

# **PROGRAMME PROJECT REPORT**

(includes curriculum and syllabus)



## **P.G. Diploma in Data Science**

**Submitted**

**To**

**The UGC – DEB**

*(ODL) - MODE*

**MADHYA PRADESH BHOJ (OPEN) UNIVERSITY,**

**Raja Bhoj Marg Kolar Road, BHOPAL (M.P.)**

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**Madhya Pradesh Bhoj Open University, Bhopal**

**PROGRAMME PROJECT REPORT**

**Name of the Programme: P.G.Diploma in Data Science**

**Introduction :**

P.G.Diploma in Data Science is a postgraduate program that focuses on developing the skills and knowledge required to manage and analyze information technology in various industries. The program covers a wide range of topics such as software development, database management, computer networks, cybersecurity, and artificial intelligence.

Students who enroll in an P.G.Diploma in Data Science program are typically individuals who already have an undergraduate degree in computer science, information technology, or a related field. The program typically takes one to two years to complete, and students are required to complete coursework, research projects, and a dissertation.

The program is designed to equip graduates with the necessary skills to become IT professionals, and prepares them for roles such as systems analyst, database administrator, network administrator, cyber security specialist, and software developer. An P.G.Diploma in Data Science degree is highly valued in the job market, and graduates can expect to earn competitive salaries in their chosen field.

**(i) (a) Programme's Mission:** The mission of an P.G.Diploma in Data Science program is to provide students with a comprehensive understanding of information technology and its applications in various industries. The program aims to equip students with the necessary skills to analyze, design, and develop IT systems that are efficient, effective, and secure.

The program is designed to prepare students for careers in the rapidly evolving field of information technology, where there is a constant demand for professionals who can adapt to new technologies and solve complex problems. The program emphasizes practical, hands-on experience, and encourages students to engage in research and development activities.

In addition, the program aims to develop students' communication and teamwork skills, as these are essential for success in the field of IT. Graduates of the program are expected to be leaders in their field, with the ability to innovate, manage and lead IT projects.

Overall, the mission of an P.G.Diploma in Data Science program is to produce graduates who are well-rounded IT professionals, capable of contributing to the growth and success of organizations in various industries.

**(b) Objectives:**

The objectives of an P.G.Diploma in Data Science in IT (Information Technology) program vary depending on the specific program and institution offering it. However, some common objectives of P.G.Diploma in Data Science programs include:

- Developing advanced knowledge and skills: P.G.Diploma in Data Science programs aim to provide students with advanced knowledge and skills in areas such as computer networks, database management, programming, artificial intelligence, cybersecurity, and more.
- Preparing for leadership roles: P.G.Diploma in Data Science programs often prepare students for leadership roles in the IT industry by providing them with the knowledge, skills, and confidence to lead teams and make strategic decisions.
- Promoting innovation: P.G.Diploma in Data Science programs encourage students to think creatively and innovatively by exposing them to cutting-edge technologies and research.
- Enhancing career prospects: P.G.Diploma in Data Science programs are designed to enhance students' career prospects by providing them with specialized knowledge and skills that are in high demand in the IT industry.
- Encouraging lifelong learning: P.G.Diploma in Data Science programs promote a culture of lifelong learning by providing students with the tools and resources they need to stay up-to-date with the latest advancements in the IT industry.

**(ii) Relevance of the Programme with HEI's Mission and Goals:** The relevance of an P.G.Diploma in Data Science program with an HEI's (Higher Education Institution) mission and goals depends on the specific institution's mission and goals. However, in general, P.G.Diploma in Data Science programs are highly relevant to many HEI's missions and goals for the following reasons:

Meeting the needs of the IT industry: Many HEIs aim to prepare their graduates to meet the needs of the industries they will work in. P.G.Diploma in Data Science programs do exactly that by equipping students with advanced knowledge and skills in areas such as computer networks, cybersecurity, and artificial intelligence, which are highly sought after by employers in the IT industry.

Supporting research and innovation: Many HEIs aim to support research and innovation by providing their students with access to cutting-edge technologies and research facilities. P.G.Diploma in Data Science programs often involve research projects, internships, and other opportunities for students to explore and develop innovative solutions to real-world problems.

Enhancing the institution's reputation: Many HEIs aim to enhance their reputation by offering high-quality academic programs that produce successful graduates. P.G.Diploma in Data Science programs are highly regarded in the IT industry, and graduates of these programs are often sought after by employers, which can enhance the institution's reputation.

Encouraging lifelong learning: Many HEIs aim to promote a culture of lifelong learning by providing their students with the tools and resources they need to continue learning throughout their careers. P.G.Diploma in Data Science programs often involve ongoing professional development opportunities and access to industry experts, which can help students stay up-to-date with the latest advancements in the IT industry.

Overall, an P.G.Diploma in Data Science program can be highly relevant to an HEI's mission and goals, particularly if the institution aims to prepare its graduates for successful careers in the IT industry, support research and innovation, and promote lifelong learning.

### **(iii) Nature of prospective target group of learners:**

The prospective target group of learners for an P.G.Diploma in Data Science program can vary depending on the specific program and institution offering it. However, in general, the target group of learners for an P.G.Diploma in Data Science program are individuals who:

- Have an undergraduate degree in computer science, information technology, or a related field: P.G.Diploma in Data Science programs typically require applicants to have an undergraduate degree in a relevant field. This ensures that students have a solid foundation in IT fundamentals before embarking on more advanced coursework.
- Are interested in advancing their knowledge and skills in IT: P.G.Diploma in Data Science programs are designed for individuals who want to deepen their understanding of IT concepts, technologies, and applications. Prospective students may be interested in pursuing careers in areas such as software development, network administration, cybersecurity, or data analytics.
- Are motivated and self-directed learners: P.G.Diploma in Data Science programs require a high level of self-direction and motivation, as students must complete complex coursework, research projects, and other assignments with minimal supervision.
- Have strong analytical and problem-solving skills: P.G.Diploma in Data Science programs involve complex problem-solving and require students to think critically and analytically. Prospective students should have strong analytical and problem-solving skills to succeed in the program.
- Are interested in pursuing leadership roles in the IT industry: P.G.Diploma in Data Science programs often prepare students for leadership roles in the IT industry by providing them with the knowledge, skills, and confidence to lead teams and make strategic decisions. Prospective students who are interested in pursuing leadership roles in the IT industry may find an P.G.Diploma in Data Science program particularly appealing.

Overall, the target group of learners for an P.G.Diploma in Data Science program is typically composed of motivated, self-directed learners with a strong foundation in IT fundamentals who are interested in advancing their knowledge and skills in IT and pursuing careers in the field

### **Appropriateness of programme to be conducted in the Open and Distance Learning mode to acquire specific skills and competence:**

The P.G.Diploma in Data Science program can be appropriately conducted in the Open and Distance Learning (ODL) mode to acquire specific skills and competence. Here are some reasons why:

- **Flexibility:** The ODL mode provides flexibility in terms of time, pace, and place of learning, which is especially important for learners who are already working or have other commitments. This mode allows learners to design their own study schedules and access course materials at their convenience, which can help them to balance their work, family, and educational commitments.
- **Access to learning resources:** ODL mode can provide access to a wide range of learning resources, including digital textbooks, audio and video lectures, interactive simulations, and virtual laboratories. This mode allows learners to access these resources from anywhere, which can help them to deepen their understanding of key concepts and develop specific skills and competencies.
- **Personalized learning:** ODL mode can provide personalized learning experiences to learners by using adaptive learning technologies, providing individual feedback, and offering personalized tutoring. This mode can help learners to focus on their specific needs and interests and acquire the skills and competence they need to succeed in their chosen field.
- **Cost-effective:** ODL mode can be a cost-effective option for learners who are unable to attend traditional, on-campus programs. This mode can reduce the cost of tuition, accommodation, and transportation, making it more accessible to learners from diverse socioeconomic backgrounds.
- **Practical components:** Although some practical components of the P.G.Diploma in Data Science program may require access to laboratory equipment, there are still many theoretical components of the program that can be delivered effectively through the ODL mode. Furthermore, some universities offer online laboratories and simulations that can be used to supplement or replace the practical components of the program.

