduction to DOS and WINDOWS operating system.

Software: Types of languages, Types of software (System and Application software).

Unit-IV **10 Hrs**

Network and Internet: History and evolution of Computer Network, Types of network (LAN, MAN & WAN), Internet and its applications.

Unit-V **08 Hrs**

Office Automation: Working with MS-Word, MS-Excel and MS-POWER POINT

References:

1. Computer Concepts & C Programming, P.B.Kottur, Sapna Book House Bangalore 2009
2. Computer Fundaments, V. Rajaraman ,Prentice Hall of India,2008
3. Computer Fundamental P.K. Sinha , Prentice Hall of India, 6th Edition,1992
4. Fundamentals of Information Technology second edition, Alexis Leon,2009
5. Microsoft Office-Complete reference ,Curt Simmons, Mc Graw Hill,2003

M.Sc. 3.1: DESIGN AND ANALYSIS OF ALGORITHMS

Total Hours: 48

Upon Completion of the course, the students will be able to

- Choose appropriate advanced data structure for given problem.
- Calculate complexity.
- Select appropriate design techniques to solve real world problems.
- Apply the dynamic programming technique to solve the problems.
- Apply the greedy programming technique to solve the problems.
- Select a proper pattern matching algorithm for given problem

Unit-I: 12 hrs

Introduction: What is an algorithm?, Fundamentals of Algorithmic Problem Solving, Important Problem Types, Fundamental data Structures.

Fundamentals of the Analysis of Algorithm Efficiency: Analysis Framework, Asymptotic Notations and Basic efficiency classes, Mathematical analysis of Recursive and Non-recursive algorithms.

Brute Force and Exhaustive Search: Selection Sort and Bubble Sort, Sequential Search and Brute-Force String Matching, Depth-First Search and Breadth-First Search

Unit-II: 8 hrs

Decrease-and-Conquer

Insertion Sort, Topological sorting, Algorithms for Generating Combinatorial Objects, Binary Search.

Divide-and-Conquer

Merge sort, Quick sort, Binary tree Traversals and related properties, Multiplication of large integers, Strassen's Matrix Multiplication

Unit-III: 10 hrs

Space and Time Tradeoffs

Sorting by Counting, Input Enhancement in String Matching, Hashing.

Unit-IV: 10 hrs

Dynamic Programming

Computing a binomial coefficient, Warshall's and Floyd's Algorithms, The Knapsack Problem and Memory Functions.

Unit-V: 08 hrs

Greedy Technique Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm.

Limitations of Algorithm Power

Lower-Bound Arguments, Decision Trees, P, NP and NP-Complete Problems.

References:

1. Introduction to the Design and Analysis of Algorithms, 3rd Edition, by Anany Levitin, Pearson, 2012,
2. Introduction to Algorithms, , 3Ed, by T. Cormen , C. Leiserson , R. Rivest , C Stein. International Edition, MIT Press, 2009.

3. Fundamentals of Computer Algorithms, *Ellis Horowitz; Sartaj Sahni; Sanguthevar Rajasekaran, Universitypress,* 2008.
4. Algorithm Design, Michael T Goodrich and Roberto Tamassia, Wiley India.
5. Introduction to Design and Analysis of Algorithms "R C T Lee, S S Tseng, R C, Chang, Y T Tsai, A Strategic Approach, Tata McGraw Hill.

M.Sc. 3.3: WEB TECHNOLOGIES
Total Hours: 48

Upon Completion of the course, the students will be able to

- Students are able to develop a dynamic webpage by the use of java script and DHTML.
- Students will be able to write a well formed / valid XML document.
- Students will be able to connect a java program to a DBMS and perform insert, update and delete operations on DBMS table.
- Students will be able to write a server side java application called Servlet to catch form data sent from client, process it and store it on database.
- Students will be able to write a server side java application called JSP to catch form data sent from client and store it on database.
- Students will able to write web services.

Unit-I: 10 hrs

Web essentials – W3C - clients – servers - communication – markup languages – XHTML – simple XHTML pages style sheets – CSS

Unit-II: 12 hrs

Client side programming: Introduction to Java script, Basic Syntax, Variables and Data types, Statements, Operators, Literals, Functions, Objects, Arrays, Built-in objects, Java script debuggers.

Host objects Browsers and the DOM: Introduction to Document Object Model, DOM history and levels, Intrinsic Event Handling, Modifying Element Style, The Document tree, DOM Event handling.

Unit-III: 12 hrs

Server side programming: (Java servlets) - Servlet Architecture Overview, A "Hello World!" Servlet, Servlet Generating Dynamic Content, Servlet lifecycle, Parameter Data, Sessions, Cookies, URL Rewriting, Other Servlet capabilities, Data Storage, Servlets and Concurrency.

Separating Programming and Presentation (JSP Technology): Introduction to Java Server Pages, JSP and Servlets, Running JSP Applications, Basic JSP, Java Beans Classes and JSP, Tag Libraries and Files, Support for the Model – View Controller Paradigm.

Unit-IV: 07 hrs

Representing Web Data: XML, XML document and Vocabularies, XML Declaration, XML Namespaces, Java Script and XML: Ajax, DOM based XML processing, Event-oriented Parsing: SAX, Transforming XML Documents, Selecting XML Data: XPath Template-based Transformation: XSLT, Displaying XML Documents in browsers.

Unit-V: 07 hrs

Web Services: JAX-RPC, WSDL, XML Schema and SOAP: Web Service Concepts, Writing a Java Web Service, Writing a Java Web Service Client, Describing Web Services: WSDL, Representing Data Types: XML Schema, Communicating Object Data: SOAP. Databases and Java Servlets, Databases and JSP

References

1. Jeffrey C Jackson, “Web Technology – A computer Science perspective”, Person Education, 2007.
2. Chris Bates, “Web Programming – Building Internet Applications, “Wiley India, 2006.

