DEPARTMENT OF COMPUTER SCIENCE

Curriculum and Syllabus for
Postgraduate Programme in
Computer Science
Under Credit Semester System
(with effect from 2019 admissions)

St Berchmans College
Founded 1922
AUTONOMOUS College with Potential for Excellence | Reaccredited by NAAC with A Grade
Affiliated to Mahatma Gandhi University, Kottayam, Kerala
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PREFACE

We are currently in the midst of a technological and computing revolution that will drastically change our lives and potentially redefine what it means to be human. The revised syllabus for MSc Computer Science Programme provides a long-term career to such a dynamic, fast advancing field. The knowledge acquired by the students may also equip them to meet the industrial need, and get placed.

OBJECTIVES

The MSc Computer Science programme attracts young minds to the potentially rich and employable field of computer applications.

- To be a postgraduate programme that will act as a feeder course for higher studies in the area of Computer Science/Applications.
- To develop skills in software development so as to enable the students to take up self-employment in Indian and global software market.
- To train & equip the students to meet the requirement of the Industrial standards.

BOARD OF STUDIES IN COMPUTER SCIENCE

1. Dr. R. Vijayakumar, M.Tech, Ph.D, Professor, School of Computer Science, M.G University, Kottayam.
2. Dr. Gladston Raj S , M.Tech, Ph.D , (NET) Associate Professor, Dept. of Computer Science, Government College, Nedumangadu, TVM.
3. Dr. Preetha Mathew, M.Tech, Ph.D , Associate Professor, Dept. of Computer Science, Cochin University College of Engineering Kuttanadu, Pulincunnu.
4. Dr. Sajimon Abraham, MCA, MBA, Ph.D., Faculty Member, School of Management and Business studies, M.G University, Kottayam.
5. Mr. Jiss James, Test Analyst, Infosys, Ernakulam.
6. Mr. Johnson Joy, Lecturer, S.H Public School and Junior College, Changanacherry.
7. Mr. M.C Jose, Associate Professor Department of Statistics, S B College, Changanacherry.
8. Ms. Bobby Joseph, Head-Department of Computer Science, S B College, Changanacherry
9. Mrs. Ashalakshmi R, Faculty
   Department of Computer Science, S B College, Changanacherry.
10. Ms. Dhanya C Nair, Faculty
    Department of Computer Science, S B College, Changanacherry.
11. Mr. Bijumoan Xavier, Faculty
    Department of Computer Science, S B College, Changanacherry.
12. Ms. Linu Joseph, Faculty
    Department of Computer Science, S B College, Changanacherry.
13. Ms. Smitha Krishnan, Faculty
    Department of Computer Science, S B College, Changanacherry.
14. Mr. Tomin James, Faculty
    Department of Computer Science, S B College, Changanacherry.

REGULATIONS FOR POSTGRADUATE (PG) PROGRAMMES UNDER CREDIT SEMESTER SYSTEM (SB-CSS-PG) 2019

1. **SHORT TITLE**

1.1 These Regulations shall be called St.Berchmans College (Autonomous) Regulations (2019) governing postgraduate programmes under Credit Semester System (SB-CSS-PG).

1.2 These Regulations shall come into force with effect from the academic year 2019-20 onwards.

2. **SCOPE**

2.1 The regulation provided herein shall apply to all regular postgraduate programmes, MA/MSc/MCom, conducted by St.Berchmans College (Autonomous) with effect from the academic year 2019-20.

3. **DEFINITIONS**

3.1 'University' means Mahatma Gandhi University, Kottayam, Kerala.

3.2 'College' means St. Berchmans College (Autonomous).

3.3 There shall be an Academic Committee nominated by the Principal to look after the matters relating to the SB-CSS-PG system.

3.4 'Academic Council' means the Committee consisting of members as provided under section 107 of the University Act 2014, Government of Kerala.

3.5 'Parent Department' means the Department, which offers a particular postgraduate programme.

3.6 'Department Council' means the body of all teachers of a Department in the College.

3.7 'Faculty Mentor' is a teacher nominated by a Department Council to coordinate the continuous evaluation and other academic activities of the Postgraduate programme undertaken in the Department.

3.8 'Programme' means the entire course of study and examinations.

3.9 'Duration of Programme' means the period of time required for the conduct of the programme. The duration of a postgraduate programme shall be four (4) semesters.

3.10 'Semester' means a term consisting of a minimum 90 working days, inclusive of tutorials, examination days and other academic activities within a period of six months.

3.11 'Course' means a segment of subject matter to be covered in a semester. Each Course is to be designed under lectures/tutorials/laboratory or fieldwork/seminar/project/practical/ assignments/evaluation etc., to meet effective teaching and learning needs.

3.12 'Course Teacher' means the teacher who is taking classes on the course.

3.13 'Core Course' means a course that the student admitted to a particular programme must successfully complete to receive the Degree and which cannot be substituted by any other course.

3.14 'Elective Course' means a course, which can be substituted, by equivalent course from the same subject and the number of courses required to complete the programme shall be decided by the respective Board of Studies.

3.15 The elective course shall be either in the fourth semester or be distributed among third and fourth semesters.

3.16 'Audit Course' means a course opted by the students, in addition to the compulsory courses, in order to develop their skills and social responsibility.

3.17 'Extra Credit Course' means a course opted by the students, in addition to the compulsory courses, in order to gain additional credit that would boost the performance level and additional skills.

3.18 Extra credit and audit courses shall be completed by working outside the regular teaching hours.

3.19 There will be optional extra credit courses and mandatory audit courses. The details of the extra credit and audit courses are given below.

Semester	Course	Type
I	Course on Mendeley Reference Management Software	Optional, Extra credit Grades shall be given
	Course on Basic Life Support System and Disaster Management	Compulsory, Audit Grades shall be given
First summer vacation	Internship/Skill Training	Optional, Extra credit Grades shall be given
Any time during the programme	Oral Presentation in National/International seminar	Optional, Extra credit
	Publication in a recognized journal with ISSN number	

3.20 'Project' means a regular research work with stated credits on which the student conducts research under the supervision of a teacher in the parent department/any appropriate research centre in order to submit a report on the project work as specified.

3.21 'Dissertation' means a minor thesis to be submitted at the end of a research work carried out by each student on a specific area.

3.22 'Plagiarism' is the unreferenced use of other authors' material in dissertations and is a serious academic offence.

3.23 'Seminar' means a lecture expected to train the student in self-study, collection of relevant matter from books and Internet resources, editing, document writing, typing and presentation.

3.24 'Tutorial' means a class to provide an opportunity to interact with students at their individual level to identify the strength and weakness of individual students.

3.25 'Improvement Examination' is an examination conducted to improve the performance of students in the courses of a particular semester.

3.26 'Supplementary Examination' is an examination conducted for students who fail in the courses of a particular semester.

3.27 The minimum credits, required for completing a postgraduate programme is eighty (80).

3.28 'Credit' (C) of a course is a measure of the weekly unit of work assigned for that course in a semester.

3.29 'Course Credit': One credit of the course is defined as a minimum of one (1) hour lecture/minimum of two (2) hours lab/field work per week for eighteen (18) weeks in a semester. The course will be considered as completed only by conducting the final examination.

3.30 'Grade' means a letter symbol (A,B,C etc.) which indicates the broad level of performance of a student in a course/semester/programme.

3.31 'Grade Point' (GP) is the numerical indicator of the percentage of marks awarded to a student in a course.

3.32 'Credit Point' (CP) of a course is the value obtained by multiplying the grade point (GP) by the credit (C) of the course.

3.33 'Semester Grade Point Average' (SGPA) of a semester is calculated by dividing total credit points obtained by the student in a semester by total credits of that semester and shall be rounded off to two decimal places.

3.34 'Cumulative Grade Point Average' (CGPA) is the value obtained by dividing the sum of credit points in all the courses obtained by the student for the entire programme by the total credits of the whole programme and shall be rounded off to two decimal places.

3.35 'Institution average' is the value obtained by dividing the sum of the marks obtained by all students in a particular course by the number of students in respective course.

3.36 'Weighted Average Score' means the score obtained by dividing sum of the products of marks secured and credit of each course by the total credits of that semester/programme and shall be rounded off to two decimal places.

3.37 'Grace Marks' means marks awarded to course/courses, in recognition of meritorious achievements of a student in NCC/NSS/Sports/Arts and cultural activities.

3.38 First, Second and Third position shall be awarded to students who come in the first three places based on the overall CGPA secured in the programme in the first chance itself.

4. PROGRAMME STRUCTURE

4.1 The programme shall include two types of courses; Core Courses and Elective Courses. There shall be a project/research work to be undertaken by all students. The programme will also include assignments, seminars, practical, viva-voce etc., if they are specified in the curriculum.

4.2 Total credits for a programme is eighty (80). No course shall have more than four (4) credits.

4.3 **Project/dissertation**

Project/research work shall be completed by working outside the regular teaching hours except for MSc Computer Science programme. Project/research work shall be carried out under the supervision of a teacher in the concerned department. A student may, however, in certain cases be permitted to work in an industrial/research organization on the recommendation of the supervisor. There shall be an internal assessment and external assessment for the project/dissertation. The external evaluation of the Project/Dissertation shall be based on the individual presentation in front of the expert panel.

4.4 **Evaluations**

The evaluation of each course shall contain two parts.

i Internal or In-Semester Assessment (ISA)

ii External or End-Semester Assessment (ESA)

Both ISA and ESA shall be carried out using indirect grading. The ISA:ESA ratio is 1:3. Marks for ISA is 25 and ESA is 75 for all courses.

4.5 **In-semester assessment of theory courses**

The components for ISA are given below.

Component	Marks
Attendance	2
Viva	3
Assignment	4
Seminar	4
Class test	4
Model Exam	8
Total	**25**

4.6 Attendance evaluation of students for each course shall be as follows:

% of Attendance	Marks
Above 90	2
75 – 90	1

4.7 **Assignments**

Every student shall submit one assignment as an internal component for every course.

4.8 **Seminar**

Every student shall deliver one seminar as an internal component for every course. The seminar is expected to train the student in self-study, collection of relevant matter from the books and internet resources, editing, document writing, typing and presentation.

4.9 **In-semester examination**

Every student shall undergo at least two in-semester examinations one as class test and second as model examination as internal component for every theory course.

4.10 To ensure transparency of the evaluation process, the ISA mark awarded to the students in each course in a semester shall be published on the notice board according to the schedule in the academic calendar published by the College. There shall not be any chance for improvement for ISA. The course teacher and the faculty mentor shall maintain the academic record of each student registered for the course which shall be forwarded to the office of the Controller of Examinations through the Head of the Department and a copy shall be kept in the office of the Head of the Department for at least two years for verification.

4.11 **In-semester assessment of practical courses**

The internal assessment of practical courses shall be conducted either annually or in each semester. There shall be one in-semester examination for practical courses. The examination shall be conducted annually or in each semester. The components for internal assessment is given below.

Component	Marks
Attendance	2
Lab Test	15
Viva-Voce	5
Record	3
Total	**25**

Attendance evaluation of students for each course shall be as follows:

% of Attendance	Marks
Above 90	2
75 – 90	1

4.12 End-semester assessment

The end-semester examination in theory and practical courses shall be conducted by the College.

4.13 The end-semester examinations for theory courses shall be conducted at the end of each semester. There shall be one end-semester examination of three (3) hours duration in each lecture based course.

4.14 The question paper should be strictly on the basis of model question paper set by Board of Studies.

4.15 A question paper may contain short answer type/annotation, short essay type questions/problems and long essay type questions. Marks for each type of question can vary from programme to programme, but a general pattern may be followed by the Board of Studies.

4.16 Question Pattern for external theory examination shall be,

Section	Total No. of Questions	Questions to be Answered	Marks	Total Marks for the Section
A	8	5	2	10
B	8	5	5	25
C	6	3	15	45
			Maximum	**75**

4.17 Photocopies of the answer scripts of the external examination shall be made available to the students for scrutiny as per the regulations in the examination manual.