Overall, the P.G.Diploma in Data Science program can be appropriately conducted in the ODL mode, providing learners with the opportunity to acquire specific skills and competence in a flexible, accessible, personalized, and cost-effective manner.

**(iv) Instructional Design:** The P.G.Diploma in Data Science programme is a Two-year degree programme of 86 credits. The course material for the programme has been developed in-house with contributions from seasoned academicians as well. The instructional design comprises all learning activities i.e., reading and comprehending the SLM, availing audio-visual aids to enhance knowledge, attending counselling sessions and preparing assignments.

The Programme is of 2 year duration with semester examinations. The maximum period allowed is 4 years(double the duration). The Programme structure is as below.

P.G. DIPLOMA IN DATA SCIENCE

M.P.BHOJ(OPEN) UNIVERSITY, BHOPAL												
P.G.DIPLOMA IN DATA SCIENCE SEMESTER-I SYLLABUS												
Sr. No.	Sub. Code	Name of the subject	CREDIT	Teaching scheme (per week)				Examination Scheme				Total Marks
								Theory		Practical		
				CIE	End Sem	CIE	End Sem					
Th.	Tut.	Pr.	Total (hr.)	Th.	Th.	Pr.	Pr.					
1	BSDS0101	<a href="#">Principal of Cyber Security</a>	4	3	0	0	5	60	40	0	0	100
2	BSDS0102	<a href="#">Computer Organization</a>	4	4	0	0	4	60	40	0	0	100
3	BSDS0103	<a href="#">Programming in C</a>	4	3	0	3	3	60	40	60	40	200
4	BSDS0104	<a href="#">Database Management Systems &amp; Distributed Databases</a>	4	4	2	5	6	60	40	60	40	200
5	BSDS0105	<a href="#">Computer Graphics</a>	4	0	0	4	4	60	40	60	40	200
		TOTAL	20	14	2	12	28	300	200	180	120	800

(a)

M.P.BHOJ(OPEN) UNIVERSITY, BHOPAL												
P.G.DIPLOMA IN DATA SCIENCE SEMESTER-II SYLLABUS												
Sr. No.	Sub. Code	Name of the subject	CREDIT	Teaching scheme (per week)				Examination Scheme				Total Marks
								Theory		Practical		
				CIE	End Sem	CIE	End Sem					
Th.	Tut.	Pr.	Total (hr.)	Th.	Th.	Pr.	Pr.					
1	BSDS0201	<a href="#">Object Oriented Programming</a>	4	3	0	4	7	60	40	60	40	200
2	BSDS0202	<a href="#">Introduction to Python Programming</a>	4	3	0	2	5	60	40	60	40	200
3	BSDS0203	<a href="#">Basic of Data Science</a>	4	3	0	0	3	60	40	0	0	100
4	BSDS0204	<a href="#">Data Structure</a>	4	3	0	2	5	60	40	60	40	200
5	BSDS0205	Machine Learning	4	3	0	0	5	60	40	0	0	100
		TOTAL	20	15	0	08	25	300	200	180	120	800

(b)

(c)

(d)

(e)

M.P.BHOJ(OPEN) UNIVERSITY, BHOPAL												
1. P.G.DIPLOMA IN DATA SCIENCE SEMESTER-III SYLLABUS												
Sr. No.	Sub. Code	Name of the subject	CREDIT	Teaching scheme (per week)				Examination Scheme				Total Marks
								Theory		Practical		
				CIE	End Sem	CIE	End Sem					
Th.	Tut.	Pr.	Total (hr.)	Th.	Th.	Pr.	Pr.					
1	BSDS0301	Java Programming	6	4	0	4	8	60	40	60	40	200
2	BSDS0302	Operating Systems	6	4	0	4	8	60	40	60	40	200
3	BSDS0303	Computer Networks	4	4	0	0	4	60	40	0	0	100
4	BSDS0304	Numerical Methods & Statistical Analysis	4	4	0	0	4	60	40	0	0	100
5		Cloud Computing	2	2	0	0	2	60	40	0	0	100
		TOTAL	22	18	0	08	26	300	200	120	80	700

(f)

M.P.BHOJ(OPEN) UNIVERSITY, BHOPAL												
P.G.DIPLOMA IN DATA SCIENCE SEMESTER-IV SYLLABUS												
Sr. No.	Sub. Code	Name of the subject	CREDIT	Teaching scheme (per week)				Examination Scheme				Total Mark
								Theory		Practical		
				CIE	End Sem	CIE	End Sem					
Th.	Tut.	Pr.	Total (hr.)	Th.	Th.	Pr.	Pr.					
1	BSDS0401	Data Analysis using Python	6	4	0	4	8	60	40	60	40	200
2	BSDS0402	Fundamentals of R Programming	6	4	0	4	8	60	40	60	40	200
3	BSDS0403	Data Warehousing and DataMining	4	4	0	0	4	60	40	0	0	100
4	BSDS0404	Artificial Intelligence	4	4	0	0	4	60	40	0	0	100
5	BSDS0405	Deep Learning	4	3	2	0	5	60	40	0	0	100
		TOTAL	24	19	2	8	29	300	200	120	80	700

(g) **Duration of the Programme:** The Duration of the Programme is Two years.

(h) **Faculty and Support Staff Requirement:** At present, there are three faculty members in the Department. The Department have all support staff for its the smooth functioning.

(i) **Instructional Delivery Mechanism:**

The instructional delivery mechanisms of the program should be designed to cater to the diverse needs of the learners, provide flexibility, and ensure effective learning outcomes. The program should also provide adequate support services such as academic counselling, technical support, and mentorship to ensure that learners receive the necessary guidance and assistance throughout the program.

As the University functions in the Open and Distance Learning mode, the programmes that we offer are designed to meet the varied requirements of the distant learner. Keeping this in view, the course material developed by the Department is learner friendly. Each course is divided into four to five blocks, which are further divided into units. Each Block consists of three to four units. This number has been determined taking into consideration the learning capabilities of our learners. The structure of the unit is in line with the guidelines laid down by the DEB-UGC, the apex regulatory body of Open and Distance Learning. The content is kept simple and lucid and follows the self-instructional pattern. Each lesson includes a number of self-assessment questions along with hint answers so that the students are able to track their progress as they proceed with the lesson. At the end of each unit, a list of other relevant books is also provided. Besides providing quality study material to our learners, the Department, following the ODL pattern, has defined its programmes in the terms of



credits. In the ODL system, one credit is equivalent to 30 study hours i.e. the study input required for completion of the programme. Normally the P.G.Diploma in Data Science programme is a 86 credit programme. This comprises all learning activities ie., reading and comprehending the SLM, availing audio-visual aids to enhance knowledge, attending counselling sessions and preparing assignments. Thus, in the P.G.Diploma in Data Science programme, a learner is expected to put in 2160 study hours to complete the programme in two years' time.

**(v) Procedure for admission, curriculum transaction and evaluation:**

**Admission Process :**

Notification issued by the University in Regional and National Newspapers and in the official website. Admission process is online through the MPOnline Portal. Payment of fee through online (various options like net banking etc.). Submission of the printout of the application by the candidate to concern study center along with original documents for eligibility, date of birth etc., and along with fee paid receipt. After the Verification of applications- for fulfillment of eligibility criteria (marks cards) documents, fee paid details. Approval of the admission and issue of self-learning material (Study Materials) to the students.

**Contact Programmes :**

The personal contact programme in every course shall extend over a period of 13 working days in each semester and is usually conducted at the beginning of the session. The students are expected to come prepared in the class in order to discuss their problems meaningfully. 75% attendance in the personal contact programme is mandatory.