M.Sc. 3.4: Artificial Intelligence and Machine Learning

Total Hours: 48

Upon Completion of the course, the students will be able to

- Apply artificial intelligence techniques, including search heuristics, knowledge representation, planning and reasoning
- Describe the key components of the artificial intelligence (AI) field
- Explain search strategies and solve problems by applying a suitable search method analyze and apply knowledge representation
- Describe and list the key aspects of planning in artificial intelligence
- Analyze and apply probability theorem and Bayesian networks
- Describe the key aspects of intelligent agents
- Differentiate the key aspects of evolutionary computation, including genetic algorithms and genetic programming
- Describe the key aspects of machine learning
- Analyze problem specifications and derive appropriate solution techniques for them
- Design and implement appropriate solutions for search problems and for planning problems

Unit-I: **12 hrs**

Introduction: Introduction to AI applications and AI techniques, Production systems, control strategies, reasoning - forward and backward chaining. Intelligent Agents: Definitions of a rational agent, reflex, model-based, goal-based, and utility-based agents, the environment in which a particular agent operates.

Unit-II: **12 hrs**

Searching Techniques and Game Playing: Breadth first search, depth first search, iterative deepening, uniform cost search, hill climbing, simulated annealing, genetic algorithm search, heuristic search, Best first search, A* algorithm, AO* algorithm, Minimax and game trees, refining minimax, Alpha - Beta pruning, constraint satisfaction.

Unit-III: **10 hrs**

Knowledge Representation: First order predicate calculus, resolution, unification, natural deduction system, refutation, logic programming, PROLOG, semantic networks, frame system, value inheritance, conceptual dependency, Ontologies. Planning: basic representation for planning, symbolic-centralized vs. reactive-distributed, partial order planning algorithm.

Unit-IV: **07 hrs**

Machine learning: Introduction to different types of learning, Supervised and Unsupervised learning — Reinforcement learning- Basics of Neural network models.

Unit-V: **07 hrs**

Applications of Artificial Intelligence- Natural Language Processing, Speech recognition, Computer vision, Expert systems.

References:

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach (3rd ed.), Pearson Education, 2010.
2. Elaine Rich and Kelvin Knight, Artificial Intelligence, Tata McGraw Hill, 2002.
3. Nils J Nilson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann Publishers, Inc., San Francisco, California, 2000.
4. R. Akerkar, Introduction to Artificial Intelligence, Prentice-Hall of India, 2005.
5. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India, 2006.
6. Nils J. Nilson, Principles of Artificial Intelligence, Narosa Publishing House, 2001.
7. W.F. Clocksin and C.S. Mellish, Programming in PROLOG, Narosa Publishing House, 5th edition, 2003.
8. Saroj Kaushik, Logic and Prolog Programming, New Age International Publisher,2006.

M.Sc. OEC 3.7: SPSS SOFTWARE

Total Hours: 48

Upon Completion of the course, the students will be able to

- Be comfortable using SPSS as a data analysis tool
- Understand how to work with SPSS
- Understand how to learn to use new features of SPSS on their own
- Understand how to acquire information (samples)
- Understand how to enter and reorganize information within SPSS
- Understand how to effectively summarize research finds using SPSS
- Through the use of appropriate indexes and tables
- Choose charts to successfully highlight their research results
- Understand and interpret charts
- Understand the basic principles behind inferential statistics
- Carry out inferential statistical analysis using SPSS
- Integrate information and build models
- Edit SPSS output
- Use SPSS output to produce scientifically sound research reports

UNIT-I **10Hrs**

Table of Contents

Overview of PASW Statistics, Introduction to PASW: Menus, Tool Bar, Dialogue Box, Designate Window, Basic Steps for performing any Statistical Procedure

Data Management

Creating a Data File, Defining Variables, Entering the Data, Saving Data, Opening an existing Data File, Inserting Variables, Inserting Cases, Identifying Duplicate Cases, Identifying Unusual Cases, Sorting Cases, Merging a File: Add Cases, For Adding Variables, Data Aggregation, Splitting File, Selecting Cases, Listing Cases

UNIT-II **10Hrs**

Data Transformation

Computing a New Variable, Recoding Variables, Automatic Recode, Visual Binning, Rank Cases

Describing Data Numerically

Types of Measurement Scales, Summary Measures, Frequencies, Descriptive Statistics, Explore, Crosstabs

UNIT-III **10Hrs**

Describing Data Graphically

Line Chart, Pie Chart, Bar Chart, Histogram and the Standard Normal Curve, Box Plot, Scatter Diagram, P-P Plot, Q-Q Plot, Chart Builder, Formatting Charts

UNIT-IV **10Hrs**

One Sample t-Test

Hypothesis Testing, Steps in Hypothesis Testing, Assumptions of Hypothesis Testing, Testing for Population Mean, Statistical and Practical Significance

Independent Sample t-Test
Assumptions of Independent Sample t-Test, Procedure for Testing for Differences in Means between Groups, Interpretation of Null Results, Effect Size

UNIT-V **08Hrs**
Nonparametric Statistics
Runs Test, Chi-Square Test, Mann-Whitney U Test, Wilcoxon Signed Rank Test, Kruskal-Wallis Test

References:

1. SPSS In Simple Steps byKiran Pandya Smruti Bulsari Sanjay Sinha, Dreamtech Press (2011)
2. Applied Statistics with SPSS byEelko Huizingh, New ed Edition, Sage Publications (CA) (2007)
3. SPSS: A User-Friendly Approach by Jeffery E. Aspelmeier, Thomas W. Pierce , Worth Publishers (2009)
4. Statistical Methods For Practice And Research : A Guide To Data Analysis Using SPSS 0002 Edition, Response Books (2009)
5. A Visual Approach to SPSS for Windows: A Guide to SPSS 17.0,by Leonard D. Stern, Pearson (2009)

M.Sc.4.1: SOFTWARE ENGINEERING

Total Hours: 48

Upon successful completion of this course, the students will be able to

- Define various software application domains and remember different process model used in software development.
- Explain needs for software specifications also they can classify different types of software requirements and their gathering techniques.
- Convert the requirements model into the design model and demonstrate use of software and user interface design principles.
- Distinguish among SCM and SQA and can classify different testing strategies and tactics and compare them.
- Justify role of SDLC in Software Project Development and they can evaluate importance of Software Engineering in PLC.
- Generate project schedule and can construct, design and develop network diagram for different.

Unit-I **10 Hrs**

The Product and The Process: Evolving role of software, software characteristics and components, Crisis, Software Myths, Software Engineering-A Layered Technology, Software process, linear sequential model, Prototyping model, RAD model, Evolutionary software process model.

Project Management Concepts: The Management Spectrum, The People, The Product, The Process, and The Project .W5HH Principle.

Software Process and Project Metrics: Measures, Metric Indicators, Metric in process and the Project Domains ,Software Measurement, Metrics for software quality.

Unit-II **10 Hrs**

Software Project Planning: Project Planning Objectives, Software Project Estimation, decomposition Techniques, Empirical Estimation Models.

Risk Analysis and Management: Software Risks, Risk Identification, Risk Projection, Risk Refinement and Risk Mitigation, Monitoring, and Management.

Unit-III **10Hrs**

Analysis Concepts and Principles: Requirement analysis, communication techniques, analysis principles, software prototyping and specification.

Analysis Modeling: Elements of analysis model, data modeling, functional modeling, behavioral modeling, the mechanics of structured analysis, data dictionary, other classical analysis methods.

Unit-IV **10hrs**

Design Concepts and Principles: Software design and software engineering design process, design principles, design concepts, design methods, data design, architectural design and process, transform and transaction mappings, design post processing, architectural design optimization, interface design, procedural design.

Unit-V **08 hrs**

Software Testing Techniques and Strategies: Fundamentals, Test case design, White box testing, Basis path testing, Control structure testing, Black box testing, Software testing strategies.

Software Configuration Management: Configuration management, maintenance costs, maintenance side effects, maintenance tissues.
Software Quality Assurance: Quality Concepts, Software Quality Assurance, FTR, ISO 9001, ISO-9002, ISO-9003, Introduction to CASE, DOD standard 2167 A.

REFERENCES:

1. Software Engineering, Fifth Edition, Roger - Pressman, McGraw Hill.
2. Software Engineering , Ian Sommerville, International Computer Science, Series
3. Software Engineering, Schooma, McGraw Hill
4. Object Oriented Design and Analysis, Booch, Benjamin / Cummings,
5. Software Engineering: A Practitioner's Approach 7th Edition, Roger – Pressman,Tata McGraw - Hill Education (2010)

M. Sc 4.3: DATA MINING

Total Hours: 48

Upon successful completion of this course, the students will be able to

- Understand Data Warehouse fundamentals, Data Mining Principles
- Design data warehouse with dimensional modelling and apply OLAP operations.
- Identify appropriate data mining algorithms to solve real world problems
- Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining
- Describe complex data types with respect to spatial and web mining.
- Benefit the user experiences towards research and innovation.

Unit-I **10 Hrs**

Data mining – Motivation – Importance - DM Vs KDD - DM Architecture - Data Types – DM Tasks –DM System Classification - Primitives of DM - Data Mining Query Language - DM Metrics - DM Applications - DM Issues – Social Implications of DM

Unit-II **10 Hrs**

Data Preprocessing: Summarization - Data cleaning - Data Integration and Transformation - Data Reduction - Discretization and Concept Hierarchy Generation

Unit-III **10 Hrs**

Mining Frequent Patterns – Frequent Item set Mining Methods. Classification: Classification by Decision Tree Induction – Bayesian Classification – Rule based Classification - Prediction– Accuracy and Error Measures

Unit-IV **10 Hrs**

Cluster Analysis – Types of Data in Cluster Analysis – Categorization of clustering Methods – Partition Methods - Outlier Analysis – Mining Data Streams – Social Network Analysis – Mining the World Wide Web

Unit-V **8 Hrs**

Data Warehousing: OLTP Vs OLAP - Multidimensional Data Model -DW Architecture Efficient Processing of OLAP queries - Metadata repository – DWH Implementation – OLAM

References:

1. JiaweiHan, Micheline amber, "Data Mining: Concepts and Techniques", 3rd Edition, Elsevier India Private Limited, 2012.
2. Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education, 2012.
3. K.P.Soman, ShyamDiwakar, V.Ajay, “Insight into Data Mining Theory & Practice, Prentice
4. Hall India, 2012 5. G.H.Gupta, “Introduction to Data Mining with Case Studies”, 2nd Edition, PHI.