4.18 Practical examination shall be conducted in each semester. Practical examination shall be conducted by one external examiner and one internal examiner. The question paper setting and evaluation of answer scripts shall be done as per the directions in the examination manual of the College. The duration of practical examination shall be decided by the Board of Studies.

4.19 Project/Dissertation evaluation shall be conducted at the end of the programme. Project/Dissertation evaluation shall be conducted by one external examiner and one internal examiner. The components and mark division for internal and external assessment shall be decided by the respective Board of Studies.

Components of Project Evaluation	Marks
Internal Evaluation	25
Dissertation (External)	50
Viva-Voce (External)	25
Total	**100**

4.20 Comprehensive viva-voce shall be conducted at the end of the programme. Viva-voce shall be conducted by one external examiner and one internal examiner. The viva-voce shall cover questions from all courses in the programme. There shall be no internal assessment for comprehensive viva-voce. The maximum marks for viva-voce is one hundred (100).

4.21 For all courses (theory and practical) an indirect grading system based on a seven (7) point scale according to the percentage of marks (ISA + ESA) is used to evaluate the performance of the student in that course. The percentage shall be rounded mathematically to the nearest whole number.

Percentage of Marks	Grade	Performance	Grade Point
95 and above	S	Outstanding	10
85 to below 95	A+	Excellent	9
75 to below 85	A	Very Good	8
65 to below 75	B+	Good	7
55 to below 65	B	Above Average	6
45 to below 55	C	Satisfactory	5
40 to below 45	D	Pass	4
Below 40	F	Failure	0

4.22 **Credit Point**

Credit Point (CP) of a course is calculated using the formula

$$\mathbf{CP = C \times GP}$$

where C is the credit and GP is the grade point.

4.23 **Semester Grade Point Average**

Semester Grade Point Average (SGPA) is calculated using the formula

SGPA = TCP/TCS

where TCP is the total credit point of all the courses in the semester and TCS is the total credits in the semester.

GPA shall be rounded off to two decimal places.

4.24 **Cumulative Grade Point Average**

Cumulative Grade Point Average (CGPA) is calculated using the formula

CGPA = TCP/TC

where TCP is the total credit point of all the courses in the whole programme and TC is the total credit in the whole programme

GPA shall be rounded off to two decimal places.

Grades for the different courses, semesters, Semester Grade Point Average (SGPA) and grades for overall programme, Cumulative Grade Point Average (CGPA) are given based on the corresponding Grade Point Average (GPA) as shown below:

GPA	Grade	Performance
9.5 and above	S	Outstanding
8.5 to below 9.5	A+	Excellent
7.5 to below 8.5	A	Very Good
6.5 to below 7.5	B+	Good
5.5 to below 6.5	B	Above Average
4.5 to below 5.5	C	Satisfactory
4 to below 4.5	D	Pass
Below 4	F	Failure

4.25 A separate minimum of 40% marks each in ISA and ESA (for theory and practical) and aggregate minimum of 40% are required for a pass in a course. For a pass in a programme, a separate minimum of grade 'D' is required for all the individual courses.

5. SUPPLEMENTARY/IMPROVEMENT EXAMINATION

5.1 There will be supplementary examinations and chance for improvement. Only one chance will be given for improving the marks of a course.

5.2 There shall not be any improvement examination for practical courses and examinations of the final year.

6. ATTENDANCE

6.1 The minimum requirement of aggregate attendance during a semester for appearing the end semester examination shall be 75%. Condonation of shortage of attendance to a maximum of ten (10) days in a semester subject to a maximum of two times during the whole period of postgraduate programme may be granted by the College. This condonation shall not be counted for internal assessment.

6.2 Benefit of attendance may be granted to students representing the College, University, State or Nation in Sports, NCC, NSS or Cultural or any other officially sponsored activities such as College union/University union activities etc., on production of participation/attendance certificates, within one week from competent authorities, for the actual number of days participated, subject to a maximum of ten (10) days in a semester, on the specific recommendations of the Faculty Mentor and Head of the Department.

6.3 A student who does not satisfy the requirements of attendance shall not be permitted to appear in the end-semester examinations.

6.4 Those students who are not eligible even with condonation of shortage of attendance shall repeat the course along with the next batch after readmission.

7. BOARD OF STUDIES AND COURSES

7.1 The Board of Studies concerned shall design all the courses offered in the programme. The Board shall design and introduce new courses, modify or re-design existing courses and replace any existing courses with new/modified courses to facilitate better exposure and training for the students.

7.2 The syllabus of a programme shall contain programme objectives and programme outcome.

7.3 The syllabus of a course shall include the title of the course, course objectives, course outcome, contact hours, the number of credits and reference materials.

7.4 Each course shall have an alpha numeric code which includes abbreviation of the course in two letters, semester number, course code and serial number of the course.

7.5 Every programme conducted under Credit Semester System shall be monitored by the Academic Council.

8. REGISTRATION

8.1 A student who registers his/her name for the external exam for a semester will be eligible for promotion to the next semester.

8.2 A student who has completed the entire curriculum requirement, but could not register for the Semester examination can register notionally, for getting eligibility for promotion to the next semester.

8.3 A student may be permitted to complete the programme, on valid reasons, within a period of eight (8) continuous semesters from the date of commencement of the first semester of the programme

9. ADMISSION

9.1 The admission to all PG programmes shall be as per the rules and regulations of the College/University.

9.2 The eligibility criteria for admission shall be as announced by the College/University from time to time.

9.3 Separate rank lists shall be drawn up for seats under reservation quota as per the existing rules.

9.4 There shall be an academic and examination calendar prepared by the College for the conduct of the programmes.

10. ADMISSION REQUIREMENTS

10.1 Candidates for admission to the first semester of the PG programme through SB-CSS-PG shall be required to have passed an appropriate degree examination of Mahatma Gandhi University or any University or authority, duly recognized by the Academic council of Mahatma Gandhi University as equivalent thereto.

11. MARK CUM GRADE CARD

11.1 The College under its seal shall issue to the students, a Mark cum Grade Card on completion of each semester, which shall contain the following information.

i. Name of the Student
ii. Register Number
iii. Photo of the Student
iv. Degree
v. Programme
vi. Semester and Name of the Examination

vii. Month and Year of Examination
viii. Faculty
ix. Course Code, Title and Credits of each course opted in the semester
x. Marks for ISA, ESA, Total Marks (ISA + ESA), Maximum Marks, Letter Grade, Grade Point (GP), Credit Point (CP) and Institution Average in each course opted in the semester
xi. Total Credits, Marks Awarded, Credit Point, SGPA and Letter Grade in the semester
xii. Weighted Average Score
xiii. Result
xiv. Credits/Grade of Extra Credit and Audit Courses

11.2 The final Mark cum Grade Card issued at the end of the final semester shall contain the details of all courses taken during the entire programme including those taken over and above the prescribed minimum credits for obtaining the degree. The final Mark cum Grade Card shall show the CGPA and the overall letter grade of a student for the entire programme.

11.3 A separate grade card shall be issued at the end of the final semester showing the extra credit and audit courses attended by the student, grade and credits acquired.

12. **AWARD OF DEGREE**

The successful completion of all the courses with 'D' grade shall be the minimum requirement for the award of the degree.

13. **MONITORING COMMITTEE**

There shall be a Monitoring Committee constituted by the Principal to monitor the internal evaluation conducted by the College. The Course Teacher, Faculty Mentor, and the College Coordinator should keep all the records of the continuous evaluation, for at least a period of two years, for verification.

14. **GRIEVANCE REDRESS COMMITTEE**

14.1 In order to address the grievance of students relating to ISA, a two-level grievance redress mechanism is envisaged.

14.2 A student can approach the upper level only if grievance is not addressed at the lower level.

14.3 Department level: The Principal shall form a Grievance Redress Committee in each Department comprising of course teacher and one senior teacher as members and the Head of the Department as Chairman. The Committee shall address all grievances relating to the internal assessment of the students.

14.4 College level: There shall be a College level Grievance Redress Committee comprising of Faculty Mentor, two senior teachers and two staff council members (one shall be an elected member) and the Principal as Chairman. The Committee shall address all grievances relating to the internal assessment of the students.

15. **TRANSITORY PROVISION**

Notwithstanding anything contained in these regulations, the Principal shall, for a period of three years from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any programme with such modifications as may be necessary.

REGULATIONS FOR EXTRACURRICULAR COURSES, INTERNSHIP AND SKILL TRAINING

COURSE ON BASIC LIFE SUPPORT SYSTEM AND DISASTER MANAGEMENT (BLS & DM)

i. The course on BLS & DM shall be conducted by a nodal centre created in the college.
ii. The nodal centre shall include at least one teacher from each department. A teacher shall be nominated as the Director of BLS & DM.
iii. The team of teachers under BLS & DM shall function as the trainers for BLS & DM.
iv. The team of teachers under BLS & DM shall be given intensive training on Basic Life Support System and Disaster Management and the team shall be equipped with adequate numbers of mannequins and kits for imparting the training to students.
v. Each student shall under go five (5) hours of hands on training in BLS & DM organised by the Centre for BLS & DM.
vi. The training sessions shall be organised on weekends/holidays/vacation during the first semester of the programme.
vii. After the completion of the training, the skills acquired shall be evaluated using an online test and grades shall be awarded.
viii. Nodal centre for BLS & DM shall conduct online test and publish the results.
ix. Students who could not complete the requirements of the BLS & DM training shall appear for the same along with the next batch. There shall be two redo opportunity.
x. For redressing the complaints in connection with the conduct of BLS & DM students shall approach the Grievance Redress Committee functioning in the college.

COURSE ON MENDELY REFERENCE MANAGEMENT SOFTWARE

i. College shall arrange workshop with hands on training in Mendely reference management software during the first semester.
ii. Students completing the course can enrol for an evaluation and those who pass the evaluation shall be given one credit.

INTERNSHIP/SKILL TRAINING PROGRAMME

i. Postgraduate student can undergo an internship for a minimum period of five days (25 hours) at a centre identified by the concerned department. In the case of disciplines where internship opportunities are scanty (e.g. Mathematics) special skill training programmes with duration of five days (25 hours) shall be organised.
ii. Each department shall identify a teacher in charge for internship/skill training programme.
iii. The department shall select institutions for internship/organising skill training programme.
iv. Internship/skill training programme shall be carried out preferably during the summer vacation following the second semester or during the Christmas vacation falling in the second semester or holidays falling in the semester.
v. At the end of the stipulated period of internship each student shall produce an internship completion cum attendance certificate and an illustrated report of the training he/she has underwent, duly certified by the tutor and Head of the institution where the internship has been undertaken.
vi. Students undergoing skill training programme shall submit a training completion cum attendance certificate and a report of the training he/she has underwent, duly certified by the trainer, teacher co-ordinator of the programme from the concerned department and the head of the department concerned.
vii. Upon receipt of the internship completion cum attendance certificate and illustrated report of the training or a training completion cum attendance certificate and a report of the training, the teacher in charge of internship/skill training programme shall prepare a list of students who have completed the internship/skill training programme and a list of students who failed to complete the programme. Head of the department shall verify the lists and forward the lists to the Controller of Examinations.

PAPER PRESENTATION

i. During the period of the programme students shall be encouraged to write and publish research/review papers.
ii. One research/review paper published in a UGC approved journal or oral presentation in an international/national seminar which is later published in the proceedings shall fetch one credit.

VIRTUAL LAB EXPERIMENTS/MOOC COURSES

i. During the tenure of the programme, students shall be encouraged to take up Virtual Lab Experiments and/or MOOC Courses.

ii. College shall arrange dedicated infrastructure for taking up Virtual Lab experiments and/or MOOC courses.

iii. There shall be a Nodal Officer and a team of teachers to coordinate the logistics for conducting Virtual Lab experiments and MOOC courses and to authenticate the claims of the students regarding the successful completion of the Virtual Lab experiments and or MOOC courses.

iv. Students who are desirous to do Virtual Lab experiments and or MOOC courses shall register with the Nodal Officer at the beginning of the experiment session/MOOC course. Students also shall submit proof of successful completion of the same to the Nodal officer.

v. Upon receipt of valid proof, the Nodal Officer shall recommend, to the Controller of Examinations, the award of extra credits. In the case of Virtual Lab experiments, 36 hours of virtual experimentation shall equal one credit and in the case of MOOC courses 18 hours of course work shall equal one credit.

