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UNIVERSITY OF MYSORE

Estd.1916

Vishwavidyanilaya Karyasoudha
Crawford Hall, Mysore 570 005

(Re-accredited by NAAC at "A" Grade with a CGPA of 3.47)

(NIRF-2020 Ranked 27 in University Category & 47 in Overall Category)

No.: PMEB/AC10/759/2019-20 **Date: 14-10-2020.**

NOTIFICATION

Sub: Introduction of **B.Sc.(Hon's) (Data Science & Artificial Intelligence)** course under Specialized Programme from the academic year 2020-21- reg.

Ref: 1. Decision of the BOS Meeting held on 11-06-2020.
2. Decision of the Academic Council meeting held on 14-09-2020.

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The Board of Studies in **B.Sc.(Hon's) in Data Science & Artificial Intelligence(UG)** at its meeting held on **11-06-2020** has recommended to introduce **B.Sc.(Hon's) (Data Science & Artificial Intelligence)** course in University of Mysore under specialized/specified program. The Regulations, Syllabus and Scheme of Examination was approved from the academic year 2020-21.

The Academic Council has also approved the above said proposals at its meeting held on 14-09-2020 and the same is hereby notified.

The Regulations, Syllabus of **B.Sc.(Hon's) (Data Science & Artificial Intelligence)** course is uploaded in University website. The contents may be downloaded from the University website **www.uni-mysore.ac.in.**

REGISTRAR

To;

1. The Registrar(Evaluation), University of Mysore, Mysuru.
2. The Dean, Faculty of Science & Technology, DOS in Psychology, MGM.
3. Prof. Suresha, Chairperson, BOS in B.Sc.(Hon's) in Data Science & Artificial Intelligence(UG), DoS in Computer Science, MGM.
4. Sri B.S.Parthasarathy, President, Sarada Vilas Educational Institutions, Saradavilas Road, Krishnamurthy Puram, Mysuru.
5. The Deputy Registrar/ Asst. Registrar/ Superintendent, Examination Branch, UOM, Mysuru.
6. The Special Officer to Hon'ble Vice-Chancellor, University of Mysore, Mysuru.
7. The PA to Vice-Chancellor/Registrar/Registrar(Evaluation), University of Mysore, Mysuru.
8. Office Copy.

REGULATIONS AND SYLLABUS APPROVED BY THE BOARD OF STUDIES
OF THE UNIVERSITY OF MYSORE FOR

BACHELOR OF SCIENCE (HON'S)(DATA SCIENCE & ARTIFICIAL INTELLIGENCE)

[B.Sc (Hon's)(DS & AI)]

(UNDERGRADUATE COURSE)

1. **Introduction**

1.1. Under the scheme launched by the University Grants Commission (UGC), skill development based higher education leading to the **BACHELOR OF SCIENCE (HONOURS) IN DATA SCIENCE AND ARTIFICIAL INTELLIGENCE** corresponding to the NSQF Standards is introduced in Sarada Vilas College, Mysore, Karnataka State.

1.2. The proposed course will have a judicious mix of both the skills and the generic education components. The design put-forth hereunder meets the objective of equipping the aspirants to cope with emerging trends, industry expectations and challenges.

1.3. The University of Mysore, Karnataka State, has accorded approval and recognition to the Course leading to award of the degree "**B.Sc.(Hon's)(DS&AI)**" designating Sarada Vilas College as a "**Recognised Specialised Centre of University of Mysore**".

1.4. In addition to the Degree awarded by the University of Mysore, skill-based certificates are awarded by the National Skill Development Corporation (NSDC). This enhances the career prospects for the successful students.

2. **Entry level**

The eligibility for admissions to the courses shall be governed in accordance with the rules framed by the University of Mysore from time to time. The eligibility criteria for admission to the B.Sc.(Hon's)(DS&AI) Degree course shall be pass in:

1. 10+2 examination or Pre-university or its equivalent with Mathematics/Computer Science/ Business Mathematics/ Statistics with a minimum 50% overall marks in core subjects; OR
2. 3-year Diploma after SSLC/10^{th} Class with Computer Science/Information Systems or its equivalent.

3. **Scheme of the Program**

3.1. The duration of the B.Sc.(Hon's)(DS&AI) shall be FOUR years consisting of Eight semesters of five months each inclusive of the days of examinations.