5. Ralph Kimball, Margy Ross “The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling”, 3rd Edition ,wiley , Jul 2013

M.Sc.4.4: OPERATION RESEARCH

Total Hours: 48

Upon successful completion of this course, the students will be able to

- Formulate a real-world problem as a mathematical programming model
- Understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand
- Understand the relationship between a linear program and its dual, including strong duality and complementary slackness
- Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change
- Solve specialized linear programming problems like the transportation and assignment problems
- Solve network models like the shortest path, minimum spanning tree, and maximum flow problems
- Understand the applications of, basic methods for, and challenges in integer programming
- Understand how to model and solve problems using dynamic programming
- Model a dynamic system as a queuing model and compute important performance measures
- Learn optimality conditions for single- and multiple-variable unconstrained and constrained non-linear optimization problems, and corresponding solution methodologies

Unit- I **10hrs.**

Introduction: History, Definitions, Features of Operation Research, Models and modeling in OR, Methods for solving OR models, Advantages of OR Study. Linear Programming: Structure of Linear programming model, General Mathematical model of LPP, guidelines on linear programming models, Examples of LP model formulation.

Unit- II **12hrs.**

Linear programming: Graphical solution Methods of LP problems, Simplex algorithm(Maximization case), Simplex algorithm (Minimization case): two phase and Big-M method. Duality in Linear programming

Unit- III **10hrs.**

Transportation Problem : Mathematical model of transportation problem, The transportation algorithm, NWCM, LCM, VAM, Test for optimality, variations in Transportation problem.

Unit -IV **10hrs.**

Assignment Problem: Mathematical models of Assignment Problem, Hungarian method for solving Assignment problem. Network Models: Scope and definition of Network models, minimal spanning tree algorithm, TSP as a network model, project management :CPM and PERT.

Unit- V **6hrs.**

Decision Theory and Decision Trees : Steps in decision making, Types of Decision making environment Decision making under uncertainty, Decision making under risk, Posterior probabilities and Baysian Analysis, Decision Tree Analysis.

References:

1. Sharma J.K, Operations Research, Theory and Applications, McMillan India Ltd.
2. Hamdy A. Taha, Operations Research, 8/e, Pearson Education.
3. Filet B. E,.Introduction to Operation Research : A Computer Oriented Algorithm Approach
4. Gillet B.E, Introduction to Operations Research, TMH.
5. Chandrasekhar Salimath and Bhupender parashar, Operation Research, University Press, 2014

Core Theory Electives: I

Paper Code	Paper Title
M.Sc.3.2 A	Operating System Concepts
M.Sc.3.2 B	Computer Vision
M.Sc.3.2 C	Mobile Computing
M.Sc.3.2 D	Business Intelligence Systems
M.Sc.3.2 E	Computer Graphics

M. Sc 3.2A: Operating System Concepts

Total Hours: 48

Upon Completion of the course, the students will be able to

- Describe the important computer system resources and the role of operating system in their management policies and algorithms.
- Understand the process management policies and scheduling of processes by CPU
- Evaluate the requirement for process synchronization and coordination handled by operating system
- Describe and analyze the memory management and its allocation policies.
- Identify use and evaluate the storage management policies with respect to different storage management technologies.
- Identify the need to create the special purpose operating system.

Unit-I **10 Hrs**

Introduction: Operating system concepts, types of operating system – Batch, interactive, time sharing, real time and distributed operating systems. Operating system services, system calls, system components, system programs.
Process Management: Processes-process scheduling, operation on processors, co- operating process threads, interprocess communication, concept of critical section problem and solution, semaphores and implementation.

Unit-II **10 Hrs**

CPU Scheduling: Scheduling criteria and scheduling algorithms, multiple processor scheduling.
Deadlock: Deadlock problem, characterization, prevention, avoidance, detection, recovery, combined approach to deadlock handling.

Unit-III **10 Hrs**
Memory Management: Logical and physical address, swapping overlays, contiguous allocation, paging segmentation, segmentation with paging, virtual memory-demand paging page replacement algorithms.

Unit-IV **10 Hrs**

Disk and Drum Scheduling: Physical characteristics FCFS, Shortest seek time first, SCAN scheduling, selection of disk scheduling algorithm, sector queuing.

Unit-V **08 Hrs**
File System: Files, access method, directory structure, protection and file system implementation, allocation methods.
Protection: Goals, mechanism and policies, doman of protection, access matrix and its implementation, dynamic protection structure, revocation, security.

REFERENCES:

1. Operating systems Concepts, Peterson, J. and Sliberschatz, McGraw Hill.2006
2. Operating system, Madnick, S.E. Donovan J.J., McGraw Hill.
3. Operating system Principles, Brinch Hansen P., PHI.
4. A logical Design of Operating systems, Shaw A.., PHI
5. Operating systems, Milan Milenkovic, McGraw Hill.
6. Fundamentals of Operating system, including case studies, Sridhar. R.,:MS- DOS, UNIX & OS/2, Dynaram Publications.
7. Windows 3.1 A Complete Tutorial, Galgotia Publication Pvt., Ltd., Subhash Mehta.
8. Systems Programming and Operating system, McGraw Hill.

M.Sc. 3.2B: COMPUTER VISION

Total Hours: 48

Upon Completion of the course, the students will be able to

- identify basic concepts, terminology, theories, models and methods in the field of computer vision,
- describe known principles of human visual system,
- describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition,
- suggest a design of a computer vision system for a specific problem

Unit- I: 12hrs

Introduction and image processing: What is computer vision? History of computer vision, Photometric image formation, the digital camera, Image processing: Point operators, Linear filtering, Neighbor hood operators.

Unit -II: 10 hrs

Feature detection and matching: Feature detectors, feature descriptors, feature tracking, edge detection, edge linking, Lines: successive approximation, Hough transform, vanishing points, Application: Rectangel detection.

Unit-III: 10 hrs

Segmentation: Active contours: snakes, Dynamic snakes and condensation, Scissors, Level Sets. Split and merge: Watershed, Region splitting (divisive clustering), and Region merging (agglomerative clustering) Graph-based segmentation.