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MARK CUM GRADE CARD

Date:

Name of the Candidate :

Permanent Register Number (PRN) :

Degree :

Programme :

Name of Examination :

Faculty :

Photo

Course Code	Course Title	Credits (C)	Marks						Grade Awarded (G)	Grade Point (GP)	Credit Point (CP)	Institution Average	Result
			ISA		ESA		Total						
			Awarded	Maximum	Awarded	Maximum	Awarded	Maximum					
	Total SGPA: SG: WAS: ***End of Statement***												

*WAS: Weighted Average Score

Entered by:

Verified by:

Controller of Examinations **Principal**

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CONSOLIDATED MARK CUM GRADE CARD

Name of the Candidate :

Permanent Register Number (PRN) :

Degree :

Programme :

Faculty :

Date :

Photo

Course Code	Course Title	Credits (C)	Marks						Grade Awarded (G)	Grade Point (GP)	Credit Point (CP)	Institution Average	Result
			ISA		ESA		Total						
			Awarded	Maximum	Awarded	Maximum	Awarded	Maximum					
SEMESTER I													
SEMESTER II													
SEMESTER III													

SEMESTER IV													
	End of Statement												

PROGRAMME RESULT

Semester	Marks Awarded	Maximum Marks	Credit	Credit Point	SGPA	Grade	WAS	Month & Year of Passing	Result
I II III IV									
Total					**FINAL RESULT: CGPA =**		**; GRADE =**	**;WAS =**	

*** Separate grade card is issued for Audit and Extra Credit courses.**
**** Grace Mark awarded.**

Entered by:

Verified by:

Controller of Examinations **Principal**

Reverse side of the Mark cum Grade Card (COMMON FOR ALL SEMESTERS)

Description of the Evaluation Process

Grade and Grade Point

The evaluation of each course comprises of internal and external components in the ratio 1:3 for all Courses. Grades and Grade Points are given on a seven (7) point scale based on the percentage of Total Marks (ISA + ESA) as given in Table 1. Decimals are corrected to the nearest whole number.

Percentage of Marks	Grade	Performance	Grade Point
95 and above	S	Outstanding	10
85 to below 95	A+	Excellent	9
75 to below 85	A	Very Good	8
65 to below 75	B+	Good	7
55 to below 65	B	Above Average	6
45 to below 55	C	Satisfactory	5
40 to below 45	D	Pass	4
Below 40	F	Failure	0

Table 1

Credit Point and Grade Point Average

Credit Point (CP) of a course is calculated using the formula

CP = C × GP

where C is the Credit and GP is the Grade Point

Grade Point Average of a Semester (SGPA) or Cumulative Grade Point Average (CGPA)for a Programme is calculated using the formula

SGPA or CGPA = TCP/TC

where TCP is the Total Credit Point for the semester/programme and TC is the Total Credit for the semester/programme

GPA shall be rounded off to two decimal places.

The percentage of marks is calculated using the formula;

$$\%\ \text{Marks} = \left(\frac{\text{total marks obtained}}{\text{maximum marks}}\right) \times 100$$

Weighted Average Score (WAS) is the score obtained by dividing sum of the products of marks secured and credit of each course by the total credits of that semester/programme and shall be rounded off to two decimal places.

Grades for the different Semesters and overall Programme are given based on the corresponding GPA, as shown in Table 2.

GPA	Grade	Performance
9.5 and above	S	Outstanding
8.5 to below 9.5	A+	Excellent
7.5 to below 8.5	A	Very Good
6.5 to below 7.5	B+	Good
5.5 to below 6.5	B	Above Average
4.5 to below 5.5	C	Satisfactory
4 to below 4.5	D	Pass
Below 4	F	Failure

Table 2

Note: Course title followed by (P) stands for practical course. A separate minimum of 40% marks each for internal and external assessments (for both theory and practical) and an aggregate minimum of 40% marks is required for a pass in each course. For a pass in a programme, a separate minimum of Grade D for all the individual courses and an overall

Grade D or above are mandatory. If a candidate secures Grade F for any one of the courses offered in a Semester/Programme, only Grade F will be awarded for that Semester/Programme until the candidate improves this to Grade D or above within the permitted period.

PROGRAMME STRUCTURE

	Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
Semester I	BMCS101	Mathematical Foundations of Computer Science	5	90	4	25	75	100
	BMCS102	Web Programming	5	90	4	25	75	100
	BMCS103	Digital Fundamentals and Computer Organization	5	90	4	25	75	100
	BMCS104	Programming in C	4	72	4	25	75	100
	BMCS1P01	Programming in C & Web Programming (P)	6	108	3	25	75	100
		Total	**25**	**450**	**19**	**125**	**375**	**500**
Semester II	BMCS205	Object Oriented Programming in Python	4	72	4	25	75	100
	BMCS206	Computer Networks	5	90	4	25	75	100
	BMCS207	Operating System	5	90	4	25	75	100
	BMCS208	Algorithms and Data Structures	4	72	4	25	75	100
	BMCS2P02	Data Structure and Python Programming Lab (P)	7	126	3	25	75	100
		Total	**25**	**450**	**19**	**125**	**375**	**500**
Semester III	BMCS309	Database Management Systems	4	72	4	25	75	100
	BMCS310	Computer Graphics	5	90	4	25	75	100
	BMCS311	Java Programming	4	72	4	25	75	100
	BMCS312	Software Engineering	5	90	4	25	75	100
	BMCS2P03	DBMS & Java Programming Lab (P)	7	126	3	25	75	100
		Total	**25**	**450**	**19**	**125**	**375**	**500**
Semester IV	BMCS413	Compiler Design	6	108	4	25	75	100
		Elective Course: Group A	5	90	4	25	75	100
		Elective Course: Group B	5	90	4	25	75	100
	BMCS4PJ	Project	9	162	8	25	75	100
	BMCS4VV	Viva-Voce	-	-	3	-	100	100
		Total	**25**	**450**	**23**	**100**	**400**	**500**
		Grand Total	-	-	**80**	**475**	**1525**	**2000**

ELECTIVE COURSES: GROUP A

Course Code	Course Title
BMCS4E01	Object Oriented Analysis and Design
BMCS4E02	Data Mining and Warehousing
BMCS4E03	Cloud Computing
BMCS4E04	Internet of Things
BMCS4E05	Database Administration using SQL Server

ELECTIVE COURSES: GROUP B

Course Code	Course Title
BMCS4E06	Artificial Intelligence
BMCS4E07	Cyber Security and Cyber Law
BMCS4E08	Data Analytics
BMCS4E09	Digital Image Processing
BMCS4E10	Theory of Computation

SEMESTER I

BMCS101: MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

Credit: 4 **Total Hours: 90**

Objectives: Use the language of logic and set theory in order to make precise formal statements.

- Recognize, understand and construct rigorous mathematical proofs. Critically analyze and solve counting problems on finite, discrete structures

Outcome:

- Students' mathematical sophistication and skills will be extended

Module 1

Propositional Calculus: Statements and notation, Connectives, Negation, Conjunction, Disjunction, Statement formulas and truth tables, Conditional and Bi-conditional, Well formed formulas, Tautologies, equivalence of formulas, tautological implications, Normal form, disjunctive and conjunctive normal forms, Theory of inference for statement calculus, Validity using truth tables, Rules of inference, sample problems. Predicate Calculus: Predicates, statement functions, variables and quantifiers, predicate formulae, free and bound variables, the universe of discourse, valid formulas and equivalences.

Module 2

Graphs: Definition and examples , incidence and degree, isomorphism, sub graphs, walks, paths, and circuits, weighed graphs, shortest path algorithms, incidence and adjacency matrices and their properties, definition and properties of trees and binary trees. Definition of spanning tree, minimum spanning tree algorithms, Cut sets and cut vertices, max-flow min-cut theorem, Digraphs, directed paths and connectedness, directed trees, arborescence, tournaments.

Module 3

Theory of Automata: Definition, Description of finite automata, Transition system and its properties, Acceptability of a string by a finite automata, NFA Equivalence of DFA and NFA, Minimization of finite automata, Construction of minimum automaton.

Module 4

Regular sets and Regular grammars: Regular expressions, identities for regular expressions, finite automata and regular expressions, transition system containing ^- moves, conversion of nondeterministic systems to deterministic systems, Algebraic method using Arden‘s theorem, Construction of finite automata equivalent to a regular expression.

Module 5

Languages and Grammars: Basic definition and example, Definition of a grammar, derivation and the language generated by a grammar, Chomsky classification of languages, Context free languages and derivation trees.

The following guidelines shall be followed during question paper setting.

	Part A **Short questions**	**Part B** **Short essays**	**Part C** **Long essays**
Module 1	1	2	1
Module 2	2	2	1
Module 3	2	1	2
Module 4	1	2	1
Module 5	2	1	1
Total	**8**	**8**	**6**

References

1. Tremblay J P & R Manohar - Discrete mathematical structures with Applications to Computer Science, McGraw Hill
2. Deo Narsingh- Graph theory with applications to engineering and computer science, Prentice Hall of India
3. Mishra KLP, N Chandra Shekharan – Theory of Computer science (Automata, Languages and Computation), Prentice Hall of India
4. George J Klie and Bo Yuvan-Fuzzysets and Fuzzylogic – Theory and applications, Prentice Hall of India

BMCS102: WEB PROGRAMMING

Credit: 4 **Total Hours: 90**

Objectives:

- To design and implement websites.
- To use client-side technologies (CSS, forms, JavaScript).
- To recognize and evaluate website organizational structure and design elements.

Outcome:

- Students can develop web pages

Module 1

Internet Programming -Introduction-Internet-Internet History-World Wide Web-http-URL HTML-Core Elements and Attributes-Basic Text Formatting-Presentational Elements-<marquee> Lists-Basic Links-Adding Images using <img> element- Using Images as Links-Image Maps- Basic Table elements and Attributes- Advanced Tables- Forms- Form Controls-Text Input, Buttons, Checkboxes, Radio Buttons, Select Boxes, File Select Boxes, GET vs POST, Frames, and .

Module 2

CSS- Introduction- The <link> and <style> elements- inline, internal and external methods-CSS Properties- Controlling Fonts- Text Formatting- Text Pseudo Classes- Selectors- Links-Backgrounds- Lists – Padding – Positioning – Margins – Opacity – Visibility.

Module 3

JavaScript- JavaScript Variables- Operators- Functions- Conditional Statements- Looping-Events- Pop up boxes - Built-in Objects- The Document Object Model - Writing JavaScript-Form Validation- Timers.

Module 4

Introduction to php - advantages- features - php syntax - php tags and styles - data types, variables, operators- type casting - control structures – Arrays - Creating index based, Associative and Multi-dimensional array, Accessing array element, Looping with Index based array, Looping with associative array using each() and for each(),array operators - sorting arrays-user defined functions in php, Call by value and Call by reference methods, Recursive function

,Some useful Library functions - date and time functions –string manipulation functions and regular expression functions, require() and include() functions- file functions.

Module 5

Working with PHP and MySQL: Working with html forms – using GET and POST input, input validation, trim(), html special characters(), stripslahes() – Exception handling techniques- Cookies and Session control- PDO, Introduction to RDBMS, Connection with MySQL Database, Performing basic database operations(DML) - Insert, Delete, Update, Select - PEAR and PHP frameworks.

The following guidelines shall be followed during question paper setting.

	Part A **Short questions**	**Part B** **Short essays**	**Part C** **Long essays**
Module 1	1	2	1
Module 2	2	1	1
Module 3	1	2	1
Module 4	2	1	2
Module 5	1	2	1
Total	**8**	**8**	**6**

References

1. Beginning Web Programming with HTML, XHTML and CSS, Jon Duckett, Wrox publication.
2. Beginning PHP5, Wrox publication.
3. Advanced PHP Programming, George Schlossnagle, Pearson Education.