**Eligibility:** 12th with Mathematics

**Fee Structure: P.G.Diploma in Data Science**

Rs. 9000: Per Year

**Evaluation norms:** A learner will be evaluated on the basis of Assignments and term-end examination. Assignments carry 30% weightage whereas the term end examination carry 70% weightage.

**Evaluation system:**

- Students shall have a minimum of 50% of total marks of the University examinations in each Course. The overall passing minimum is 50% both in aggregate of Continuous Internal Assessment and External Examination in each Course.
- Every course shall have two components of assessment namely,
  - Continuous Internal Assessment “CIA”: This assessment will be carried out throughout the semester as per the Academic Schedule.

- End Semester Examination “ESE”: This assessment will be carried out at the end of the Semester as per the Academic Schedule.

#### **Continuous Internal Assessment “CIA”:**

- Continuous Internal Assessment for each Course shall be by means of Written Tests/ Assignments, and Class Tests for a total mark of 30.
- Continuous Internal Assessment for each Course shall be the responsibility of the concerned Course Faculty. The valued answer papers/assignments shall be given to the students after the valuation is completed and they be asked to check and satisfy themselves about the marks they scored.
- All records in respect of Continuous Internal Assessments shall be in the safe custody of the PI for at least one year after the assessment.

#### **Theory course assessment weightages:**

The general guidelines for the assessment of Theory Courses, Department Electives and Non – Department Electives shall be done on a continuous basis as given in Table.

**Table : Weightage for Assessment**

S.No.	Assessment	Weightage	Duration
1.	First Periodical Assessment	10%	2 periods
2.	Second Periodical Assessment	10%	2 Periods
3.	Practical/Project/ Lab	5%	--
4.	End Semester Exam	70%	2 to 3 hours

#### **Grading System**

Based on the student’s performance in each semester, grade is awarded with a final letter grade at the end of the exam evaluation of each Course. The letter grades and the corresponding grade points are as follows.

**Table 3: Grading system**

Range of Marks	Letter Grade	Grade Points	Remarks
90 – 100	S	10	Outstanding
80-89	A	09	Excellent

70-79	B	08	Very Good
60-69	C	07	Good
50-59	D	06	Average
40-49	E	05	Pass
<40	U	00	To Reappear for End-Semester Examination

## **GPA and CGPA**

Grade Point Average (GPA) is the ratio of the sum of the product of the number of credits  $C_i$  of course “i” and the grade points  $P_i$  earned for that course taken over all courses “i” registered and successfully completed by the student to the sum of  $C_i$  for all “i”. That is,

$$GPA = \frac{\sum_1^n C_i P_i}{\sum_1^n C_i}$$

Cumulative Grade Point Average (CGPA) will be calculated in a similar manner, in any semester, considering all the courses enrolled from the first semester onwards. The Grade card will not include the computation of GPA and CGPA for courses with letter grade “U” until those grades are converted to the regular grades.

### **Grade Sheet**

Based on the performance, each student is awarded a final letter grade at the end of the semester in each course. The letter grades and corresponding grade points are given in Table 3. A student is considered to have completed a course successfully and earned credits if he/she secures a letter grade other than U in that course. After results are declared, grade sheet will be issued to each student which will contain the following details:

- Program and discipline for which the student has enrolled.
- Semester of registration.
- The course code, name of the course, category of course and the credits for each course registered in that semester
- The letter grade obtained in each course
- Semester Grade Point Average (GPA)
- The total number of credits earned by the student up to the end of that semester in each of the course categories.
- The Cumulative Grade Point Average (CGPA) of all the courses taken from the first semester.
- Credits earned under Non – CGPA courses.
- Additional credits earned for the respective UG degree or respective Degree with Minor specialization

### **Class/Division**

Classification is based on as follows:  $\text{CGPA} \geq 8.0$ : First

Class with Distinction

$6.5 \leq \text{CGPA} < 8.0$ : First Class

$5.0 \leq \text{CGPA} < 6.5$ : Second Class

- (i) Further, the award of 'First class with distinction' is subject to the candidate becoming eligible for the award of the degree, having passed the examination in all the courses in his/her first appearance with effect from II semester and within the minimum duration of the programme.
- (ii) The award of 'First Class' is further subject to the candidate becoming eligible for the award of the degree, having passed the examination in all the courses within 5 years.
- (iii) The period of authorized break in study will not be counted for the purpose of the above classification.

### **Eligibility For The Award of Degree**

A student will be declared to be eligible for the award of the P.G.Diploma in Data Science degree if he/she has Registered and successfully obtained credit for all the core courses:

- Successfully acquired the credits in the different categories as specified in the curriculum corresponding to the discipline of his/her study within the stipulated time:
- Has no dues to all sections of the institute including hostels and has no disciplinary action pending against him/her.
- The award of the degree must be recommended by the Academic Council and approved by the Board of Management of the university.

### **Re-View Of Answer Scripts / Single Valuation**

If any student feels aggrieved on the final outcome of the assessment in any course, the student shall apply to the Controller of Examinations, along with the prescribed fee, for the review of Tern End examination answer script, within the stipulated time after the announcement of the results of the examinations. The Controller of Examinations shall facilitate the review of the answer script jointly to be carried out by the student and the faculty detailed for this purpose. If any discrepancy is noticed during review the same shall be rectified and the originally awarded grade accordingly amended.

### **(vi) Requirement of the laboratory support and library resources:**

#### **Internet Leased Line**

**Computer Lab:** The University has most modern high-tech Computer Lab with 24 hrs. Internet facility

for studying and R&D activities. The state-of-the-art facility features hardware & software that is geared to specific academic programmes.

**Research Lab:** University equipped with round the clock available Hi-tech research Lab. which includes latest configured systems with Hi-speed internet facility loaded with latest software for research purpose.

**Library:** The University library is the hub of knowledge with more than 105832 books, Online Journals/Magazines, Back Volumes:, Thesis & Dissertations:, News Papers: 12, Book Bank: 25850 are conveniently accessible for the students and staff of MPBOU. Library includes Main reading area, separate reading area and reference section.

The MPBOU system consists of a Central Library and Departmental Libraries which collectively support the teaching, research and extension programmes of the Institute. All students, faculty members and employees of the Institute are entitled to use the Library facilities enrolling membership.

**Internet Facilities:** One Gbps – Lease Line Link are available at the university. University is fully networked with a campus wide network interconnecting all departments. Campus is fully Wi-Fi with high Speed internet connection available round-d-clock.

**MS TEAMS Platform:** The University has acquired the Zoom platform license and has gone 100% virtual in terms of delivering the regular classes during the COVID lockdown. This has given enough experience for the faculty and expertise to handle the platform for online learning. More than 150 guest lecturers have been organised in the brief period of three weeks inviting industry experts. The MPBOU team is now digitally empowered to conduct OL classes on this virtual platform on a regular basis which shall make the learning process very effective.

**LMS:** The Institute is using MOODLE and Microsoft Teams for Online teaching and to conduct test and Assignments

**(Viii) Cost estimate of the Programme and the provisions:**

The P.G.Diploma in Data Science in English has been prepared in-house. The internal faculty has made contribution through units. The Department has utilized the acumen and expertise of seasoned academicians in the development of the course material. The expenses incurred in outsourcing units is as follows:

Cost Estimates for Development of the Programme:

Programme	Programme Development	Delivery	Total
M.Sc. Information Technology	5,00000/-	3,00000/-	8,00000/-

**(ix) Quality Assurance Mechanism and expected programme outcomes:**

Quality assurance mechanisms are important in ensuring that P.G.Diploma in Data Science programs meet the desired standards and deliver the expected outcomes. The following are some of the quality assurance mechanisms that can be put in place for an P.G.Diploma in Data Science program:

- **Curriculum design and review:** The curriculum of an P.G.Diploma in Data Science program should be designed to meet the needs of the industry and reflect the latest developments and trends in the field. Regular reviews should be conducted to ensure that the curriculum remains relevant and up-to-date.
- **Faculty qualifications and training:** Faculty members should have the necessary qualifications and experience to teach the courses in the program. They should also receive regular training to enhance their teaching skills and keep up with the latest developments in the field.
- **Student assessment:** A variety of assessment methods should be used to evaluate student learning and mastery of the course material. These assessments should be aligned with the program's learning outcomes.
- **Student support:** Adequate support should be provided to students, including academic advising, mentoring, and counseling services. The program should also provide access to resources such as a library, online databases, and study materials.
- **Continuous improvement:** The program should have a process in place for continuous improvement, which involves gathering feedback from students, alumni, and employers to identify areas of strength and weakness and make necessary adjustments.