Unit-IV: 8 hrs

Color Image processing: color fundamentals, color models, Pseudo color image processing, color transformations, color image smoothing and sharpening, Image segmentation based on color.

Unit-V: 8 hrs

Recognition: Object detection, Face recognition, Instance recognition, category recognition, context and scene understanding

References:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Pearson Education, 2003.
3. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson Education, 2013.
4. Anil K. Jain, Fundamentals of Digital image processing, Prentice-Hall of India Pvt Ltd., 1997.
5. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image processing, Analysis and Machine vision, Cengage Learning: 4th edition, 2014.

M. Sc 3.2C: MOBILE COMPUTING

Upon Completion of the course, the students will be able to

- Explain the principles and theories of mobile computing technologies.
- Describe infrastructures and technologies of mobile computing technologies.
- List applications in different domains that mobile computing offers to the public, employees, and businesses.
- Describe the possible future of mobile computing technologies and applications.

UNIT-1 **10hrs**

Mobile Computing Architecture: An Overview

Mobile IP, Cellular and WLAN Wi-Fi IEEE 802.11X Networks, Ad Hoc Networks, Wireless Personal Area Network, Mobile Enterprise Network, Mobile Cloud Network, Mobile Computing, Mobile Computing Operating System, Mobile Computing Architecture, Design Considerations for Mobile Computing, Mobile Computing and the Apps, Limitations of Mobile Devices, Security Issues

UNIT-2 **10hrs**

Mobile Client Devices and Pervasive Computing

Moving beyond Desktops, Pervasive Computing, Mobile Devices-Classifications and Characteristics, Tablet and e-Book Reader, Smart Identification Devices: Smart Cards, Labels, and Tokens, RFID, Smart Sensors, Actuators, and Mobile Robotic Systems, Smart Home and Appliances, Limitations and Devices Design Constraints, Automotive Systems

UNIT-3 **10hrs**

Second-generation Architecture—GSM, GPRS, and Others

GSM Services, GSM System Architecture, Call Routing, Public Land Mobile Network (PLMN) Interface, GSM Subscriber Addresses and Identities, Protocols, Localization, Call Handling, Handover, Security, Introduction to SMS, General Packet Radio Service, High-speed Circuit-switched Data

UNIT-4 **10hrs**

Wireless Medium Access Control, CDMA, 3G, WiMax, 4G and 5G Networks

Modulation, Medium Access Control, Exposed and Hidden Terminal Problem, Near and Far Terminal Problem, and Power Control for Medium Access, MAC Algorithms, WLAN and CAMA/CA Wireless Protocols, Applications of 3G Mobile Services, 3G Mobile Services: IMT2000 and UMTs, CDMA 2000: 3G, WCDMA 3G, OFDM, High-speed Packet Access, Long-term Evolution and WiMax 16E, 4G Networks: HS-OFDM, LTE Advanced and WiMax 16M, Upcoming 5G Network Features

UNIT-5 **08hrs**

Mobile IP Network Layer

Mobile IP, Packet Delivery and Handover Management, Location Management, Registration, IP Header: Encapsulation and Routes Optimization, Mobility Binding, Tunneling, and Reverse Tunneling, Dynamic Host Configuration Protocol, Cellular IP, Mobile IP with IPv6, Voice over IP, IP Security

Reference Books:

1. Raj Kamal, "Mobile Computing", 3rd edition, oxford University press.
2. Pattnaik, "Fundamentals of mobile computing", 2nd edition, PHI
3. Uwe Hansmann, "Principles of mobile computing", 2nd edition, Springer international, 2014

M. Sc 3.2D: BUSINESS INTELLIGENCE SYSTEMS

Total hours: 48

Upon Completion of the course, the students will be able to

- Describe the concepts and components of Business Intelligence (BI).
- Critically evaluate use of BI for supporting decision making in an organization.
- Understand and use the technologies and tools that make up BI (e.g. Data warehousing, Data reporting and use of online analytical processing (OLAP)).
- Understand and design the technological architecture that underpins BI systems.
- Plan the implementation of a BI system.

Unit-I 12hrs.

Decision support and Business intelligence-Changing Business environment and computerized decision support, managerial decision making and support for decision making-DSS concept and framework Business intelligence-Major tools and techniques of managerial decision support –BI architecture.

Unit-II 12hrs.

Essentials of Business Intelligence-Origin and drivers of business intelligence, successful BI implementation ,characteristics of BI-Architecting the data ,Enterprise Data model and its Benefits, Granularity of Data in Data warehouse and role of Metadata

Unit-III 10hrs.

Advanced Data Warehousing principles- Data Warehousing architecture, DW development, real time DW and DW Administration and security issues-Visualization of Dimension model-Star, snowflake and other advanced models-Aggregated Fact Tables-Relational DBMS Support for Dimensional Modelling-Advanced Topics in Dimensional Modelling-Selecting a Modelling Tool-Populating Data Warehouse.

Unit-IV 07hrs.

Dimensional modelling in BI environment-Dimensional Modelling-Modelling considerations-Dimensional model design life cycle-Case studies-Business Analytics and data visualization-Business analytics overview, reports and queries, Advanced Business Analytics, data visualization Real time BI, Business analytics and web intelligence-Structure of mathematical models for decision support and visual interactive simulation.

Unit-V 07hrs.

Business performance Management-Business Intelligence Applications: Marketing models, Logistic and production models and Data Development analysis.