BMCS103: DIGITAL FUNDAMENTALS AND COMPUTER ORGANIZATION

Credit: 4 **Total Hours: 90**

Objectives:

- Think critically, independently, and quantitatively about computer design
- Analyze architectures and computational designs
- Design and synthesize new and better architectures

Outcome:

- Able to understand the characteristics and operation of different analog
- Able to understand the applications of above ICs in the design of electronic circuits

Module 1

Boolean Algebra-Truth Tables, Logic gates and Map Simplification, Flip-flops, Design of Combinational and Sequential Circuits, Examples of Digital circuits–Adders, Multiplexers, Decoders, Counters, Shift Registers. Register transfer language and micro operations.

Module 2

Functional units of computer - Basic operational concepts. Data Representation: Signed Number Representation-Sign and Magnitude, 1‘s Complement, 2‘s Complement, Floating point Number representation. Machine Instructions: Classification- Function, Addresses, Size, Addressing Modes. Instruction Sequencing.

Module 3

Processing unit: Fundamental concepts, register transfers, performing arithmetic or logic operations, memory read and write, execution of a complete instruction, branch instruction, Single bus, two bus, three bus organization, a complete processor, **Control unit**: hardwired control, microprogrammed control, micro instructions-types.

Module 4

Arithmetic and Logic Unit: Addition of positive numbers – Fast Adders – Signed Addition and Subtraction- addition/subtraction logic unit–Multiplication of positive numbers –Array Multiplier, Sequential Multiplier-Signed number Multiplication- Multiplication using Booth's algorithm-Fast Multiplication– bit pair recording of multiplication, Division-restoring and non-restoring algorithms, Floating point numbers and Operations.

Module 5

The Main Memory: Memory Hierarchy– Main memory– RAM, ROM-memory cells- cell organization-working– Performance Considerations-Cache Memory–Virtual Memory-Memory Management Requirements, Secondary storage – memory interleaving.

Input / Output Organization: Accessing I/O devices–Programmed I/O, Interrupt I/O Interrupts-Interrupt processing– hardware interrupts–programmable interrupt controller – Vectored Interrupts-Interrupt nesting –Daisy chaining-Direct memory access (DMA): DMA operations & DMA Controller, Introduction to I/O interfaces, I/O channels, IO Processors.

The following guidelines shall be followed during question paper setting.

	Part A **Short questions**	**Part B** **Short essays**	**Part C** **Long essays**
Module 1	1	2	1
Module 2	2	2	1
Module 3	2	1	1
Module 4	1	2	1
Module 5	2	1	2
Total	**8**	**8**	**6**

References

1. V C Hamacher, Computer Organization, Mc-Graw Hill International Edition, Fifth Edition.
2. Morris Mano, Digital logic and Computer design, Prentice Hall of India
3. M Morris Mano, Computer System Architecture, Prentice Hall, Third Edition.
4. William Stallings, Computer Organization and Architecture-Fifth Edition.
5. Andrew S Tanenbaum, Structured Computer Education, Prentice Hall, 4thEdition.

BMCS104: PROGRAMMING IN C

Credit: 4 **Total Hours: 72**

Objectives:

- To be able to build own logic for a given problem and finally develop one's own programs
- To understand the syntax and the semantics of C programming language

Outcome:

- Students can develop their own applications in C.

Module 1

Introduction to algorithm, flowchart, structured programming concept, programs – Compiler, Interpreter. Introduction to C Language: The C character set, identifiers and keywords, datatypes, constants, variables and arrays, declarations, expressions, statements, L values and R values, type conversion, symbolic constants.

Module 2

Operators and expressions: Arithmetic operators, unary operator, relational and logical operator, assignment operators, the conditional operator, type conversion, Library function Data input and output: Single character input, single character output, scanf, printf, puts gets functions, interactive programming. Control statement: Branching: if else statement, Looping, nested control structure, switch statement, break statement, continue statement, comma operator, go to statement.

Module 3

Functions: Overview, function prototypes, passing arguments to a function, recursion. Program structure: Storage classes, automatic variables, external variables, static variables, multifile program. Arrays: Defining an array, passing array to functions, multidimensional arrays, strings: one dimensional character array, array of strings.

Module 4

Pointers: Fundamentals, void pointer, null pointer, passing pointers to a function, pointers and one dimensional arrays, dynamic memory allocation, operation on pointers, pointers and multidimensional arrays, array of pointers, pointer to an array, pointers and strings, structure pointer, pointers to function, pointers and variable length arguments list, passing functions to other functions. Structures and unions: Defining a structure, processing a structure, user

defined data types, structure and pointers, passing structure to function, self-referential structures, and union.

Data files: opening and closing a data file, reading and writing a data file, processing a data file, unformatted data file, concept of binary file. Low level programming: Register variable, bitwise operations, bit fields. Additional features of C: Enumeration, Command line parameters, Macros, C Pre-processor.

Module 5

Understanding Linux-overview of Linux features-advantages-directory and file system structure – boot loaders booting-Login-Shells-Kernel- types of users- file types-file permissions-chmod--simple commands bash-wildcard characters-grep, pipe, tee-shell variables-shelltypes–filters–pr,head,tail,cut,paste,sort,unique,nl,grep. Linux Editors-vi and emacs.

The following guidelines shall be followed during question paper setting.

	Part A **Short questions**	**Part B** **Short essays**	**Part C** **Long essays**
Module 1	1	2	1
Module 2	2	2	1
Module 3	2	1	1
Module 4	2	1	2
Module 5	1	2	1
Total	**8**	**8**	**6**

References

1. The c programming language – Brian W Kernighan & Dennis Ritchie, Eastern Economy Edition, Prentice Hall
2. Programming with C – Byron S Gottfried– Schaum's outlines 2nd Edition
3. Computer Science: A Structured Programming Approach Using C, Forouzan
4. Understanding pointers in C- Yashavant Kanetkar – BPB publication
5. Let us C –Yashavant Kanetkar – BPB publication

PRACTICAL

BMCS1P01: PROGRAMMING IN C & WEB PROGRAMMING

Credit: 3 **Total Hours: 108**

Objectives:

- To design and implement websites.
- To use client-side technologies (CSS, forms, JavaScript).
- To use c programming concepts

Outcome:

- Students can develop web pages as well as develop c application programs

PROGRAMMING IN C

- Data Types in Control Structures, Looping Constructs Implementation of arrays.
- Implementation of functions
- Various string operations,
- Recursion
- Pointers, Structure and Union
- Implementation of pointers to structures and unions.
- Dynamic allocation of memory (Hint: malloc, calloc, realloc, free).
- Sorting techniques (Hint: selection sort, bubble sort).
- Searching techniques (Hint: linear search, binary search).
- Various file operations. (Hint: Text file)

WEB PROGRAMMING

- HTML

  {List, Forms, Tables, Div}
- DHTML
- Cascading Style Sheet
- JavaScript

  {Form validation, Image Precaching, Interchangeable Images and Image Roll overs Different Event Handlers

  Important DOM Objects and related methods, (Window, Document, Location, Form, Form Elements, Body etc.)}
- Designing User Interface using PHP.

- Programs using decision making and loops.
- Implementing OOP concepts using class and objects.

SEMESTER II

BMCS205: OBJECT ORIENTED PROGRAMMING IN PYTHON

Credit: 4 **Total Hours: 72**

Objectives

- To learn how to design and program Python applications.
- To learn how to use lists, tuples, and dictionaries in Python

Outcome:

- Students can develop their own applications using python

Module I

Introduction to Python

What is Python, The application areas of Python, Download and install Python, Introduction to Python IDE in web development, scientific and mathematical and desktop & GUI, Execute Python program from command prompt and using IDLE, Save programs with .py extension and execute it from prompt, Data types and variables, int, float, boolean, string, numbers and list; variables, expressions, statements, tuple assignment Operators and operator precedence, Data type conversions, Command line argument, comments, inputs , assignments and outputs Import modules

Module2

Control Flow, Functions ,Lists, Tuples, Dictionaries

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension; Sets,Range ,String,Tuple,, Set

Module 3

Functions Modules

What is function, Define a function, Pass arguments, Arguments with default values, Arbitrary arguments, Local and global variables, Return a value from function, Return multiple values, Documentation Strings **Python built in functions:** Mathematical functions,· Random number functions, Mathematical constants.

Python Modules : What is module?, Import module using import statement, Use from import statement, Use from . import* statement, Location modules, PYTHONPATH variable, Namespaces and scoping, Dir(), globals(), locals() and reload()

Module 4

Files, Packages

File Handling: Reading, Writing, and File manipulations, Directories, **Exception Handling**: What is exceptions, Python built-in exceptions, Try, Except, Finally, Raise exceptions, User defined exception, Assertions **Python classes and objects:** Class definition. Creating objects, Constructors,, Accessing attributes, Build-in class attributes, Destructors, Inheritance Overriding Overloading Data hiding. **Regular Expressions**: Match(), Search(), Search and replace, Modifiers, Patterns, Character classes, Repetitions, **Database programming**: With MySQL, MySql data types, CRUD operations: insertion,deletion,updation, selection,

Module 5

Introduction to packages; Panda - Head and Tail, Attributes and the raw ndarray(s), Accelerated operations, Flexible binary operations, Descriptive statistics, Function application.

Numpy - Data types, Array creation, I/O with NumPy, Indexing, Broadcasting, Byte-swapping, Structured arrays , Subclassing ndarray

Django - Introduction, Concept Battery included philosophy. The following guidelines shall be followed during question paper setting.

The following guidelines shall be followed during question paper setting.

	Part A **Short questions**	**Part B** **Short essays**	**Part C** **Long essays**
Module 1	1	2	1
Module 2	2	2	1
Module 3	2	1	1
Module 4	2	1	2
Module 5	1	2	1
Total	**8**	**8**	**6**

References:

- Core Python Programming Paperback by R. Nageswara Rao Dreamtech Press (2016) ISBN-13: 978-9351199427
- Python Programming: A modular approach by Taneja Sheetal (Author), Kumar Naveen (Author) Pearson ISBN-13: 978-9332585348
- Python for Complete Beginners by Martin Jones (Author) Createspace Independent Pub;ISBN-13: 978-1514376980

BMCS206: COMPUTER NETWORKS

Credit: 4 **Total Hours: 90**

Objectives:

- To build an understanding of the fundamental concepts of computer networking.
- To familiarize the categories and topologies of networks
- To understand the details of IP operations in the Internet and associated routing principles

Outcome:

- Students will get expertise in networking concepts.

Module 1

Introduction to networks– topology–LAN, MAN, WAN, Client-server model concepts – transmission media – guided, unguided – transmission impairments. Digital and analog signals, Concepts of ISO/ OSI reference model (detailed study not required), TCP/IP reference model – comparison.

Module 2

Network Layer – Internet addressing– classless and classful- IP address–IPV4and IPV6 – sub netting– subnet masking– address mapping– ARP, RARP, DHCP,ICMP, IGMP– DNS– networking & inter-networking devices– NIC, hub, switch, bridge, router, gateway.

Module 3

Routing– routing algorithms– static and dynamic– shortest path routing, flooding, distance vector routing, link state routing. Transport layer protocols– TCP, UDP, SCTP– protocols, uses, services.

Module 4

Application layer – email– SMTP, POP, IMAP, FTP, HTTP, TELNET– CSMA, CSMA/CD – Ethernet– gigabit networks, wireless network– wireless LAN, Bluetooth, GSM– 3G, introduction to 4G– entertainment networks– satellite TV, DTH technology, VOD services, VoIP services.

Module 5

Web security– cryptography–encryption, RSA, DES– Digital signature– hacking–ethical hacking– uses – phishing– spoofing– cyber forensics.