3.2. Only such students who successfully complete 180 credits in eight semesters without break shall be considered for declaration of merits/medals.

4. **Continuous Assessment**

Assessment and evaluation processes happen in a continuous mode. However, for the purposes of reporting, a semester is divided into three discrete components identified as C1, C2 and C3. The performance of a student will be assessed as explained below:

4.1. The outline for continuous assessment activities for C1 and C2 will be proposed by the Board of Studies (BoS) based on test/assessment/ tutorial / viva-voce / seminar / any other.

4.2. The first component, C1, of assessment is for 10%. During the first half of the semester, the first 50% of the syllabus should be completed. This should be completed by the 8th Week of the semester.

4.3. The second component, C2, of assessment is for 10%. C2 will be based on the remaining 50% of the syllabus. C2 will be completed during the 15th Week of the semester.

4.4. A student cannot repeat C1 and C2.

4.5. During the 18th -20th Week of the semester, a semester-end examination shall be conducted by the University of Mysore for the course. This forms the final component of assessment (C3) for 80%. The student has to apply for the C3 examination as per the notification by the University of Mysore.

4.6. The BoS will decide the scheme of valuation for C3 component of the Practical.

4.7. Project work shall be evaluated as per the scheme recommended by the BoS. C1 and C2 components of the project shall be evaluated by the Project Supervisor for 30 marks each. C3 component of the project work shall be evaluated jointly by the Project Supervisor and one External Examiner for 40 marks.

5. **Evaluation for C1 and C2**

5.1. Students will be evaluated for each course by the teacher(s) handling that course.

5.2. After the evaluation, the results have to be announced. The course teacher has to obtain signatures of the students registered for the course in a register maintained specifically for the purpose, indicating that they have no objection to the marks awarded within 5 days from the date of announcement of the marks.

5.3. In case a student is not satisfied with the assessment, the student can make an appeal to the Grievance Cell within 5 days from the date of announcement of the results. Otherwise it is presumed that the student has no objection to the marks awarded.

5.4. The student can appeal to the Grievance Cell by paying the prescribed fee as fixed by the University. The Grievance Cell is empowered to take corrective measures. The concerned course teacher has to provide all the relevant documents to the Grievance Cell. The decision taken by the Grievance Cell is final.

6. **Examination, and Evaluation for C3**

6.1. If a paper has both Lecture (L) and Practical (P) components, then:

6.1.1. If the credit is equal to 3 or more, C3 exam should be conducted for 80 marks each.

6.1.2. If the credit is less than 3, C3 exam should be conducted for 40 marks each.

6.2. For a paper with all the three components L:T:P, say in the ration $C_l : C_t : C_p$, the C3 marks is computed as follows: If the candidate scores M_t in the theory exam, and scores M_p in the practical exam then the C3 marks is

$$\text{C3 Marks} = \frac{[(C_l + C_t) \times M_t] + [(C_t + C_p) \times M_p]}{C_l + 2C_t + C_p}$$

6.3. Question paper setting

a) The question paper pattern for C3 component of each course shall be prepared by the respective Boards of Studies.

b) Each subject shall have a Board of Examiners which shall prepare, scrutinize, and approve the question papers for all the courses of that subject.

6.4. Valuation

a) Before the valuation the answer scripts shall be coded.

b) There shall be centralized, single valuation of the C3 theory answer scripts.

c) C3 component of the Practical's will be conducted with two examiners of whom at least, one is an external examiner.

Any examiner on the approved panel of examiners of the University not belonging to the parent college is an external examiner.

d) Project shall be evaluated as per the scheme recommended by the relevant Board of Studies. C1 and C2 components of the project shall be evaluated by the project supervisor for 30 marks each. C3 components of the project shall be evaluated jointly by the project supervisor and one external examiner for 40 marks.

6.5 Awarding the grades should be completed latest by 26th week of the semester.

7. **Photocopy, Re-totalling, and Revaluation**

7.1. A student can avail the following services by paying the prescribed fees to the University within 15 days from the date of announcement of the results:

- Photocopy of the answer script (C3)
- Viewing and Re-totalling
- Revaluation

7.2. There shall be no provision for only seeing the answer script of C3.

7.3. The Re-totalling shall provide for checking whether all the answers have been valued, and the totalling is correct.

In case any answer or part thereof has not been valued, that part may be referred to another valuer and marks so awarded shall be added to the total.