REFERENCES:

1. E Turban, J E Aronson, Teng pend Liang and Ramesh Sharada, “Decision Support and Business Intelligence”, 8th Edition, pearson Education, 2009.
2. Dan Volitich,”IBM Cognos Business Intelligance”, TMH ,2008.
3. Chuck Bullard.,Dirk Herreman, Don Schau,Rhonda Bell,Eunsaeng Kim,ann Valencic,”Data Modelling Techniques for Data Warehousing”, IBM Corporation,1999

M.Sc. 3.2E: Computer Graphics
Total Hours: 48

Upon successful completion of this course, the students will be able to

- Explain the core concepts of computer graphics, including viewing, projection, perspective, modelling and transformation in two and three dimensions,
- Apply the concepts of color models, lighting and shading models, textures, hidden surface elimination, anti-aliasing, and rendering,
- Interpret the mathematical foundation of the concepts of computer graphics,
- Describe the fundamentals of animation, parametric curves and surfaces, and spotlighting, identify a typical graphics pipeline and
- Apply graphics programming techniques to design and create computer graphics.

Unit-I **10 Hrs**

Introduction: Computer graphics and its applications in various fields. Hardware system for graphics working of different input devices, visual display devices and hard copy device. Introduction to different coordinate systems.
Raster Scan display: Concepts of resolution, aspect ratio refresh rate and frame buffer. Random scan displays: Concepts of display file and display file interpreted comparison between raster scan and random scan. Implementation of graphics in 'C' language and study of various graphics functions.

Unit-II **10 Hrs**
Line drawing methods: DDA algorithm and Bresenham's algorithm for different scope conditions, midpoint method for line generation. Two-dimensional transformation: Mathematical treatment of basic transformation such as translation scaling and rotation. Development of composite transformation matrices using homogeneous coordinates. General fixed point scaling and pivot point rotation.
Clipping: Study of Cohen Sutherland line clipping procedure and Sutherland hodgmen polygon clipping procedure.
Windows and view ports: Derivation of generalized window to view port transformation matrix. Introduction to interrupt driven programming in 'C' and interacting with the mouse.

Unit-III **10 hrs**
Three-dimensional Computer Graphics: Introduction to left and right hand coordinate systems. Basic 3D transformation. Hidden line removal.Projection**:** Study of orthographic and oblique parallel transformation equations for them.

Unit-IV **10 Hrs**
Graphic software standards: GKS and PHIGS. Study of various attributes of output primitives such as line attributes, area fill attributes and character attributes.
Graphics Software Study: DirectX and Open GL

Unit-V **08 Hrs**
Segments: Concepts and advantages. Segment table various operations on segments.

Data structures for the display file arrays on segment, linked list and paging schemes M **Miscellaneous topics** – Brief introduction to Bezier curves and their application, fractal morphing and animation.

REFERENCE:

1. Newman and Sproull: Principles of Interactive Computer Graphics McGraw Hill, 1996.
2. S. Harrington: Computer graphics McGraw Hill, 1997.
3. YeshwantKanetkar: Graphics under "C" BPB, 1995.
4. YeshwantKanetkar: C Pearls BPB, 1996.
5. Hearn Donald Pauling Baker .M: Computer Graphics EEE PHI, 1998

Core Theory Electives-II:

Subject Code	Elective Title
M.Sc.4.2 A	Cloud Computing
M.Sc.4.2 B	Internet of Things (IoT)
M.Sc.4.2 C	Mobile Communications
M.Sc.4.2 D	Deep learning
M.Sc.4.2 E	Information Security and Cryptography
M.Sc.4.2 F	Soft Computing

M.Sc 4.2A CLOUD COMPUTING

Total Hours: 48

Upon Completion of the course, the students will be able to

- Describe the principles of Parallel and Distributed Computing and evolution of cloud computing from existing technologies
- Implement different types of Virtualization technologies and Service Oriented Architecture systems
- Elucidate the concepts of NIST Cloud Computing architecture and its design challenges
- Analyze the issues in Resource provisioning and Security governance in clouds
- Choose among various cloud technologies for implementing applications CO6 Install and use current cloud technologies

Unit –I: New Computing Paradigms and Services 08Hrs

Edge computing, Grid computing, Utility computing, Distributed computing, Cloud computing and its history and evolution

Unit –II: Introduction to Cloud Computing 10 Hrs

Cloud Computing Architectural Framework, Cloud Deployment Models, private, public and hybrid, Challenges in adapting a cloud in the context of i) Security issues ii) Bandwidth and iii) Integration issues, Virtualization in Cloud Computing, Parallelization in Cloud Computing, Security for Cloud Computing, Cloud Economics

Unit-III : Cloud source Service Models 10 Hrs

Software as a Service (SaaS), Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Seven Business Models for cloud, five-layer cloud service stack, compute and storage cloud services case studies Jeff Bezos and Amazon

Unit -IV : Foundational Elements of Cloud Computing 10 Hrs

Virtualization, Browser as a platform, Introduction to Web 2.0, Introduction to Autonomic Systems, Service Level Agreements, Cloud Computing architecture and industry frameworks such as MapReduce.

Unit –V: Cloud Computing Practices 10 Hrs

Virtualization, Cloud Computing Operating System, Creating Windows servers on the cloud, Creating Linux servers on the cloud, Deploying applications on the cloud, Major cloud solutions.

References:

1. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2013
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif," Cloud Security and Privacy",Oreilly,2009
3. Barrie Sosinsky, "Cloud Computing Bible" , Wiley-India, 2011
4. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers,2013.
5. Ronald L. Krutz, Russell Dean Vines,"Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley-India, 2010
6. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
7. Rajkumar Buyya,Chirstian Vecchiola,S.Thamarai Selvi,"Mastering Cloud Computing" , Tata McGraw Hill,2013

M.Sc. 4.2B: INTERNET OF THINGS (IoT)

Total Hours: 48

Upon Completion of the course, the students will be able to

- Interpret the impact and challenges posed by IoT networks leading to new architectural models.
- Compare and contrast the deployment of smart objects and the technologies to connect them to network.
- Appraise the role of IoT protocols for efficient network communication.
- Elaborate the need for Data Analytics and Security in IoT.
- Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.