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	1	2	1
Module 2	2	2	1
Module 3	2	1	1
Module 4	2	1	2
Module 5	1	2	1
Total	**8**	**8**	**6**

References:

1. Data communications& Networking, Behrouz A Forouzan, IV edition
2. Computer Networks, Andrew S Tanenbaum, V edition.
3. Data Communication by William Stallings

BMCS207: OPERATING SYSTEM

Credit: 4 **Total Hours: 90**

Objectives:

- To understand the services provided by an operating system.
- To know about memory management and the file system
- To Study the various working of assembler and compiler

Outcome:

- Students will get to know the functionalities of Operating System.
- Able to apply the concepts of operating system to study Linux
- Understand various phases of compiler and assembler

Module 1

Introduction to operating systems-Functions of operating system-Types of operating systems-Batch Operating System, Multi programming-Time sharing, Real time, distributed operating systems.

Processor Management-Job and process concept, Operating system view of process, process state, state transition diagram, PCB (Process control block), System state and process lists, process switch, threads, Multi-threading operating system, operating system services for process management.

Process Scheduling: - Types of schedulers, scheduling and performance criteria, scheduling algorithms, multiple processor scheduling.

Module 2

Inter process synchronization and communication-Concurrent Processes-need for inter process synchronization, critical section problem, mutual exclusion-mutual exclusion algorithms, semaphore definition, primitives, implementation of semaphores, monitors, inter process communication using messages.

Deadlocks:-Definition–Deadlock characterization - Resource allocation graph, methods for handling deadlocks, deadlock prevention, deadlock avoidance-safe state-resource allocation graph algorithm, Banker‘s algorithm, deadlock detection, recovery from deadlock.

Module 3

Memory Management:-Preliminaries-address binding, dynamic linking and loading, Overlays. Logical versus physical address space, Swapping, Contiguous allocation–

fragmentation – compaction-Paging-principles of page allocation. Structure of page table-hardware support, multilevel paging, Segmentation-principles of operation, hardware, implementation of segment table, protection and sharing, fragmentation, segmentation with paging. Virtual Memory- Demand paging –Page replacement algorithms page allocation policies–Thrashing –hierarchical address translation tables -MMUS.

Module 4

File Management:-File structure, file types, File access, File attributes, File operations. Directories-Flat directory systems, hierarchical directory systems. File system implementation-Allocation methods, contiguous allocation, linked allocation, indexed allocation

Module 5

General concepts –system software and application software. Review of machine and assembly language programming. Assembly language statements – imperative declaration and assembler directives.

Assemblers–Two pass and one pass assembler Linkers and loaders–Linker: translated, linked and load time address relocation and linking concepts– object module. Loader–absolute loader, relocating loader

Compilers–Different phases of compilers

Case study of latest operating systems (To be taken as seminars)

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	2	2	1
Module 2	2	1	1
Module 3	1	2	2
Module 4	2	1	1
Module 5	1	2	1
Total	**8**	**8**	**6**

References

1. Operating System Concepts, Silberschatz, Galvin, Gagne: 7th Edition
2. Operating systems, Milan Milenkovic, TATA McGrawHill.
3. Modern Operating System, Andrew S. Tanenbaum, Prentice Hall India
4. System software and operating systems, Dhamd here, Tata McGraw Hill
5. An Introduction to Operating System, H M Deitel, Adison Wesley
6. Modern Operating systems, Tanenbaum, Prentice Hall
7. Operating Systems, William Stallings, Pearson Education

BMCS208: ALGORITHMS AND DATA STRUCTURES

Credit: 4 **Total Hours: 72**

Objectives:

- To learn the use and working of the various data structures.
- To build own algorithms and pseudo codes for the various applications of the basic data structures**.**

Outcome:

- Able to understand the representation and use of primitive data types, built in data structure and allocation, use in memory.
- Able to understand the concept of stack, link list, Memory allocation & garbage collection and applications of Data Structures

Module 1

Algorithm: Analysis–Algorithm design techniques-Algorithm classification- complexity analysis of algorithms-Time Space Trade off -worst case and average case – Asymptotic notations and their significance –Recurrence equations–Analysis of linear search.

Module 2

Concept of data structures, types of data structures, examples.

Arrays: Organization, representation and implementation of arrays, examples.

Stacks and Queues, Circular Queues (Sequential), Priority Queues, Double ended queues, Multiple stack, Applications of stacks and queues.

Module 3:

Lists: Representation and implementation of singly linked list, doubly linked list, circularlists, linked list representation of stacks and queues, examples. Dynamic storage management: boundary tag system. Garbage collection and compaction.

Module 4:

Search techniques: sequential (linear) search, binary search, Tree search, Multiway search tree sorting techniques: Bubble sort, quick sort, binary tree sort, selection sort, heap sort, simple insertion sort, shell sort, merge sort, radixsort.

Module 5

Trees: Representation and Implementation, Binary trees, insertion and deletion of nodes in binary tree, binary tree traversals, Binary search trees, Threaded Binary trees, Applications of binary trees, balanced trees (AVL trees), B-trees-Insertion and Deletion of nodes.

File Organizations: sequential, indexed sequential, random, linked organizations.

Hashing: Static hashing, hash tables, hash functions, overflow handling.

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	2	1	1
Module 2	1	2	1
Module 3	1	2	1
Module 4	2	1	2
Module 5	2	2	1
Total	**8**	**8**	**6**

References

1. Data structures using C & C++, Aaron M Tenenbaum, Moshe J Augustein , Pearson Education
2. Dinesh Mehta Fundamentals of data structures, Ellis Horowitz, Sartaj Sahini, Galgotia publications Book Source, New Delhi
3. Data Structures and Program Design in C (Second Edition), Robert Kruse, C.L. Tondo, Bruce Leung, Pearson Education.
4. Introduction to data structures with applications, Tremblay and Sorenson, TMH, McGraw Hill Book Company

PRACTICAL

BMCS2P02: DATA STRUCTURE AND PYTHON PROGRAMMING LAB

Credit: 3 **Total Hours: 126**

DATA STRUCTURE

- Implementation of stacks and queues, Application programs
- Implementation of circular queues
- Implementation of Singly linked list, Doubly linked list, Circular Linked list Linked list representation of Stacks and Queues Applications.
- Representation of binary trees, binary tree node insertion and deletion, Tree traversals, Application programs.
- Linear search, binary search, tree search, bubble sort, quick sort, binary tree sort, Selection sort, heap sort, shell sort, merge sort. Sample programs related to search and sort.

PYTHON

- Implement a sequential search
- Create a calculator program
- Explore string functions
- Implement Selection Sort
- Implement Stack
- Read and write into a file
- Demonstrate usage of basic regular expression
- Demonstrate use of advanced regular expressions for data validation.
- Demonstrate use of List
- Demonstrate use of Dictionaries
- Create Comma Separate Files (CSV), Load CSV files into internal Data Structure
- Write script to work like a SQL SELECT statement for internal Data Structure made in earlier exercise
- Write script to work like a SQL Inner Join for an internal Data Structure made in earlier exercise
- Demonstrate Exceptions in Python

SEMESTER III

BMCS309: DATA BASE MANAGEMENT SYSTEMS

Credit: 4 **Total Hours: 72**

Objectives:

- To understand conceptual and physical design of a database.
- To understand RDBMS and queries to design database and manipulate data in it.
- To know basic database backup and recovery

Outcome:

- Students will be able to manage database
- Able to develop skills for query processing and optimization.
- Able to identify the basic issues of transaction processing

Module 1

Basic concepts

Database, need for DBMS, users, architecture of DBMS, data models, views of data, data Independence, conventional data models & systems, ER model, attributes, relationship attributes, relationship set, generalization, aggregation, structure of relational Database and different types of keys, expressing M: N relation.

Module 2

Relational Model and Relational Database Design

Codd's rules, Relational data model & relational algebra, Relational model concept, Relational model constraints, relational algebra, relational data base language, Introduction to MySQL, Data definition in SQL, Views and Queries in SQL, Specifying constraints, indexes in SQL, Specifying constraints management systems, ER to Relational, Functional dependencies, Normalization, multi-valued and other kinds of Dependencies. Connecting My SQL with PHP

Module 3

File Structure, Transaction and Concurrency control

Overview of physical storage media, Magnetic disk, RAID, Tertiary storage, Storage access, File organization, Organization of records in files, Data dictionary storage, Concept of

transaction, ACID properties, serializability, states of transaction, Concurrency control, Locking techniques, Time stamp based protocols, Granularity of data items, Deadlock.

Module 4

Crash Recovery and Backup

Failure classifications, storage structure, Recovery and atomicity, Log base recovery, Recovery with concurrent transactions, Database backup & recovery Remote Backup System, Database security issues, Discretionary access control based on grant & revoking privilege, Mandatory access control and role based, access control for multilevel security, Encryption & public key infrastructures.

Module 5

Data base system Architectures

Object Oriented Database, A brief introduction to XML data base, NOSQL, Distributed Databases, Parallel Database, New Applications, Web interfaces to Data bases, Introduction to E-commerce, DSS, Multimedia Database, Data mining, Data Ware Housing.

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	2	2	1
Module 2	2	1	2
Module 3	1	2	1
Module 4	1	2	1
Module 5	2	1	1
Total	**8**	**8**	**6**

References

1. System Concepts, Avi Silberschatz, Henry F. Korth, S. Sudarshan, Database Fifth Edition, McGraw-Hill
2. Fundamentals of Database Systems, Ramez Elmasri, Sham Navathe, Fifth edition, Pearson education
3. Database Management systems, Raghu Ramakrishnan, Johannes Gehrke, Third Edition, (McGraw-Hill)

BMCS310: COMPUTER GRAPHICS

Credit: 4 **Total Hours: 90**

Objectives:

- To provide a comprehensive introduction to computer graphics
- To focus on 2D & 3D Modelling
- To create interactive graphics techniques using different algorithms

Outcome:

- Students will be able to develop graphics application programs

Module 1

Introduction: Fundamentals of Graphics Systems, Display technologies, Graphics Software and Hardware. Various Graphic File formats, Two dimensional Graphics, Line Drawing Algorithms, Circle drawing algorithms, Transformations: 2D, 3D

Module 2

Clipping and windowing algorithms: Line clipping, Polygon Clipping. Structures and hierarchical modelling– Concepts– Basic Structure functions- Basic Modelling concepts– Local Coordinates and Modelling Transformations, Interactive graphical techniques.

Module 3

Three Dimensional Object representations: Spline representations, Cubic spline Interpolation methods, Bezier curves and surfaces

Three Dimensional Graphics:

Concepts, representation of objects with plane transformations, viewing, Parallel Projection– Perspective Projection–Depth Cueing

Module 4

Visible-surface detection methods–back–face detection, depth buffer, scan-line, depth sorting and are a sub-division methods, Illumination and surface rendering methods – Illumination models, polygon-rendering methods.

Module 5

Animation: Principles of Animation, Animation Techniques and File formats, Design of Animation sequences, raster animations, computer animation languages, key frame systems,

motion specifications, Video File formats–NTSC, PAL, SECAM,MPEG, Analogue Video, Digital video.

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	2	2	1
Module 2	2	1	1
Module 3	1	2	1
Module 4	2	1	2
Module 5	1	2	1
Total	**8**	**8**	**6**

References

1. Computer Graphics, Hearn D, M. P. Baker, Prentice Hall of India.
2. Computer Graphics, Foley J.D, A. Van Dam, Feiner S.K., Hughes J.F., Pearson Education
3. Computer Graphics- A Programming Approach, Harrington S, McGraw Hill.

BMCS311: JAVA PROGRAMMING

Credit: 4 **Total Hours: 72**

Objective:

- To learn servlets
- To learn spring Frame work
- To learn android

Outcome:

- Students will be able to develop applications using advanced java concepts and android

Module 1

Java Servlet: Introduction, Characteristics of Servlet, Advantages of Servlet, Servlet Structure, Servlet Lifecycle, Http Servlet class, Http Servlet Request interface, Http Servlet Response interface, service(), doGet(), doPost(), State and Session Management using Hidden form field, Rewritten URL, Http Session & Cookies. Accessing JDBC using Servlets

Module 2

Java Server Pages: Overview, Advantages, Structure of JSP, Directives, Declaratives, Expressions, Scriptlets, Implicit Objects. Creating and using JSP Error Pages. State & Session Management in JSP. Accessing JDBC using JSP

Module 3

Android: Basic Building blocks like Activities, Views, Services, Broadcast Receivers &Content providers, Intents & Intent Filters. Downloading and Installing the SDK. Developing with Eclipse. ADT Plugin Dalvik Virtual Machine. Dalvik Debug Monitor Service (DDMS). The Android Debug Bridge (ADB) Activities and Activity lifecycle Application Manifest. Uses-permission Assets Activities and Activity lifecycle. Resources and R.java. Layouts and Drawable Resources. String.xml

Module 4

Creating Activity User Interfaces with Views. Handling User Interaction Events. Defining an Activity. Menu MenuItemOptions.CreatingSubmenus.UsingContextMenus.ImplicitIntents, Explicit intents. Returning Results from Activities Handling Sub-Activity Results. Array Adapter. Simple Cursor Adapter. List View and List Activity. Using Adapters for Data

Binding .Using and Managing Dialogs- Date Picker Dialog. Time Picker Dialog. Progress Dialog.