The expected program outcomes of an P.G.Diploma in Data Science program may include the following:

- **Advanced knowledge and skills in IT:** Graduates of an P.G.Diploma in Data Science program should have advanced knowledge and skills in areas such as software development, network administration, cyber security, and data analytics.
- **Critical thinking and problem-solving skills:** Graduates should be able to apply critical thinking and problem-solving skills to analyze complex IT problems and develop effective solutions.
- **Effective communication skills:** Graduates should be able to communicate effectively with both technical and non-technical stakeholders, including colleagues, clients, and managers.
- **Leadership and teamwork skills:** Graduates should be able to work effectively in teams and demonstrate leadership skills in managing projects and teams.
- **Ethical and professional conduct:** Graduates should be aware of ethical and professional standards in the IT industry and demonstrate ethical and professional conduct in their work.

Overall, an P.G.Diploma in Data Science program should aim to produce graduates who are well-prepared for careers in the IT industry and can make significant contributions to the field. Quality assurance mechanisms can help ensure that the program meets these goals and delivers the expected outcomes.

## **Detailed Syllabus**

### **P.G.DIPLOMA IN DATA SCIENCE SEMESTER-I SYLLABUS**

#### **BSDS0102:Computer Organization**

##### **Unit- I**

Register transfer language, Bus and memory transfer, Arithmetic, micro operation, Logic micro operation, Shift micro operation, Arithmetic logic shift unit

##### **Unit- II**

Instruction codes, Computer registers, Computer instructions, Timing and control, Instruction cycle, Memory reference instruction, I/O and interrupt, Design of basic computer and Accumulator logic.

##### **Unit- III**

Machine language, assembly language, Assembler programming, arithmetic and logic operation, I/O programming. Micro programmed and hardwired control unit, General register organization of C.P.U, Stack organization, Instruction format, Addressing modes, Program control, RISC v/s CISC.

##### **Unit- IV**

Parallel processing, Pipelining, Arithmetic pipelining, Instruction pipeline, RISC pipeline, Vector processing, Memory interleaving, Array processor, multiprocessor.

##### **Unit- V**

Peripheral devices, I/O interfaces, Asynchronous Data transfer DMA, Priority Interrupt, I/O processor, Multiprocessor system organization and Data communication processor. Auxiliary memory, Microcomputer, memory, Memory hierarchy, Associative memory, Virtual memory, Cache memory, Memory management hardware.

##### **References:**

1. Morris Mano “computer System Architecture”,
2. Computer Organization & Architecture, W. Stallings, “, PHI.
3. Computer Architecture and Organization, J. P. Hayes, McGraw Hill,
4. Computer Architecture, A Quantitative Approach, John L. Hennessy & David A. Patterson,”Morgan Kaufmann, .
5. Modern Computer Architecture ,Rafiqzaman and Chandra,”. Galgotia Publication.



## **BSDS0103:Programming in C**

### **UNIT 1: INTRODUCTORY CONCEPTS**

Learning Objectives, Introduction, Algorithm, Conventions Used in Writing Algorithm, Method for Developing an Algorithm, Pseudocode, Flowchart, Symbols of Flowchart, Advantages and Limitations of Flowchart, Let Us Sum Up, Answers to Check Your Progress, Further Reading, Model Questions

### **UNIT 2: ELEMENTS OF C PROGRAMMING**

Learning Objectives, Introduction, C Character Set, Tokens, Identifiers, Reserved Words, Constants, Variables, Let Us Sum Up, Answers to Check Your Progress, Further Reading, Model Questions

### **UNIT 3: VARIABLES AND DATA TYPES**

Learning Objectives, Introduction, Basic Data Types in C, C Variables and their Declarations, Symbolic Constants, Let Us Sum Up, Answers to Check Your Progress, Further Reading, Model Questions

### **UNIT 4: OPERATORS AND EXPRESSIONS**

Learning Objectives, Introduction, Operators, Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increments and Decrement Operators, Conditional Operators, Bitwise Operators, Special Operators, Precedence and Associativity, Expressions, Type Conversion, Let Us Sum Up, Answers to Check Your Progress, Further Reading, Model Questions

### **UNIT 5: PREPROCESSOR DIRECTIVES AND I/O FUNCTIONS**

Learning Objectives, Introduction, Header Files, Formatted Input/Output Functions, Control Strings used in printf() and scanf() Functions, Escape Sequences, Unformatted Input/Output Functions, Let Us Sum Up, Answers to Check Your Progress, Further Reading, Model Questions

### **UNIT 6: CONDITIONAL STATEMENTS**

Learning Objectives, Introduction, Decision Control Statements, Conditional Branching Statement, if Statement, if-else Statement, Nested if-else Statement, switch Statement, break Statement, continue Statement, goto Statement, Conditional Operator Statement, Let Us Sum Up, Answers to Check Your Progress, Further Reading, Model Questions

### **UNIT 7: LOOP CONTROL STRUCTURES**

Learning Objectives, Introduction, Loop Control Statements, while Loop, do-while Loop, for Loop, Let Us Sum Up, Answers to Check Your Progress, Further Reading, Model Questions

## **BSDS0104 Database Management Systems & Distributed Databases**

### **Unit - 1 : Introduction to Database Management System**

Objective, Introduction, Data, Field, Record, Data Base, Database Management System, Elements of Database Management Systems, Database Schema, Table, Columns, Rows, Data Types, Keys, Primary Keys, Foreign Keys, Relationships, Database Management System Vs File Management System, Database Management Systems, Advantages of DBMS, Features commonly offered by Database Management Systems Include. Features of DBMS, Summary , Self-Assessment Questions

### **Unit - 2 : Basic concepts of DBMS**

Objective, Introduction, Purpose of Database Management System 2.3 Functions of DBMS 2.4 The Service Provided by the DBMS Includes 2.5 DBA, Database Designers, End Users & Application Programmers 2.5.1 Database Administrator (DBA) 2.5.2 Database Designers 2.5.3 End Users 2.5.3.1 Casual End Users 2.5.3.2 Native End Users 2.5.3.3 Standalone end Users/On-line End Users 2.5.4 Application Programmers 2.6 DBMS-Architecture and Data Independence 2.7 Data Independence 2.7.1 Physical Independence 2.7.2 Logical Independence 2.8 Database Schema 2.9 Database Instance 2.10 Data-Definition Language 2.11 Data-Manipulation Language 2.12 Summary 2.13 Self-Assessment Questions

### **Unit - 3 : Database Models**

Objective, Introduction, Types of Database Models, Introduction to Hierarchical Model, Introduction to Network Model, Introduction to Relational Model, Summary, Self Assessment Questions

### **Unit - 4 : The Entity Relationship Models**

Objective, Introduction, Entity, Attribute, Relationship, Constraints , Cardinality, Participation, Disjoint Constraints, Degree and Domain, Data modeling using the Entity relationship model , E-R model concepts, Notation for E-R diagram, Entity sets, Keys, Concepts of Super Key, Concepts of Candidate Key , Concepts of Primary Key , Extended E-R features , Generalization , Specialization , Aggregation , Summary , Self Assessment Questions