In case there is a mistake in totalling or carryover of marks from the inside sheets to the facing sheet, the Registrar (Evaluation) shall have it corrected with the approval of the Vice-Chancellor of the University.

7.4. The result of Re-totalling shall be announced within five days from the date of applying for the same.

7.5. The result of the revaluation shall be announced within twenty days from the last date for the receipt of the application.

7.6. Revaluation shall be carried out by an examiner from the University who has not valued that particular script.

7.6.1. If the difference between the original marks and the revaluation marks does not exceed 15 percent of the maximum marks prescribed for that theory paper, the average of the two will be the final award of marks.

7.6.2. If the difference between the original marks and the re-valued marks is more than 15 percent of the maximum prescribed for that theory paper, such scripts shall be valued by an external examiner outside the University. The average of the nearest two shall be the final award of marks.

7.6.3. In case one or more answers are not valued by the original examiner, then the marks awarded by the subsequent examiner as far as these answers are concerned shall be taken as they are, without averaging with the marks other answers.

7.6.4. In cases where there is a difference between the original marks, first revaluation marks or/and the second revaluation marks clearly indicating that a particular examiner has been erratic in his/her valuation, then such cases shall be referred to the Malpractice

and Lapses Inquiry Committee to establish whether or not an punitive measures need to be taken.

7.6.5. If there is a complaint of unfair valuation of answer scripts for a group of students, the Vice-Chancellor may, after a preliminary inquiry, order for revaluation of the concerned group of or entire set of students in the paper concerned. After such revaluation, a random sample of 10% of the answer scripts, subject to a minimum of ten, shall be referred for review.

8. **Passing Criteria**

8.1. A student is considered to have passed the course, only on securing a minimum of 50% from C1, C2 and C3 put together.

8.2. A student can take C3 exam irrespective of the marks scored in C1 and C2 of a particular course.

8.3. In case a student secures less than 40% in C3 or absents for C3, the student is said to have not completed the course. The student shall complete the course by re-appearing only for C3 component of that course when University conducts the examination. The student carries the marks already awarded in C1 and C2.

8.4. On successful completion of UG program, a final grade card consisting of grades of all courses successfully completed by the student will be issued by the University.

9. **Makeup Examination**

9.1. For students who could not attend C1 or C2 due to medical reasons/extraordinary circumstances/participation in Sports/NCC/NSS or any other extracurricular activities (approved by the College), C1 and C2 exams will have to be conducted for them separately before the 15th week of the semester.

9.2. Makeup examination (only for C3) shall be conducted by the University within 15 days from the date of notification or results. This shall be only for those students who do not fulfil the passing criteria specified earlier.

9.3. Makeup examination (only for C3) shall be conducted only for 7th and 8th semesters (8 semester UG program).

10. **Percentage, and Grading**

10.1. If P is the percentage of the marks secured by a candidate in a course (C1+C2+C3) which is rounded to nearest integer, the grade, G earned by the student in that course will be as given below.

Percentage (P)	Grade (G)	Percentage (P)	Grade (G)
40 – 49	5.0	75 – 79	8.0
50 – 59	6.0	80 – 84	8.5
60 – 64	6.5	85 – 89	9.0
65 – 69	7.0	90 – 94	9.5
70 – 74	7.5	95 – 100	10.0

10.2. The overall percentage in a subject is 10 x SGPA.

10.3. The overall percentage in a program is 10 x CGPA.

11. **Class Declaration**

The final Qualitative Index to be awarded to the student is based on CGPA. It is given as:

CGPA	Qualitative Index
$5 \leq CGPA \leq 6$	Second Class
$6 \leq CGPA \leq 8$	First Class
$8 \leq CGPA \leq 10$	Distinction

12. **Nodal Officer, Subject Coordinator and Student Advisor**

12.1. College shall nominate a Faculty Member as CBCS Nodal Officer who will act as a liaison with the University and facilitate the implementation of the program.

12.2. Head of the Department shall be the Subject Coordinator. He is responsible for the Student Advisor's work and student support services.

12.3. Every student will have a member of faculty of the Department as Student Advisor. All teachers of the department shall function as Student Advisors and will have more or less equal number of students. The Student Advisor will advise the students in choosing elective courses and offer them all possible assistance.