Unit-1 **10hrs**

Introduction to IoT: what is IOT? Genesis of IoT and digitization, IOT impact, Convergence of IT and OT, IOT challenges.

IoT Network Architecture and Design: Drivers behind New Network Architectures, IoT architecture drivers, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT data management and compute stack

Unit-2 **10hrs**

Engineering IoT networks: Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Wireless Sensor Networks (WSNs), Communication Protocols for Wireless Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

Unit-3 **10hrs**

IP as the IoT Network Layer: The Business Case for IP, The Need for Optimization, IP versions, Optimizing IP for IoT, header compression, Fragmentation, Mesh addressing, 6TiSCH, RPL, Authentication and encryption on constrained nodes.

Unit-4 **10hrs**

Application Protocols for IoT: The Transport Layer, IoT Application Transport Methods, Application Layer Protocol Not Present, SCADA, A Little Background on SCADA, Adapting SCADA for IP, Tunneling Legacy SCADA over IP Networks, SCADA Protocol Translation, SCADA Transport over LLNs with MAP-T, Generic Web-Based Protocols, IoT Application Layer Protocols , CoAP

Unit-5 **08hrs**

Data and Analytics for IoT: An Introduction to Data Analytics for IoT, Structured Versus Unstructured Data, Data in Motion Versus Data at Rest, Machine Learning Overview, Supervised Learning, Unsupervised Learning, Machine Learning and Getting Intelligence

from Big Data, Predictive Analytics, Big Data Analytics Tools and Technology, Edge Analytics Core Functions, Network Analytics

References:

1. David Hanes, “IoT Fundamentals”, Ciscopress.com, 2017

2. Adrian McEwen, “ Designing Internet of things”, wiley, 2014

3. Samuel greengard, “The internet of things”, MIT press, 2015

4. Cuno Pfister, “ Getting started with internet of things”, O’Reilly, 2011

M.Sc.4.2C: MOBILE COMMUNICATIONS

Total Hours: 48

Upon Completion of the course, the students will be able to

- To get aware of historical development of different wireless technologies
- To get familiar with key concepts of wireless networks, standards, technologies and their basic operations
- To learn about various wireless local area network standard, design and analyse various medium access
- To learn how to evaluate MAC and network protocols using network simulation software tools.
- The students should get familiar with the wireless/mobile market and the future needs and challenges
- Understand the concepts, applications of wireless sensor networks, Bluetooth and Zigbee

Unit-1 **10hrs**

Introduction and overview of wireless communication

Wireless Comes of Age 2, The Global Cellular Network, The Mobile Device Revolution , Future Trends, The Trouble With Wireless, Signals for Conveying Information, Analog and Digital Data Transmission, Channel Capacity, Transmission Media, Spectrum Considerations, Line-Of-Sight Transmission, Fading in the Mobile Environment, Channel Correction Mechanisms, Digital Signal Encoding Techniques, Coding and Error Control, Orthogonal Frequency Division Multiplexing (OFDM)

Unit-2 **10hrs**

Signal Encoding Techniques and error control

Signal Encoding Criteria, Digital Data, Analog Signals, Analog Data, Analog Signals, Analog Data, Digital Signals, Orthogonal Frequency Division Multiplexing, Orthogonal Frequency Division Multiple Access (OFDMA), Single-Carrier FDMA, Error Detection , Block Error Correction Codes, Convolutional Codes, Automatic Repeat Request

Unit-3 **10hrs**

Wireless LAN Technology - Overview and Motivation, IEEE 802 Architecture, IEEE 802.11 Architecture and Services, IEEE 802.11 Medium Access Control, IEEE 802.11 Physical Layers, Gigabit Wi-Fi 356nce Page

Bluetooth and IEEE 802.15- The Internet of Things, Bluetooth Motivation and Overview, Bluetooth Specifications, Bluetooth High Speed and Bluetooth Smart, IEEE 802.15, ZigBee

Unit-4 **10hrs**

Cellular Wireless Networks

Principles of Cellular Networks, First-Generation Analog, Second-Generation TDMA, Second-Generation CDMA, Third-Generation Systems, Approach to 4G, LTE Architecture, Evolved Packet Core.

Unit-5 **08hrs**

Mobile Applications and Mobile IP - Mobile Application Platforms, Mobile App Development, Mobile Application Deployment, Mobile IP

References:

1. Cory Beard and William Stallings, “wireless communication networks and system”, Pearson, 2016
2. Jochen Schiller, “Mobile Communication”, Addision-wesley, 2016
3. Gordon stuber, “Principles of Mobile Communication”, Springer, 2013

M.Sc.4.2D: DEEP LEARNING

Total Hours: 48

Upon Completion of the course, the students will be able to

- Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
- Implement deep learning algorithms and solve real-world problems.

Unit- I **10hrs**

Introduction: Historical context and motivation for deep learning; basic supervised classification task, optimizing logistic classifier using gradient descent, stochastic gradient descent, momentum, and adaptive sub-gradient method.

Unit- II **10hrs**

Neural Networks: Feed forward neural networks, deep networks, regularizing a deep network, model exploration, and hyperparameter tuning.

Unit-III **8hrs.**

Optimization for training deep models: Challenges in Neural Network optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithm with Adaptive Learning Rates, Approximate second order Methods, Optimization Strategies and Meta-Algorithms.