### **Unit - 5 : Relational Model**

Objective, Introduction, Data Models, Object Based Logical Models, Object Oriented Model, Record Based Logical Models, Relational Model, Network Model, Hierarchical Model, Physical Data Models, Relational Algebra, Fundamental Operation, Extended Relational Algebra Operations, Modification of the Database, Views, Tuple Relational Calculus, Domain Relational Calculus, Codd's Rules, Summary, Answers to Self-Learning Exercises, Self Assessment Questions

### **Unit - 6 : RDBMS**

Objective, Introduction, Integrity Constraints, Check Integrity Constraints, Assertions, Trigger, Not Null, Unique Key, Primary Key , Referential Integrity , Summary , Answers to Self-Learning Exercises, Self Assessment Questions

### **Unit - 7 : Normalization**

Objective, Introduction, Database Design, Meaning of 'Relation' , Introduction to Normalization, Purpose of Normalization, Steps of Normalization, Functional Dependency , Normal Forms, First Normal Form (1NF) , Second Normal Form (2NF) , Third Normal Form (3NF) , Boyce-Codd Normal Form (BCNF) , Summary , Answer to Self-Learning Exercises , Self Assessment Questions

### **Unit - 8 : Introduction to Popular RDBMS Packages**

Objective, Introduction , Various Types of RDBMS Packages , Commercial RDBMS V/s. Open Source RDBMS, SQL Server, Characteristics , Strength, Limitations , Oracle , Characteristics , Strength , Limitations , Summary , Answer to Self-Learning Exercises , Self Assessment Questions

### **Unit - 9 : Introduction to SQL**

Objective , Introduction , What is SQL? , Characteristics of SQL , Types of SQL , The Relational database , Client/Server Technology , Web-Based Database System , Advantage of , SQL Data types and Literals, String types , Numeric types , Date and time types , Large Object Types , Numeric Types , Decimal Types , Integers , Floating-Point Decimals , Date and Time Types , NULL Data Types , User-Defined Types, Types of SQL Commands , Data Definition Language (DDL) , Data Manipulation Language (DML), Data Query Language (DQL) , Data Control Language (DCL) , Transactional Control Commands , Summary ,Self-Assessment Questions

### **Unit - 10 : More on SQL**

Objective , Introduction , Aggregate Functions , Group By Clause , Having Clause , Order By Clause , Join , Inner join , Outer join , Self join , Set Operations , Union , Union All , Intersection , Minus , Summary , Self Assessment Questions

### **Unit - 11 : Queries and Subqueries**

Objective , Introduction , Queries with join , Equi Joins ,Cartesian Join , Outer Join , Self Join , Set Operators , Union , Intersect , Minus , Sub Queries , Summary , Self Assessment Questions.

### **Unit - 12 : Transaction Processing**

Objective , Introduction , States of Transaction , Properties of Transaction , Concurrent Execution , Lost Update Problem , Inconsistent Read Problem , Semantics of Concurrent Transactions , Serializability , Precedence Graph , Serializability Algorithm : Read-Before-Write Protocols , Serializability Algorithm : Read-Only and Write Only Protocols , Recovery , Logs , Checkpoints , Do, Undo, Redo , Summary , Self Assessment Questions.

### **Unit - 13 : Concurrency Control**

Objective , Introduction , Locking and Types of Locking , Granting of Locks , Two Phase Locking , Time Stamp Based Order , Summary , Self Assessment Questions

## **BSDS0105:Computer Graphics**

### **Unit -I**

Overview of Graphics Systems: Video Display Devices , Refresh cathode ray tubes, Refresh scan displays, Random scan displays, color CRT Monitors, DVST, Flat- Panel displays, Three Dimensional viewing devices, Raster scan systems, Input Devices: Keyboards, Mouse, Track ball, Joysticks, Data Glove, Touch Panels, Light pens.

### **UNIT –II**

Curves and Surfaces:Line Drawing Algorithm, DDA Algorithm, Bresenham's Line Drawing Algorithm, Bresenham's Circle Drawing Algorithm, Ellipse Drawing Algorithm, Pixel Addressing and object geometry: Screen Grid coordinates, Maintaining Geometry properties of Displayed objects.

### **UNIT –III**

Geometric Transformation: Homogeneous Coordinate System for 2D and 3D, Various 2D, 3D Transformation matrices (Translation, Scaling, Rotation, Shear), Rotation about an arbitrary point (2D), Rotation about an arbitrary axis (3D), Computing location of V.P, Clipping Algorithms, Sutherland-Cohen Clipping Algorithm.

### **UNIT-IV**

Curves and Visible Surface Detection Methods: Bezier Curves, 4 point and 5 point Bezier curves using Bernstein Polynomials, B-Spline Curves, Computing control points given end slopes for a specified curve segment. Back Face Detection, Depth Buffer (Z-Buffer, A- Buffer) Method, Scan Line Method, Depth Sorting Method, Area Subdivision Method.

**UNIT –V Illumination Model and Surface Rendering: Basic Illumination models, shading models for curve surfaces, Half tone Pattern and Dithering Techniques, Rendering, Color Models: XYZ Color Model, RGB, YIQ, CMY, HSV, HLS.**

#### **References:**

1. Computer Graphics, D. Hearn and P. Baker, Prentice Hall.
2. Computer Graphics, R. Plastock and Z.Xiang, Schaum's Series, McGraw Hill.
3. Computer Graphics Principles & Practice, Foley et. al., Addison Wesley.
4. Procedural Elements for Computer Graphics, David F. Rogers, McGraw Hill.
5. Principles of Interactive Computer Graphics, W. Newman and R. Sproul, McGraw-Hill.

### **P.G.DIPLOMA IN DATA SCIENCE SEMESTER-II SYLLABUS**

#### **BSDS0203: Basic of Data Science**

##### **UNIT-1**

Introduction, Toolboxes: Python, fundamental libraries for data Scientists, Integrated development environment (IDE). Data operations, Reading, selecting, filtering, manipulating, sorting, grouping, rearranging, ranking, and plotting.

##### **UNIT-2**

Descriptive statistics, data preparation. Exploratory Data Analysis data summarization, data distribution, measuring asymmetry. Sample and estimated mean, variance and standard score. Statistical Inference frequency approach, variability of estimates, hypothesis testing using confidence intervals, using p-values

##### **UNIT-3**

Supervised Learning: First step, learning curves, training-validation and test. Learning models generalities, support vector machines, random forest.

Examples

#### **UNIT-4**

Regression analysis, Regression: linear regression simple linear regression, multiple & Polynomial regression, Sparse model. Unsupervised learning, clustering, similarity and distances, quality measures of clustering, case study.

#### **UNIT-5**

Network Analysis, Graphs, Social Networks, centrality, drawing centrality of Graphs, PageRank, Ego-Networks, community Detection.