Module 5

Introduction to Spring Frame Work: Spring IDE**,** Inversion of Control (IoC), Spring Setter Injection, Spring Constructor Injection, Spring MVC Framework, Spring Simple Form Controller, Spring Annotation Based Controller, Spring Form Tags, Spring Annotation, Spring Form Validation, Spring Interceptor, Spring Multi Action Controller, Spring JDBC, Spring Exception Handling

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	2	2	1
Module 2	2	1	2
Module 3	2	1	1
Module 4	1	2	1
Module 5	1	2	1
Total	**8**	**8**	**6**

References

1. Java2 The Complete Reference, Patrick Naughton
2. Pure JSP, James Good Will
3. Inside Servlets, Dustin R Callaway
4. Developing Java Servlets, James Good Will
5. Android Programming, Nicolas Gramlich
6. Learning Android, O‘Reilly
7. Professional Java Development with Spring Frame Work, Rod Johnson

BMCS312: SOFTWARE ENGINEERING

Credit: 4 **Total Hours: 90**

Objectives:

- To gain knowledge of various software mode
- To gain knowledge of various software design activities.
- To familiarize about coding and metrics

Outcome:

- Students will be able to document their projects.
- Students will be able to understand software development concepts

Module 1

Introduction–The nature of software, Software engineering, The Software Process, Software Myths, Software Process Models– Generic Process Model, Prescriptive Process Model, Specialized Process Model, The Unified Process, Agile Development.

Module 2

Requirements Engineering –Understanding Requirements, Requirements Modelling- Requirements Analysis, Scenario based Modeling, Data Modelling Concepts, Class Based Modelling, Flow- Oriented Modelling, Creating Behavioural Model.

Module 3

Software Design–The Design Process, Design Concepts, The Design Model; Architectural Design–Software Architecture, Architectural Styles and Designs, Architectural Mapping Using Data Flow; Component-level Design–Designing Class- Based Components and Traditional Components, Component-Based Development; User- Interface design.

Module 4

Testing – Software Testing Strategies, Testing Conventional Applications, Testing Object oriented applications.

Module 5

Quality Management–Software Quality Management, SCM–Software Configuration Management, The SCM Repository, The SCM Process; Product Metrics, Software Measurement, Metrics for Quality; Software Project Estimation, Decomposition Techniques,

Empirical Estimation Models, Estimation for Object-Oriented Projects, Project Scheduling, Risk Management, Software Maintenance, Software Re-engineering.

Introduction to UML: Class Diagram, Deployment Diagram, Use-Case Diagram, Sequence Diagram, Communication Diagram, Activity Diagram, State Diagram

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	2	1	1
Module 2	1	2	1
Module 3	2	2	1
Module 4	1	2	1
Module 5	2	1	2
Total	**8**	**8**	**6**

References

1. Software Engineering: A Practitioner's Approach, Roger S. Pressman, McGraw Hill International Edition
2. Fundamentals of Software Engineering, Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli
3. Software Engineering Concepts, Richard Fairley, Tata McGraw Hill Edition
4. Software Engineering- Design Reliability and Management, Martin L. Shooman, McGraw Hill International Edition

PRACTICAL

BMCS3P03: DBMS & JAVA PROGRAMMING LAB

Credit: 3 **Total Hours: 126**

Objective:

- Write sub queries and understand their purpose
- Use Aggregate and group functions to summarize data
- Use Java Concepts to develop programs

Outcome:

- Students can develop their own application programs and manage databases

DBMS

Creating a new Database– Creating, Altering, Dropping a table, Adding, Updating and Deleting data-Retrieving data using basic SQL commands, Aggregate Functions– Group by and Having Clauses, Advanced Select statements– Joins–Subqueries. Setting relationships– Retrieving data from multiple tables. Creating Users and setting privileges.

JAVA PROGRAMMING

- Arrays-Method Overloading-Method Overriding–Constructor Overloading.
- Inheritance-Abstract Classes-Interfaces-Applets-Exception Handling.
- Package-Multithreading– Event Handling.
- AWT-Swing-Database Connectivity.
- RMI

SEMESTER IV

BMCS413: COMPILER DESIGN

Credit: 4 **Total Hours: 108**

Objectives

- The Objectives of this course is to explore the principles, algorithms, and data structures involved in the design and construction of compilers.
- Topics include context-free grammars, lexical analysis, parsing techniques, symbol tables, error recovery, code generation, and code optimization.

Outcome

- Student can implement a compiler for a small programming language.

Module 1

Introduction to Compiling

Compilers, Analysis of the source program, the phases of a compiler, Compiler Construction tools. Specification and Recognition of tokens, Regular Expressions and Finite Automata, From a Regular Expression to an NFA, Design of a Lexical Analyzer Generator.

Module 2

Syntax Analysis

Parsing, Context Free Grammars, Top-down and Bottom-up Parsing, Operator precedence parsing, Predictive parsing, LR parsing, Parser Generators, Using Ambiguous Grammars, Abstract syntax- Semantic Actions, Abstract Parsing, Syntax Directed Translation.

Module 3

Semantic Analysis

Type Checking– Specification of a Simple type checker, Run-time Environments- Source Language issues, Storage organization, Storage Allocation Strategies, Access to nonlocal names, Parameter passing, Symbol tables, Dynamic storage allocation techniques.

Module 4

Code Generation

Translation to Intermediate Code- Declarations, Assignment statements, Boolean expressions, Control statements. Issues in the Design of a code generator- The target

machine, Run-time storage management, Basic blocks and flow graphs, A simple code generator, Register allocation and Assignment, The dag representation of basic blocks, Peephole optimization, Generating code from dags.

Module 5

Code Optimization

The principal sources of optimization, Optimization of basic blocks, Loops in flow graphs, Global dataflow analysis, Code improving transformations, Efficient dataflow algorithms.

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	2	2	1
Module 2	1	2	1
Module 3	2	2	1
Module 4	1	1	2
Module 5	2	1	1
Total	**8**	**8**	**6**

References

1. Compilers Principles, Techniques and Tools, V Aho, A., Ravi Sethi, D Ullman, Pearson Education
2. Modern Compiler Implementation in C, W. Appel, Andrew, Cambridge University Press

ELECTIVE COURSES: GROUP A

BMCS4E01: OBJECT ORIENTED ANALYSIS AND DESIGN

Credit: 4 **Total Hours: 90**

Objective:

- To understand the Object –based view systems.
- To develop robust object-based models for System.
- To indicate necessary skills to handle complexity in software design

Outcome:

- Ability to analyse and model software specification

Module 1

Introduction to OOAD –OOAD–UML, United process (UP) phases - Case study–theNext Gen POS system, Inception -Use case Modelling - Relating Use cases – include extend and generalization.

Module 2

Elaboration - Domain Models - Finding conceptual classes and description classes – Associations – Attributes – Domain model refinement – Finding conceptual class hierarchies- Aggregation and Composition-UML activity diagrams and modelling

Module 3

System sequence diagrams - Relationship between sequence diagrams and use cases Logical architecture and UML package diagram – Logical architecture refinement – UML class diagrams - UML interaction diagrams

Module 4

GRASP: Designing objects with responsibilities – Creator – Information expert – Low Coupling –Controller – High Cohesion – Designing for visibility - Applying GoF design patterns – adapter, singleton, factory and observer patterns.

Module 5

UML state diagrams and modelling - Operation contracts- Mapping design to code -UML deployment and component diagrams.

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	1	2	1
Module 2	1	2	1
Module 3	2	1	2
Module 4	2	2	1
Module 5	2	1	1
Total	**8**	**8**	**6**

References

1. Applying UML and Patterns: An Introduction to object-oriented Analysis and Design and iterative development, Craig Larman, Third Edition, Pearson Education
2. Object-Oriented Analysis & Design: Understanding System Development with UML 2.0, Mike O' Docherty, John Wiley & Son
3. Java Design Patterns A Tutorial, James W Cooper, Addison-Wesley,
4. Object - Oriented Modelling and Design with UML, Micheal Blaha, James Rambaugh, Prentice Hall of India Private Limited
5. Design patterns: Elements of Reusable object-oriented software, Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides Addison-Wesley

BMCS4E02: DATA MINING AND WAREHOUSING

Credit: 4 **Total Hours: 90**

Objective:

- To learn online processing
- Pre-process the data for mining applications
- To learn association rules for mining the data
- To learn Evaluate various mining techniques on complex data objects

Outcomes:

- Upon Completion of the course, the students will be able to Store voluminous data for online processing
- Pre-process the data for mining applications
- Apply the association rules for mining the data

Module 1

Introduction: Data mining, Relational Databases, Data Warehouses**,** Data Mining Functionalities, Mining Frequent Patterns, Associations and Correlations, Classification and Prediction, Cluster Analysis, Classification of Data Mining systems, Major issues in Data Mining, **Data Warehouse and OLAP Technology for Data Mining,** Multi-dimensional Data Model, From Tables and Spread sheets to Data Cubes, Stars, Snowflakes and Fact Constellations, Schemas for Multi-dimensional Databases, Examples for Defining Star, Snowflake and Fact Constellation Schemas, **Data Warehouse Architecture,** Steps for the Design and Construction of Data Warehouses, A Three-Tier Data Warehouse Architecture**, From Data Warehousing to Data Mining,** Data Warehouse Usage, From On-Line Analytical Processing to On-Line Analytical Mining.

Module 2

Data Pre-processing: Needs of Pre-processing the Data, **Data Cleaning,** Missing Values, Noisy Data, Data Cleaning as a Process, **Data Integration and Transformation,** Data Integration, Data Transformation, **Data Reduction,** Attribute Subset Selection, Dimensionality Reduction, Numerosity Reduction, **Discretization and Concept Hierarchy Generation,** Binning, Histogram Analysis, Segmentation By Natural Partitioning**.**

Module 3

Mining Frequent Patterns, Associations and correlations: Basic Concepts, Efficient and Scalable Frequent Item set Mining Methods, The Apriori Algorithm: Finding Frequent Item

sets Using Candidate Generation, Generating Association Rules from Frequent Item sets**,** **From Association Mining to Correlation Analysis,** Strong Rules Are Not Necessarily Interesting: An Example, From Association Analysis to Correlation Analysis, **Constraint-Based Association Mining,** Metarule-Guided Mining of Association Rules, Constraint Pushing: Mining Guided by Rule Constraints.

Module 4

Classification and Prediction: Issues Regarding Classification and Prediction, Preparing the Data for Classification and Prediction, Comparing Classification and Prediction Methods **Classification by Decision Tree Induction,** Decision Tree Induction, Attribute Selection Measures, Tree Pruning, **Bayesan Classification,** Bayes' Theorem, Naïve Bayesian Classification, **Rule-based Classification,** Using IF-THEN Rules for Classification, Rule

Module 5

Cluster Analysis: Introduction, Types of Data in Cluster Analysis, Interval-Scaled Variables, Binary Variables, Categorical, Ordinal and Ratio-Scaled Variables, Vector Objects, **A Categorization of Major Clustering Methods, Partitioning Methods,** Classical Partitioning Methods: *k*-Means and *k*-Medoids, **Hierarchical Methods,** Agglomerative and Divisive Hierarchical Clustering, ROCK: A Hierarchical Clustering Algorithm for Categorical Attributes, **Density-Based Methods,** DBSCAN:A Density- Based Clustering Method Based on Connected Regions with Sufficiently High Density, OPTICS: Ordering Points to Identify the Clustering Structure, **Outlier Analysis,** Statistical Distribution-Based Outlier Detection, Distance-Based Outlier Detection.