Unit-IV **12hrs**

Convolutional Networks and Sequence Modeling: Motivation, Convolution operation, Pooling, Variants of the Basic Convolution Function, Structured outputs, Efficient Convolution Algorithms. Sequence Modeling: Recurrent Nets Unfolding computational graphs, recurrent neural networks (RNNs), bidirectional RNNs, encoder-decoder sequence to sequence architectures, deep recurrent networks, Recursive neural networks.

Unit-V **8hrs**

Autoencoders : Under complete autoencoders, regularized autoencoders, sparse autoencoders, denoising autoencoders, representational power, layer, size, and depth of autoencoders, stochastic encoders and decoders, denoising autoencoders, Learning manifolds with Autoencoders, Applications of Autoencoders.

References:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2. Jeff Heaton, “Deep Learning and Neural Networks”, Heaton Research Inc, 2015.
3. Deng & Yu, “Deep Learning: Methods and Applications”, Now Publishers, 2013.
4. Nikhil Buduma, Nicholas Locascio, “Fundamentals of Deep Learning: Designing NextGeneration Machine Intelligence Algorithms”, O'ReillyMedia, 2017.
5. Mindy L Hall, “Deep Learning”, VDM Verlag, 2011.

M.Sc 4.2E: INFORMATION SECURITY AND CRYPTOGRAPHY

Total Hours: 48

Upon Completion of the course, the students will be able to

- Identify and analyze network security attacks and counter measures to prevent those attacks.
- Analyze the applications of discrete mathematics and understand their implementation in cryptography.
- Apply the knowledge of existing encryption and decryption techniques to provide security solutions.
- Assess impact of public key cryptosystems and key management to ensure secure exchange of information.
- Investigate the security requirements and solutions for maintaining Data integrity using modern techniques for data transmission.

Unit – I : Basics of Information Security 10Hrs

Information Security Overview, Threat and Attack Vectors, Types of Attacks, Common Vulnerabilities and Exposure (CVE), Security Attacks, Fundamentals of Information Security, Computer Security Concerns, Information Security Measures.

Unit –II Information Security Policies, Procedures 08 Hrs

Information Security Policies-Necessity-Key Elements and Characteristics, Security Policy Implementation, Configuration, Security Standards-Guidelines and Frameworks

Unit-III : Encryption techniques 12 Hrs

Classical Encryption Techniques Symmetric Cipher Model- Cryptography, Cryptanalysis and Brute-Force Attack, Block Ciphers and the Data Encryption Standard - Block Cipher Structure- Stream Ciphers and Block Ciphers, Feistel Cipher Structure, The Data Encryption Standard-Encryption and Decryption, Advanced Encryption Standard (AES), International Data Encryption Algorithm(IDEA).

Unit –IV : Public Key Encryption 08 Hrs

Characteristics of Public Key System; RSA Technique – Encryption-Method; Key Exchange; Diffie-Hellman Scheme; Cryptographic Hash Functions; Digital Signature – Properties of Digital Signature, Certificates; Certificate Authorities.

Unit-V : IP and Web Security 10 Hrs

IP security: Overview - Architecture – Authentication Header - Encapsulating Security Payload - Key management – Web security: Web security considerations – Secure Socket Layer and Transport Layer Security – Secure electronic transaction – Web issues.

References:

1. Cryptography and Network Security - Principles and Practice: William Stallings,

Pearson Education, 6th Edition.
2. Cryptography and Network Security: AtulKahate, McGraw Hill, 3rd Edition.
3. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan,Wiley India, 1st Edition.
4. Cryptography and Network Security :ForouzanMukhopadhyay, McGraw Hill, 3rd Edition.
5. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
6. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH.
7. Introduction to Network Security: Neal Krawetz, CENGAGE Learning.
8. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning.

M.Sc.4.2F: SOFT COMPUTING

Total Hours: 48

Course Outcomes: At the end of the course the student should be able to

- Learn about soft computing techniques and their applications
- Analyze various neural network architectures
- Understand perceptron's and counter propagation networks.
- Define the fuzzy systems
- Analyze the genetic algorithms and their applications.

Unit-I **10hrs**

Soft Computing and its Techniques, Soft Computing versus Hard Computing, Applications of Soft Computing in the current industry.

Unit-II **12hrs**

Neural Network (NN), Biological foundation of Neural Network, Neural Model and Network Architectures, Perceptron Learning, Supervised Hebbian Learning, Back-propagation, Associative Learning, Competitive Networks, Hopfield Network, Computing with Neural Nets and applications of Neural Network.

Unit-III **10hrs**

Fuzzy sets, Operations on Fuzzy sets, Fuzzy Relations, Fuzzy Measures, Applications of Fuzzy Set Theory to different branches of Science and Engineering.

Unit-IV **10hrs**

Neuro Fuzzy and Soft Computing, Adaptive Neuro-Fuzzy Inference System Architecture, Hybrid Learning Algorithm, Learning methods that Cross-fertilize ANFIS and RBFN.

Unit-V **05hrs**

Coactive Neuro Fuzzy Modeling, Framework Neuron Functions for Adaptive Networks, Neuro Fuzzy Spectrum, Hybridization of other techniques.

References:

1. J.S.R.Jang, C.T.Sun and E.Mizutani, Neuro-Fuzzy and Soft Computing, PHI, 2004.
2. J.Freeman and D.Skapura, Neural Networks: Algorithms, Applications and Programming Techniques, Addison-Wesley, 1991.
3. G.J.Klir and B.Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice-Hall, 1995.
4. S.Rajasekaran and G.A.V.Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI, 2003.