### **BSDS0204:Data Structure**

#### **UNIT 1 - INTRODUCTION TO ‘C’ LANGUAGE**

Introduction ,Objectives , Basic Concepts of C Language, Basic Constructs of Structured Programming, History of C Language, Advantages of C Language, Components of C Language, Structure of a C Program, A Sample C Language Program, Data Types, Primitive Data Types, Composite Data Types, Constants, Integer Constants ,Character Constants, Floating Point or Real Numbers, Enumeration Constant, String Constants, Logical Constants , Variables, Operators and Expressions, Arithmetic Operators, Increment and Decrement Operators, Logical Operators, Relational Operators, Conditional Operator, Assignment Operator, Bitwise Operators, Special Operators , Operators and Associativity, Type Modifiers, Type Definitions Using `typedef` , Conditional Statements, `SWITCH` Statement, Control Program, Answers to ‘Check Your Progress’, Summary, Key Terms, Self-Assessment Questions and Exercises, Further Reading

#### **UNIT 2 ARRAYS, FUNCTIONS AND STRUCTURES, POINTERS**

Introduction, Objectives, Arrays, Single-Dimensional Arrays , Multi-Dimensional Arrays , Two-dimensional Arrays, Three-dimensional Arrays, String, Function Declaration and Prototype , Function Call – Passing Arguments to a Function , Function Definition, Need of User Defined Functions , Scope and Lifetime Declaration of Variables , Return Values , Storage Classes , Command Line Arguments, Recursion in Functions , Implementation of Euclid’s gcd Algorithm, Structure Initialization , Declaration: Assigning Values to Members, Processing a Structure Variable , Comparison of Structure Variables, Array of Structures, Structure Elements passing to Functions, Structure Passing to Functions, Structure within Structure, Structure Containing Arrays, Union , Structure Pointers , Pointers: Declaration and Initialization, Pointer Notation and Accessing Variable, Arrays and Pointers , Pointer Expressions , Pointers and One Dimensional Arrays, Malloc Library Function and Calloc Library Function, Pointers and Multi-dimensional Arrays , Arrays of Pointers, Pointer to Pointers, Pointers and Functions , Function with a Variable number of Arguments, Answers to ‘Check Your Progress’, Summary, Key Terms, Self-Assessment Questions and Exercises, Further Reading

#### **UNIT-3 DATA STRUCTURES**

Introduction, Objectives, Data Structure, Primitive and Composite Data Types, Abstract Data Type, Algorithm Design, Program Analysis, Stacks and their Representation, Applications of Stacks , Simulating Recursive Function using Stack , Queues , Circular Queue , Deques , Priority Queue , Linked List , Static and Dynamic Memory Allocation, Static and Dynamic Variable, Linked Lists: Pointers , Singly Linked Lists. , Representation of Linked List, Implementation of Linked Lists , Reversing of Linked List , Concatenation of Linked List , Merging Linked List using Merge Sort , Applications of Linked List , Circular Linked List , Doubly Linked List , Generalized List , Answers to ‘Check Your Progress’ , Summary , Key Terms , Self-Assessment Questions and Exercises, Further Reading

#### **UNIT – 4 TREES AND GRAPHS**

Introduction , Objectives, Trees: Basic Terminology , Binary Trees, Theorems Associated with Binary Trees, Tree Traversal, Implementation of Binary Trees , Deleting from a Binary Tree, Graph: Definition

and Terminology, Representation of Graphs, Path Matrix, Traversal of Graph , Spanning Trees , Answers to 'Check Your Progress', Summary , Key Terms , Self-Assessment Questions and Exercises , Further Reading

### **UNIT 5 HASH TABLE, SEARCHING AND SORTING**

Introduction, Objectives, Hash Table , Hashing Function , Terms Associated with Hash Tables Bucket Overflow, Handling Bucket Overflows , ISAM, Searching, Sorting , Answers to 'Check Your Progress', Summary, Key Terms, Self-Assessment Questions and Exercises, Further Reading

## **P.G.DIPLOMA IN DATA SCIENCE SEMESTER-III SYLLABUS**

### **BSDS0301: Java Programming**

#### **Unit -1**

Objective , Introduction, Introduction to Object Oriented Programming , Objects and Classes, Characteristics of Object Oriented Programming, Differences between Procedural and Objected Oriented Languages , Introduction to Java , Features of Java ,Java Application and Applet , JDK Source File Structure, Summary , Self-Assessment Questions , References

#### **Unit-2 - Fundamentals of Java Programming**

Objective ,Introduction ,Data Types in Java , Characters ,Escape Sequences ,Variables and Constants  
Comments ,Identifiers and Reserved Words ,Operators in Java , Simple Program Input and Output, Decision Making Statement in Java,Summary ,Self-Assessment Questions , References

#### **Unit-3 - Operators in Java**

Objective ,Relational Expressions ,Relational Operators ,Logical Operators ,Precedence of Operators  
,Organization of Java , Predefined Java methods, Programmers-Defined Methods. ,Summary ,Self-Assessment Questions ,References

#### **Unit – 4 - Looping in Java**

Objective, Introduction, Loops in Java, While loop, Do –while loop, For loop, Nested loop, Break, Continue, Classes and Methods, Summary, Self-Assesment Questions, References, Loops in Java , While loop ,Do –while loop ,For loop ,Nested loop ,Break ,Continue,Classes and Methods ,Summary  
,Self-Assesment Question, References

#### **Unit – 5 Arrays in Java**

Objective ,Introduction ,The one-dimensional array ,Array Declaration ,Array Instantiation ,Multidimensional Arrays ,Working with Characters and Strings ,Important String Methods ,Formatted Data Output ,Summary ,Self-Assesment Questions , References

#### **Unit - 6 -Object Based Programming**

Objective ,Introduction ,Class ,Class Scope ,This keyword and its use ,Constructor ,Purpose and Function ,Constructor Vs Methods ,Multiple Constructors , Default Constructor ,Constructor Overloading Need ,Composition ,Garbage Collection ,Static Class member ,Static Variable ,Static Method ,Static Block ,Final Variables , Packages , Creating Packages ,Naming Packages ,Import Package ,Package Access , Data Abstraction Encapsulation ,Summary ,Self-Assessment Question  
,Reference

## **Unit 7 -Inheritance and Polymorphism**

Objective ,Introduction , Super Class and Sub Class , Super Class , Sub Class , Relation between Super Class and Sub Class , Creating Subclass ,Member Access , Inheritance , Definition , Types of Inheritance , Member Access and Inheritance ,Super Keyword, Abstract Class and Methods , Interface , Abstract class versus Interface , Final Class and Methods , Nested Class , Advantages , Types , Wrappers Classes , Summary , Self-Assessment Questions , References

## **Unit - 8 -Exceptions and Assertions**

Objective, Introduction, Java as an OOP language,Defining classes, Modifiers, Packages, Interface, Errors, Types of Error, Error handling, Exception, Terminology, Types of Exception, Use of exception, Keywords for Java Exception,Exception Handling, Throwing Exceptions, Throw, Finally Keyword, Exception Classes hierarchy, Throwable Class, Throwable constructor, Throwable methods, Assertion, Summary, Self-Assessment Questions, References

## **Unit – 9- Advance concepts in Exception**

Objective, Introduction, Handling Exception in Java, Checked and unchecked Exception,Exception and Inheritance, User Defined Exception, Rethrowing Exception, Exception Propagation,Wrapping Exception, Exception Enrichment, Summary, Self-Assessment Question, References

## **Unit - 10 -Multithreading**

Objective , Introduction , Life Cycle of a Thread ,Thread Priorities and Scheduling ,Creation of a Thread ,Thread Methods ,Thread Synchronization ,Thread Groups ,Communication of Threads Summary , Self-Assessment Question ,References

## **Unit – 11- File Input and Output**

Objective, Introduction, System Class, System.in, System.out, System.err, The "Class" class I/O Stream, Byte Stream, Character Stream, Reading Console Input, Writing Console Output, Reading and Writing Files, FileInputStream, FileOutputStream, File Navigation and I/O,File Class  
FileReader Class, FileWriter Class, Summary, Self-Assessment Questions, References

## **Unit – 12 Graphical User Interface**

Objective, Introduction, Basics of GUI Applications, Window Fundamentals, Components Container, Panel, Window, Frame, Canvas, Developing a JAVA GUI using Frame, Adding Functionality to GUI, Improving GUI Layout, Summary, Self-Assessment Questions, References

## **Unit – 13- Applets**

Objective,Introduction,Java Application Vs Java Applets, Simple Applet, Applet Life Cycle, Advantages of Applets, Restrictions of Applets, The HTML Applet Tag,The java.applet Package  
java.applet.Applet, java.applet.AppletContext, java.applet.AppletStub, java.applet.AudioClip, Summary, Self-Assessment Questions, References

## **Unit-14- AWT**

Objective, Introduction, Basic Classes in AWT, Graphics Class, Drawing with Graphics Class, Graphics Coordinate System,Graphics Primitives,Hierarchy of AWT,Types of Containers, Creating a Container, Adding Components to a Container, Event