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	1	2	1
Module 2	2	1	1
Module 3	1	2	1
Module 4	2	1	2
Module 5	2	2	1
Total	**8**	**8**	**6**

References

1. Data Mining– Concepts and Techniques-JIA WEIHAN & MICHELINE KAMBER, ELSEVIER
2. Data Mining Techniques– ARUNK PUJARI, University Press
3. Building the Data Warehouse-W. H. Inmon, Wiley Dreamtech India Pvt. Ltd.
4. Data Warehousing in the Real World– SAM ANAHORY & DENNIS MURRAY, Pearson Education Asia.
5. Data Warehousing Fundamentals– Paulraj Ponnaiah Wiley Student Edition

BMCS4E03: CLOUD COMPUTING

Credit: 4 **Total Hours: 90**

Objective:

- To provide graduate students with the comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture and applications

Outcome:

- Provides a good understanding of cloud computing and a systematic knowledge of the fundamental technologies, architecture, and security.

Module 1

Introduction to Cloud computing, , Fundamental concepts, cloud computing mechanisms, Cloud service providers, Properties, Characteristics - Benefits of Cloud Computing- Cloud computing vs. Cluster computing vs. Grid computing- Pros and Cons of Cloud Service Development - Cloud deployment models, Alternative Deployment Models- The Linthicum Model, The Jericho Cloud Cube Model.

Module 2

The NIST model- Cloud services- PaaS, SaaS, IaaS, TaaS, DaaS, Security as a Service, Issues in cloud computing, advantages and disadvantages of cloud computing, Cloud Management.

Module 3

Virtualization concepts, Virtualization architecture, Types of Virtualization, Virtualization in clusters, Pros and cons of virtualization, Virtual machines, Types of virtual machines, Virtual desktop infrastructure and virtual machine monitoring.

Module4

Security objectives- services, Security design principles, secure cloud software requirements, Secure Cloud

Module 5 Software Testing, Cloud computing risks, Security architecture, Cloud storage and disaster recovery, Cloud storage providers, Disaster management in cloud.

The following guidelines shall be followed during question paper setting.

	Part A	Part B	Part C
	Short questions	**Short essays**	**Long essays**
Module 1	1	2	1
Module 2	2	1	2
Module 3	1	2	1
Module 4	2	1	1
Module 5	1	2	1
Total	**8**	**8**	**6**

References

1. Ronald L. Krutz, Russell Dean Vines, “Cloud Security – A comprehensive Guide to Secure Cloud Computing”, Wiley – India, 2010.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach”, TMH, 2009.
3. M.N Rao “Cloud Computing” , PHI Learning Private Limited, 2015
4. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
5. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing from Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
6. Michael Miller, “Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online”, Que Publishing, first edition, 2008.
7. Haley Beard, “Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs”, Emereo Pty Limited, 2008.

BMCS4E04: INTERNET OF THINGS

Credit: 4 **Total Hours: 90**

Objective:

- The course is aimed at enabling the interconnection and integration of the physical and related technologies of **IoT** and discuss the concepts and **objectives** of **IoT**

Outcome:

- Coordinate and help to increase and optimise the utilisation of results and value creation in the area of IoT.

Module 1

Introduction to IoT: Genesis of IoT, Digitization, Impact, Connected Roadways - Challenges- safety, mobility, environment, Connected Factory -industry – mechanical assistance, mass production, electronics and control, integration, Smart Connected Buildings – heatng, ventilation, HVAC systems, BAS System, BACNet, Smart Creatures, Convergence of IT and OT, IoT Challenges – Scale, Security, Privacy, Big data and data analytics. **IoT Network Architecture and Design:** Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack

Module 2

Engineering IoT Networks: Smart Objects - Sensors, Actuators, and Smart Objects, Sensor Networks, **Connecting Smart Objects:** Communications Criteria IoT Access Technologies.

Module 3

IP as the IoT Network Layer: Business Case for IP, Need for Optimization, Optimizing IP for IoT, Profiles and Compliances, **Application Protocols for IoT:** Transport Layer, IoT Application Transport Methods.

Module 4

Securing IoT: A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment.

Module 5

Public Safety: Overview of Public Safety, An IoT Blueprint for Public Safety, Emergency Response IoT Architecture, IoT Public Safety Information Processing, School Bus Safety

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	1	2	1
Module 2	2	1	1
Module 3	1	2	1
Module 4	2	1	2
Module 5	1	2	1
Total	**8**	**8**	**6**

References

Core:

1. David Hanes, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things", Cisco Press, Pearson, 2017.

Additional

1. Graham meikle, "The internet of things", polity press, 2017
2. Andrew Minteer, "Analytics for the internet of things: Intelligent analytics for your intelligent devices", Packt publishing, 2017
3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Aves and, Stamatis Karnouskos, David Boyle, **"**From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence**",** 1st Edition, Academic Press, 2014.
4. Peter Waher**, "**Learning Internet of Things", Packt publishing, Birmingham – Mumbai
5. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer

BMCS4E05: DATABASE ADMINISTRATION USING SQL SERVER

Credit: 4 **Total Hours: 90**

Objectives:

- To gain knowledge of Database tools
- To gain knowledge of Database administration.
- To get thorough knowledge about query languages.

Outcome:

- Students will be able to familiarize Database administration.

Module 1

Managing SQL Server Databases

Introduction to SQL Server and Relational Database, SQL Server Management Studio, Database Tuning Advisor, SQL Server Management Objects (SMO), SQL Server System Views, Business Intelligence Development Studio(BIDS),SQL Server Profiler, Powershell, Microsoft recommended online sources Planning a Database, Configuration Options, Designing the Files and File – groups layout, Managing the Transaction Logs, Backup and Restore Strategies, Database Maintenance Plans, Managing Log Shipping, Managing Replicated Databases, Managing Mirrored databases Multi-terabyte data base considerations, Database Upgrade Considerations, SQL Server Error Logs and Windows Event Viewer

Module2

Managing SQL Server Objects & Microsoft SQL Server 2008 R2 Security

SQL Dependencies,PartitionedTablesandIndexes,Triggers,FunctionsandStored Procedures, Start-up stored procedures, CLR Assemblies, Synonyms, Full– text catalogs, Change Data Capture and Change Tracking Objects, SQL Server Data– tier Applications, SQL Server Security, ownership chains and Contexts witching, Instances and Database- level security, Transparent Database Encryption, Managing Certificates and Keys, SQL Server Features and security considerations.

Module 3

Managing Temp DB & SQL Server Instances

Temp DB Usage, version Store considerations, Temp DB Best Practices, Managing Local and Remote Servers, Manage SQL Server Configuration Options (sp_configure), sysprep utility, Configuring and Managing Central Management Server, Multi-Server Management,

Automating Management Tasks, Virtualization Types, Planning for virtualization, Policy-based Management, Creating and Managing Policies.

Module 4

Workload Governance

Work load types, Understanding NUMA concepts, managing a work load using UMA, Understanding Resource Governor concepts, Monitoring Resource Governor, Data Type Considerations.

Module 5

Managing Data, Data and Backup Compression, Bulk Import and Export Considerations, Managing Data Changes, Partition Switching, Replication Subscription Initialization, Managing File stream Data, Managing Spatial Data, Managing XML Schemas, Data Types and Indexes, Managing Management Data Warehouse, Using Extended Events, Managing SQL Serve Alerts.

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	2	2	1
Module 2	2	1	2
Module 3	2	1	1
Module 4	1	2	1
Module 5	1	2	1
Total	**8**	**8**	**6**

References

1. Microsoft SQL Server 2008 Bible, (John Wiley & Sons) Paul Nielsen, Mike White & Uttam Parui
2. Mastering Sql Server 2008 (John Wiley & Sons), Michael Lee, Gentry Bieker

ELECTIVE COURSES: GROUP B

BMCS4E06: ARTIFICIAL INTELLIGENCE

Credit: 4 **Total Hours: 90**

Objective:

- To provide a strong foundation of fundamental concepts in AI
- To provide a basic exposition to the goals and methods of AI
- To enable the student to apply these techniques in applications which involve perception, reasoning and learning

Outcome:

- Apply these techniques in applications, which involve perception, reasoning and learning.
- Acquire the knowledge of real world Knowledge representation**.**

Module 1

Overview of Artificial Intelligence: Definition & Importance of AI.

Knowledge: General Concepts: Introduction, Definition and Importance of Knowledge, Knowledge-Based Systems, And Representation of Knowledge, Knowledge Organization, Knowledge Manipulation, And Acquisition of Knowledge.

LISP and Other AI Programming Languages: Introduction to LISP : Syntax and Numeric Function, Basic List Manipulation Functions in LISP, Functions, Predicates and Conditionals, Input, Output and Local Variables, Iteration and Recursion, Property Lists and Arrays, Miscellaneous Topics, PROLOG and Other AI Programming Languages.

Module 2

Knowledge Representation: Introduction, Syntax and Semantics for Propositional logic, Syntax and Semantics for FOPL, Properties of Wffs, Conversion to Clausal Form, Inference Rules, The Resolution Principle, No deductive Inference Methods, Representations Using Rules.

Knowledge Organization and Management: Introduction, Indexing and Retrieval Technique in Memory, Memory Organization Systems. Integrating Knowledge

Module 3

Expert Systems Architectures: Introduction, Rule Based System Architecture, Non-Production System Architecture, Dealing with uncertainty, Knowledge Acquisition and Validation, Knowledge System Building Tools.

Module 4

Dealing with Inconsistencies and Uncertainties: Introduction, Truth Maintenance Systems, Default Reasoning and the Closed World Assumption, Predicate Completion and Circumscription, Modal and Temporal Logics.

Probabilistic Reasoning: Introduction, Bayesian Probabilistic Inference, Possible World Representations, Dumpster-Shafer Theory, Ad-Hoc Methods.

Module 5

Structured Knowledge: Graphs, Frames and Related Structures: Introduction, Associative Networks, Frame Structures, Conceptual Dependencies and Scripts.

Matching Techniques: Introduction, Structures Used in Matching, Measures for Matching, Matching Like Patterns, Partial Matching.

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	2	2	1
Module 2	2	1	2
Module 3	1	1	1
Module 4	1	2	1
Module 5	2	2	1
Total	**8**	**8**	**6**

References

1. Introduction to Artificial Intelligence and Expert Systems, Dan W. Patterson, PHI
2. Artificial Intelligence, E. Rich & K. Knight, TMH
3. Artificial Intelligence, P.H. Winston, Pearson Edition
4. Principles of AI & Expert System Development, D.W. Rolston, TMH

BMCS4E07: CYBER SECURITY AND CYBER LAW

Credit: 4 **Total Hours: 90**

Objective:

- Gain familiarity with prevalent network and distributed system attacks, defenses against them.
- To gain insight to cyber laws.
- Develop an understanding of security policies

Outcome:

- Provide an understanding of principal concepts, major issues, technologies and basic approaches in Cyber security.

Module 1

Introduction to Cyber Security

Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats:- Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

Module 2

Cyber Security Vulnerabilities and Cyber Security Safeguards Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

Module 3

Introduction Computers and its Impact in Society ,Overview of Computer and Web Technology ,Need for Cyber Law Cyber Jurisprudence at International and Indian Level Module II: Cyber Law - International Perspectives ,UN & International Telecommunication Union (ITU) Initiatives · Council of Europe - Budapest Convention on Cybercrime ,Asia-Pacific Economic Cooperation (APEC) · Organization for Economic Co-operation and Development (OECD) · World Bank · Commonwealth of Nations Module III: Constitutional

& Human Rights Issues in Cyberspace · Freedom of Speech and Expression in Cyberspace · Right to Access Cyberspace – Access to Internet · Right to Privacy · Right to Data Protection

Module 4

Cyber Crimes & Legal Framework · Cyber Crimes against Individuals, Institution and State · Hacking · Digital Forgery · Cyber Stalking/Harassment · Cyber Pornography · Identity Theft & Fraud · Cyber terrorism · Cyber Defamation · Different offences under IT Act, 2000.