Handling, Delegation Event Model, Adapter Classes, AWT Controls, Summary, Self-Assessment Questions, References

#### **Unit-15 Swing in Java**

Objective, Introduction, Layout Managers, Flow Layout Manager, Border Layout Manager, Grid Layout Manager, Card Layout Manager, Java Swings, Swings Packages, Hierarchy of Swing, Advanced Layout Managers, Box Layout Manager, Grid Bag Layout Manager, Additional Swing Components, Summary, Self-Assessment Questions, References

### **BSDS0302: Operating Systems**

#### **Unit -1 : Introduction to Operating System**

Objective, Introduction to Operating System, Some Definitions, Goals 1.1.3 Generations, Classification of Operating Systems, Single User – Single Processing System, Batch Processing Systems, Multiprogramming Operating System, Time Sharing or Multitasking System, Parallel or Multiprocessing Systems, Distributed Systems, Real Time Systems, Functions/Services of Operating Systems, Summary, Answer to the Self Answering Exercises, Self Assessment Questions

#### **Unit- 2 : User Interface & Computing Environments**

Objective, Introduction, User Interfaces, Command Interpreter / Command User Interface (CUI), Graphical User Interfaces (GUI), Difference between CUI and GUI, Computing Environments, Traditional Computing, Client-Server Computing, Peer-to-Peer Computing, Web-based Computing, System Call, Summary, Answer to the Self Learning Exercises, Self Assessment Questions

#### **Unit-3 : Types of Operating Systems**

Objective, Introduction, Evolution of Operating System, Types of Operating Systems, Batch Processing Operating System, Multiprogramming Operating System, Multitasking Operating System, Time Sharing Operating System, Real Time Operating System, Multiprocessor Operating System, Distributed operating system, Special Operating System - Embedded Operating System - Mobile O.S. or Handheld O.S, Summary, Self Assessment Questions

#### **Unit - 4 : Process Management**

Objective, Introduction, Introduction to Processes, Process State, Process Control Block, Context Switching, Process Creation & Termination, Basics of Inter-Process Communication - Shared Memory & Message Passing System, Basics of Communication in Client-Server System - Sockets - R.P.C. - R.M.I., Summary, Self Assessment Questions

#### **Unit - 5 : Threads.**

Objective, Introduction, Threads, Processes Vs Threads, User-Level Threads, Kernel-Level Threads, Multi Threading Models, Thread Libraries, Thread Issues, Thread Scheduling, Summary, Self Assessment Questions

#### **Unit - 6 : Process Scheduling : Basic Concept**

Objective, Introduction, Type of Schedulers, CPU-I/O Burst Cycle, Scheduling Criteria, Scheduling Algorithms, First-Come First-Served(FCFS) Scheduling, Shortest Job First Scheduling, Operating system Examples, Linux Scheduling, Windows Scheduling, Summary, Self Assessment Questions

#### **Unit - 7 : Process Synchronization Structure of the Unit**



Objective , Meaning of Synchronization, Need of Synchronization, Thread and Process Synchronization , Data Synchronization , File-Based Solutions, Race Condition, Race Condition Properties , Critical-Section Problem, Synchronization Hardware, Introduction to Semaphore & Monitor, Producer-Consumer Problem using Semaphores, What is Monitor? , Differences between Monitors and Semaphores , Summary , Self-Assessment Questions

### **Unit - 8 : Deadlocks**

Objective , Introduction , Necessary Conditions for Deadlocks , Prevention , Elimination of “Mutual Exclusion” Condition , Elimination of “Hold and Wait” Condition, Elimination of “No-preemption” Condition, Elimination of “Circular Wait” Condition, Deadlock Avoidance , Banker’s Algorithm, Deadlock Detection 8.6Recovery from Deadlock , Recovery from Deadlock : Process Termination , Recovery from Deadlock : Resource Preemption , Summary, Self Assessment Question

### **Unit - 9 : Memory Management**

Objective, Introduction, Memory Hierarchy, Fragmentation, Paging, Shared Pages, Kernel Memory Allocation, Summary, Self Assessment Questions

### **Unit - 10 : Introduction to Paging, Segmentation and Segmentation with Paging**

Objective, Introduction, Segmentation, Segmentation with Paging, Basic H/W Support, Structure of Page Table, Hierarchical Paging, Hashed paging, Inverted Page Tables, Summary, Self Assessment Questions

### **Unit - 11 : Virtual Memory Management**

Objective, Introduction, Pre paging and Demand Paging, Copy-on-write, Page replacement basic , Page replacement policies, Thrashing cause, Summary, Self Assessment Questions

### **Unit - 12 : File Management System**

Objective, Introduction, File Attributes, File Operations, File Types, File Structure, Internal File Structures, Accessing Method - Sequential access, Direct access, Directory Structure, File Access and Access Control, Summary, Self Assessment Questions

### **Unit - 13 : I/O**

Objective, Introduction , Overview I/O Hardware, Polling, Interrupts, Direct Memory Access, Application I/O Interface , Blocked Character Device, Blocking & Non Blocking Input Output , Kernel I/O Sub System , Input Output scheduling , Buffering, Caching, Spooling and Device Reservation , Error handling, I/O Protection, Kernel Data Structure , Summary, Self Assessment Questions

### **Unit - 14 : System Protection**

Objective , Introduction , Goals of Protection , Principles of Protection , Domain of Protection , Domain Structure , Methods for enforcement of protection mechanisms , Access Right , Access Matrix , Implementation of Access Matrices , Comparison of access list and capability list , Revocation of Access Rights , Summary , Self Assessment Questions

### **Unit - 15 : System Security**

Objective , Introduction , Need for Security, Principles of Security , Authentication , Passwords , Artifact based Authentication, Biometrics Techniques, Encryption, Program & System threats, Virus , Worms , Trojan horse , Trap Doors , Logic Bomb , Port Scanning , Stack & Buffer Overflow, Denial of services , Computer Security Classification, Summary, Self Assessment Questions

## **BSDS0304 Numerical Methods & Statistical Analysis**

### **UNIT 1 REPRESENTATION OF NUMBERS**

Introduction , Objectives , Introduction to Numerical Computing , Limitations of Number Representations, Arithmetic Rules for Floating Point Numbers , Errors in Numbers and Measurement of Errors , Generation and Propagation of Round-Off Error , Round-Off Errors in Arithmetic Operations , Errors in Evaluation of Functions, Characteristics of Numerical Computation , Computational Algorithms , Solving Equation , Bisection Method and Convergence of the Iterative Method , Newton-Raphson Method , Secant Method , Regula-Falsi Method , Descartes's Rule , Answers to 'Check Your Progress' , Summary , Key Terms , Self-Assessment Questions and Exercises, Further Reading

### **UNIT 2 INTERPOLATION AND CURVE FITTING**

Introduction , Objectives, Interpolation , Iterative Linear Interpolation , Lagrange's Interpolation , Finite Difference for Interpolation , Symbolic Operators , Shift Operator , Central Difference Operator , Differences of a Polynomial, Newton's Forward Difference Interpolation Formula , Newton's Backward Difference Interpolation Formula , Extrapolation , Inverse Interpolation , Truncation Error in Interpolation , Curve Fitting , Method of Least Squares, Trigonometric Functions , Regression , Linear Regression , Polynomial Regression , Fitting Exponential , Answers to 'Check Your Progress' , Summary , Key Terms , Self-Assessment Questions and Exercises , Further Reading

### **UNIT 3 NUMERICAL DIFFERENTIATION AND INTEGRATION**

Introduction , Objectives , Numerical Differentiation Formula , Differentiation Using Newton's Forward Difference Interpolation Formula , Differentiation Using Newton's Backward Difference Interpolation Formula , Numerical Integration Formulae , Simpson's One-Third Rule , Weddle's Formula , Errors in Integration Formulae  
Gaussian Quadrature, Solving Numerical , Taylor Series Method , Euler's Method , Runge-Kutta Methods , Higher Order Differential Equations , Answers to 'Check Your Progress' , Summary , Key Terms , Self-Assessment Questions and Exercises , Further Reading

### **UNIT- 4- STATISTICAL COMPUTATION AND PROBABILITY DISTRIBUTION**

Introduction , Objectives , History and Meaning of Statistics , Scope of Statistics, Various Measures of statistical computations , Average , Mean , Median , Mode , Geometric Mean , Harmonic Mean , Quartiles, Percentiles and Deciles , Box Plot , Measures of Dispersion , Range , Quartile Deviation , Mean Deviation , Standard Deviation , Calculation of Standard Deviation by Short-cut Method, Combining Standard Deviations of Two Distributions , Comparison of Various Measures of Dispersion , Probability , Probability Distribution of a Random Variable , Axiomatic or Modern Approach to Probability , Theorems on Probability  
4.6.4 Counting Techniques  
Mean and Variance of Random Variables , Standard Probability Distribution , Binomial Distribution , Poisson Distribution , Exponential Distribution , Normal Distribution , Uniform Distribution (Discrete Random and Continuous Variable) , Answers to 'Check Your Progress' , Summary , Key Terms , Self-Assessment Questions and Exercises , Further Reading

### **UNIT 5 ESTIMATION AND HYPOTHESIS TESTING**

Introduction , Objectives , Sampling Theory, Parameter and Statistic , Sampling Distribution of Sample Mean, Sampling Distribution of the Number of Successes , The Student's Distribution , Theory of Estimation, Point Estimation, Interval Estimation , Hypothesis Testing , Test of Hypothesis Concerning Mean and Proportion , Test of Hypothesis Concerning Standard Deviation , Answers to 'Check Your Progress' , Summary , Key Terms , Self-Assessment Questions and Exercises, Further Reading

## **Cloud Computing**

### **Unit 1: Infrastructure as a Service& Platform as a Service**

Learning Objective, Cloud Service Models, Infrastructure as a Service, Platform as a Service, Case Studies, Let's Sum up

### **Unit 2:Software as a Service and Database as a Service**

Learning Objectives, Software as a Service (SaaS), Database as a Service (DBaaS), Let's Sum up

### **Unit 3:Security as a Service**

Learning Objectives, Introduction to Security as a Service, Cloud Security Risk analysis, SECaaS Categories, Benefits Of Security As A Service, Evaluation of Cloud Security Issues, Cloud Security Standards, Let's sum up

### **Unit 4:Specialized Cloud Services**

Learning Objectives, Recovery as a Service (RaaS), Identity as a Service (IDaaS), Storage as a Service, Communication as a Service (CaaS), Let's sum up

## **P.G.DIPLOMA IN DATA SCIENCE SEMESTER-IV SYLLABUS**

### **BSDS0404:Artificial Intelligence**

#### **Unit-I**

Introduction, AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, and problem formulation.

#### **Unit-II**

Searching for solutions, uniformed search strategies – Breadth first search, depth first search, Depth limited search, Iterative-deepening depth first search bi-direction search - comparison. Search with partial information (Heuristic search) Greedy best first search, A\* search, Memory bounded heuristic search, Heuristic functions. Local search Algorithms: Hill climbing, simulated, annealing search, local beam search, genetical algorithms. Constraint satisfaction problems: Backtracking search for CSPs local search for constraint satisfaction problems.

#### **Unit-III**

Game Playing: Adversarial search, Games, minimax, algorithm, optimal decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions, cutting of search., Knowledge representation Reasoning and Agents :knowledge – Based Agents, the Wumpus world, logic, propositional logic, Resolution patterns in propositional logic, Resolution, Forward & Backward. Chaining. First order logic. Inference in first order logic, propositional Vs. first order

inference, unification & lifts forward chaining, Backward chaining, Resolution.

#### **Unit-IV**

Planning: Classical planning problem, Language of planning problems, Expressiveness and extension, planning with state – space search, Forward states space search, Backward states space search, Heuristics for states space search. Planning search, planning with state space search, partial order planning Graphs.

#### **Unit-V**

Learning :Forms of learning, Induction learning, Learning Decision Tree, Statistical learning methods, learning with complex data, learning with Hidden variables – The EM Algorithm, Instance Based learning, Neural Networks.

#### **References :**

1. Introduction to Artificial Intelligence – Rajendra Akerkar, PHI.
2. Artificial Intelligence – A Modern Approach. Second Edition, Stuart Russel, PeterNorvig, PHI/Pearson Education.
3. Artificial Intelligence, 3<sup>rd</sup> Edition, Patrick Henry Winston., Pearson Edition,
4. Artificial Intelligence and Expert Systems – Patterson PHI
5. Expert Systems: Principles and Programming- Fourth Edn, Giarrantana/ Riley,Thomson

### **BSDS0405: Deep Learning**

#### **Unit-1**

Definition of Machine Learning, Fundamentals of ANN, The Biological Neuron, Artificial neuron model, Basic Elements of ANN, Different Learning Rules, Requirements of Learning Laws, Supervised learning, Unsupervised learning, Reinforced learning, Hebbian learning, Gradient descent learning, Perceptron Model, Simple Perceptron for Pattern Classification, Perceptron Algorithm, Limitations of single layer perceptrons, Multi-Layer Perceptron Model, Multi Layer Perceptron Algorithm, linearly separable & Linear in separable tasks, Convex Region, Types of convex regions, Logistic Regression, Support Vector Machines, SVM can be of two types, Linear SVM, Gradient Descent, Types of Gradient Descent, Stochastic Gradient Descent,

#### **Unit-2**

History of Deep Learning, A Probabilistic Theory of Deep Learning, Back Propagation Networks (BPN), Need for Multilayer Networks , Multi-Layer Networks, Back Propagation Networks (BPN), BPN Algorithm, Merits, Demerits, Regularization, Difference between L1 & L2 Parameter Regularization, Batch Normalization, Procedure to do Batch Normalization, Shallow Networks, Difference Between a Shallow Net & Deep Learning Net,

#### **Unit- 3**

**Linear Factor Models, Dimensionality Reduction, Principal Component Analysis (PCA), Computing the Principal Components, Steps involved in PCA, PCA Advantages, Disadvantages of PCA, Linear Discrimination Analysis (LDA), Need for LDA, Limitations, Steps involved in LDA, Pros & Cons of LDA, Manifold Learnings, Auto Encoders, Types of AutoEncoders are, Hyperparameters of an AutoEncoder, Hyperparameter Optimization, Hyperparameter Optimization methods**

#### **Unit -4 DIMENTIONALITY REDUCTION**

**, Optimization in Deep Learning, Need for Optimization, Convex Optimization, Non-Convex Optimization, How to solve non-convex problems, Reasons For Non-Convexity, Spatial Transform Network [STN], Advantages, Recurrent Neural Networks, Need for RNN, Providing**

**Input to RNN, providing Targets to RNN, Long Short Term Memory Network's ( LSTM), Steps Involved in LSTM Networks, Applications of LSTM include, Computational and Artificial Neuro-Science, The Biological Neurons, Artificial neuron model, Basic Elements of ANN, Applications of Computational Neuro Science,**

## **UNIT V APPLICATIONS OF DEEP LEARNING**

Imagenet, Technical details of Image Net, How the images are labelled in ImageNet?, How the images of ImageNet Licensed?, Shortcomings of ImageNet, WaveNet, The Workflow of WaveNet, Natural Language Processing [NLP], Natural Language Processing Phases, Morphological Processing, Syntax Analysis, Semantic Analysis, Pragmatic Analysis, Different types based on Working, Applications of NLP, Word2Vec: Applications of Deep Learning Networks, Joint Detection, Steps Involved, Other Applications,