Module 5

Cyber Torts · Cyber Defamation · Different Types of Civil Wrongs under the IT Act, 2000

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	1	2	1
Module 2	2	1	1
Module 3	1	2	1
Module 4	2	2	2
Module 5	1	1	1
Total	**8**	**8**	**6**

BMCS4E08: DATA ANALYTICS

Credit: 4 **Total Hours: 90**

Objective:

- To provide an overview of an exciting growing field of Big Data analytics.
- To discuss the challenges traditional data mining algorithms face when analyzing Big Data.
- To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce.

Module 1

Introduction to Data Analytics

Introduction to analytics, case studies - How analytics is used in practice. Examples of successful analytics work from companies such as Google, Facebook, Kaggle, and Netflix. UNDERSTANDING BIG DATA - What is big data; why big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data and marketing – fraud and big data – risk and big data – credit risk management – big data and algorithmic trading – big data and healthcare – big data in medicine – advertising and big data – big data technologies

Module 2

NOSQL data management

Introduction to NoSQL – aggregate data models – aggregates – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – sharding – master-slave replication – peer-peer replication – sharding and replication – consistency – relaxing consistency – version stamps – map reduce – partitioning and combining – composing map-reduce calculations.

Module 3

BASICS OF HADOOP

Introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics. Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes

Module 4

HADOOP distributed file system (HDFS)

Design- HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures. HADOOP RELATED TOOLS - Hbase – data model and implementations – Hbase clients

Module 5

Data sharing

Privacy, Anonymization, Risks - The ethics and risks of sharing data on individuals. Technologies for anonymizing data: k-anonymity, and differential privacy.

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	1	2	1
Module 2	2	1	2
Module 3	1	2	1
Module 4	2	1	1
Module 5	1	2	1
Total	**8**	**8**	**6**

References

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
3. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012

BMCS4E09: DIGITAL IMAGE PROCESSING

Credit: 4 **Total Hours: 90**

Objective:

Fundamental technologies for digital image, compression, analysis, and processing

- Gain understanding of algorithm, analytical tools, and practical implementations of various digital image applications

Outcome:

- Describe basic image related concepts. • Explain various image enhancement and restoration techniques**.**
-

Module 1

Introduction: Background, Digital Image Representation, Fundamental Steps in Image Processing, Elements of a Digital Image Processing System.

Digital Image Fundamentals: Elements of Visual Perception, A Simple Image Model, Sampling and Quantization, Some Basic Relationships between Pixels, Imagining Geometry.

Module 2

Image Transforms: Introduction to the Fourier Transform, The Discrete Fourier Transform, Some Properties of the Two-Dimensional Fourier Transform, Other Separable Image Transforms.

Module 3

Image Enhancement: Spatial Domain Methods, Frequency Domain Methods, Some Simple Intensity Transformations, Histogram Processing, Image Subtraction, Image Averaging, Background, Smoothing Filters, Sharpening Filters, Low pass Filtering, High pass Filtering, Generation of Spatial Masks from Frequency Domain Specifications.

Module 4

Image Restoring: Degradations Model - Definitions, Degradation Model for Continuous Functions, Diagonalization of Circulant and Block-Circulant Matrices, Circulant Matrices, Block Circulant Matrices, Effects of Diagonalization on the Degradation Model, Algebraic Approach to Restoration, Unconstrained Restoration, Constrained Restoration, Inverse Filtering – Formulation, Removal of Blur Caused by Uniform Linear Motion, Restoration in the Spatial Domain, Geometric Transformation.

Module 5

Image Compression: Fundamentals–Coding Redundancy, Interpixel Redundancy, Psychovisual Redundancy, Fidelity Criteria. Image Compression Models – The Source Encoder and Decoder, The Channel Encoder and Decoder. Elements of Information Theory – Measuring Information, The Information Channel, Fundamental Coding Theorems, Using Information Theory. Error-Free Compression – Variable-Length Coding, Bit-Plane Coding, Lossless Predictive Coding. Lossy Compression – Lossy Predictive Coding, Transform Coding.

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	2	2	1
Module 2	1	2	1
Module 3	2	1	1
Module 4	1	2	1
Module 5	2	1	2
Total	**8**	**8**	**6**

References

1. Digital Image Processing, Rafael. C. Gonzalez & Richard E. Wood, Pearson Education, New Delhi
2. Digital Image Processing, W.K. Pratt, John Wiley & sons, Inc
3. Digital Image Processing, Analysis and Machine Vision, M. Sonka, Thomson, Learning, India Edition

BMCS4E10: THEORY OF COMPUTATION

Credit: 4 **Total Hours: 90**

Objectives:

- Students will be explored to the interconnection and integration of the physical world and the cyber space.
- They are also able to design & develop IOT Devices

Outcomes:

- Able to understand the application areas of IOT ·
- Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks · Able to understand building blocks of Internet of Things and characteristics.

Module 1

Introduction: Definition of an Automaton, Description of a Finite Automaton ,Transition Systems Properties of Transition Functions, Acceptability of a String by a Finite Automaton, Nondeterministic Finite State Machines ,The Equivalence of DFA and NDFA , Mealy and Moore Models , Finite Automata with Outputs ,Procedure for Transforming a Mealy Machine into a Moore Machine, Procedure for Transforming a Moore Machine into a Mealy Machine , Minimization of Finite Automata , Construction of Minimum Automaton

Module 2

Formal languages –Basic Definitions and Examples, Definition of a Grammar ,Derivations and the Language Generated by a Grammar ,Chomsky Classification of Languages , Languages and Their Relation , Recursive and Recursively Enumerable Sets ,Operations on Languages , Languages and Automata

Module 3

Regular sets and regular grammars-Regular Expressions Identities for Regular Expressions Finite Automata and Regular Expressions Pumping Lemma for Regular Sets, Application of Pumping Lemma, Closure Properties of Regular Sets, Regular Sets and Regular Grammars

Module 4

Context-free languages - Context-free Languages and Derivation Trees ,Derivation Trees ,Ambiguity in Context-free Grammars, Simplification of Context-free Grammars,

Construction of Reduced Grammars ,Elimination of Null Productions , Elimination of Unit Productions ,Normal Forms for Context-free Grammars ,Chomsky Normal Form , Greibach Normal Form ,Pumping Lemma for Context-free Languages

Module 5

Pushdown automata-Basic Definitions, Acceptance by pda , Pushdown Automata and Context-free Languages ,Parsing and Pushdown Automata, **Turing machines and linear bounded automat A**-Turing Machine Model, Representation of Turing Machines, Language Acceptability by Turing Machines ,Design of Turing Machines , Description of Turing Machines Linear Bounded Automata and Languages

The following guidelines shall be followed during question paper setting.

	Part A	**Part B**	**Part C**
	Short questions	**Short essays**	**Long essays**
Module 1	2	2	1
Module 2	1	2	1
Module 3	2	1	1
Module 4	1	2	1
Module 5	2	1	2
Total	**8**	**8**	**6**

References

1. Mishra K L P and Chandrasekaran N, “Theory of Computer Science – Automata, Languages and Computation”, Third Edition, Prentice Hall of India, 2004.
2. Hopcroft J. E., R. Motwani and J. D. Ullman, Introduction to Automata Theory, Languages and Computation

Model Question Papers

ST. BERCHMANS COLLEGE (AUTONOMOUS) CHANGANACHERRY

MSc COMPUTER SCIENCE

First Semester

MCS 104 PROGRAMMING IN C

Time : Three hours Maximum Marks : 75

Part A

*Answer **any five** questions .Each carries **two** marks.*

1. What is an identifier?
2. Write a notes on break and continue
3. What is recursion?
4. What is precedence of operators?
5. What is a pre-processor?
6. What is structure?
7. What do you meant by Storage classes?
8. What do you mean by shell?

(5×2=10)

Part B

*Answer any **five** of the questions. Each carries **four** marks.*

9. Explain about input and output functions?
10. What are the characteristics of an algorithm?
11. How to make formatted output?
12. How to initialize a pointer?
13. Differentiate between structure and union
14. Explain about data files?
15. Discuss on Editors in Linux.
16. How can you change access permissions of a file in Linux?

(5×4=20)

Part C

*Answer any **three** questions. Each carries **fifteen** marks.*

17. Explain Control structures in c
18. Explain about structured programming concept
19. Explain about operators in c
20. Write a program to find product of two matrices.
21. What do you mean by filters? Explain about different filter commands in Linux.
22. Write a program to sort a list of strings in alphabetic order using functions

(3×15=45)

ST. BERCHMANS COLLEGE (AUTONOMOUS) CHANGANACHERRY

MSc COMPUTER SCIENCE

Second Semester

MCS 207 Operating System and Systems Programming

Time : Three hours Maximum Marks : 75

Part A

Answer any five questions .Each carries two marks.

1. Define Operating System
2. What do you mean by process and process states?
3. What is fragmentation and what are the types of fragmentation?
4. Write on logical versus physical address space
5. What is preemptive and non-preemptive scheduling?
6. Mention the any 6 file attributes
7. What is deadlock and what are the four necessary conditions of deadlock prevention?
8. Explain free space management (5×2=10)

Part B

Answer any five of the questions. Each carries four marks.

9. Describe types of operating systems
10. Explain critical section problem
11. Explain Trashing
12. What are the various assembly language statements?
13. Explain the pass structure of assembler. Define an absolute loader.
14. Describe the differences among short-term, medium-term, and long-term scheduling.
15. Describe about Resource –Allocation graph and deadlock detection of single instance of each resource type
16. CPU burst time indicates the time, the process needs the CPU. The following are the set of processes with their respective CPU burst time (in milliseconds).

Processes	CPU-burst time
P1	10
P2	5
P3	5

order: (i) P1, P2 & P3 (ii) P2, P3 & P1

Which scheduling algorithm is suitable for above example explain. Based on that Calculate the average waiting time if the process arrived in the above orders.

(5×4=20)

Part C

Answer any three questions. Each carries fifteen marks.

17. Explain Different Allocation Methods
18. What do you mean by page replacement and explain any 3 replacement Algorithms
19. Explain how deadlock can be avoided using Banker's algorithm and Resource-Allocation Graph Algorithm
20. Explain in detail process scheduling algorithm
21. Explain Demand paging
22. Explain different phases of compiler.

(3×15=45)

ST. BERCHMANS COLLEGE (AUTONOMOUS) CHANGANACHERRY

MSc COMPUTER SCIENCE

Third Semester

MCS 310 Algorithms & Data Structures using C++

Time : Three hours Maximum Marks : 75

Part A

*Answer **any five** questions .Each carries **two** marks.*

1. What do you mean by the complexity of an algorithm?
2. What is the worst case complexity of linear search method?
3. Differentiate DEQUEUE and Priority Queue.
4. What are the different types of Linked Lists?
5. Describe the concept of binary search.
6. Write an algorithm to sort an array using simple insertion sort.
7. Define AVL tree?
8. What is hash table? *(5×2=10)*

Part B

*Answer any **five** of the questions. Each carries **four** marks.*

9. Explain asymptotic notations?
10. What are different types of Data Structures?
11. Describe the applications of Stacks and Queues?
12. Write an algorithm to insert and delete an element from a particular position of a Linked List.
13. Differentiate Garbage collection and compaction?
14. Explain the concept of radix sort with example?
15. Write an algorithm to traverse a binary tree.
16. Define hashing. What are the different hash functions? *(5×4=20)*

Part C

*Answer any **three** questions. Each carries **fifteen** marks.*

17. Explain in detail performance analysis of an algorithm?
18. Write an algorithm to perform stack operations using arrays.
19. What is circular Linked list? How can we perform different operation in a circular Linked list?
20. Explain the concept of Binary tree sort?

21. Write an algorithm to sort the following array using quick sort.

23, 12, 89, 45,10,69,4

22. Explain in detail File organization methods? *(3×15=45)*