13. **Grievance Cell**

For the UG program there will be one Grievance Cell comprising of members as follows:

- The Principal (or his/her representative).
- The Heads of the Departments.
- One senior faculty member from each Department.

14. **Conduct**

Every student is required to observe discipline and decorum both inside and outside the campus in accordance with the instructions of the college and also as per the instructions issued by the University of Mysore / Government of Karnataka / UGC from time to time regarding Student Conduct Rules.

15. **Implementation**

The details of implementing the CBCS are given in Para 21 below.

16. **Others**

Any issue not specifically mentioned in these regulations shall be decided by the Vice-Chancellor in consultation with the appropriate bodies of the University.

17. **Nature of the Course**

The pattern of the courses is as under:-

17.1. Medium of instruction shall be English.

17.2. The program is full-time. No on-line coaching is envisaged.

17.3. There will be electives in Soft-core subjects and in dissertation/practical training.

17.4. Total credits will be 180.

17.5. All vocational subjects are treated as Hard-core subjects in the course.

17.6. If a candidate fails in a semester he/she will get supplementary chances to write only failed papers as per the regulations stipulated by the University of Mysore.

Program Structure and Syllabus

18. **Definition:** The following are the definitions governing this document:
    18.1. "Discipline Specific Course" (DSC) is a core course which should be compulsorily studied by a student as a core requirement of the Program.
    18.2. Ability Enhancement Courses are of two types viz., (1) "Ability Enhancement Compulsory Course" (AECC) and (2) "Skill Enhancement Course" (SEC). AECC is a mandatory course based upon the content that leads to knowledge enhancement viz., Indian Constitution, Environmental Studies, Functional English and Modern Indian Languages (MIL). SEC courses are aimed at providing hands-on training, competencies, skills, etc.
    18.3. "Discipline-specific Elective Course" (DEC) is a course which can be chosen from a pool of courses. It may be very specific or specialised or supportive to the subject of study or which enables an exposure to some other discipline/subject/domain or nurtures the student's proficiency/ skill.
    18.4. "Grade" is a score assigned to the percentage of marks awarded in a course.
    18.5. "Grade Point Average" (GPA) refers to the performance of the student in a given semester. GPA is the ratio of the total grade points earned by the student in all the courses to the total number of credits assigned to the courses in a given semester.
    18.6. "Subject Grade Point Average" (SGPA) refers to the ratio of the total credit points earned by the student in all the courses of all the semesters of a single subject to the total number of credits assigned to the courses of all the semesters of that subject.

19. **Subjective regulations**:
    19.1. Under AECC a candidate has to study Functional English and additionally choose any ONE of the MIL viz., Kannada, Tamil, Telugu, Malayalam and Hindi.
    19.2. Change of languages once chosen will not be permitted during the period of the program.
    19.3. In the case of foreign nationals, the requirement of an Indian language may be waived by the University of Mysore. In such an eventuality, the University may permit the foreign national student for private study of choice of any one foreign language. Such a student will not be evaluated for C1 and C2 marks. However, for the final grade calculation of 80 marks of C3 will be equated to 100 marks.

20. **Extra-curricular Activities**

    Students are encouraged to participate in India's national MOOC Platform SWAYAM (Study Webs of Active-learning for Young Aspiring Minds) along with the Semesters. The Platform allows students to earn academic credit online. For details refer to portal: www.swayam.gov.in.

21. **Semester Scheme:**

YEAR - 1	Course	Subjects	L	T	P	Credits
Semester-1	AECC–1A	Functional English – 1	3	0	0	3
	AECC – 2A	Modern Indian Language (MIL) – 1	3	0	0	3
	AECC - 3	Constitution of India	2	0	0	2
	DSC – 1	Basics of Mathematics and Calculus for Science	5	1	0	6
	DSC – 2	Basics of Computers	5	1	0	6
	DSC – 3	Computer Concepts & Programming in C	4	0	2	6
Total Credits			22	2	2	26

YEAR – 1	Course	Subjects	L	T	P	Credits
Semester-2	AECC – 1B	Functional English – 2	3	0	0	3
	AECC – 2B	Modern Indian Language (MIL)–2	3	0	0	3
	AECC – 4	Environmental Science	2	0	0	2
	DSC – 4	Discrete Mathematics	5	1	0	6
	DSC – 5	Operating System and System Software	5	1	0	6
	DSC – 6	Data Structures and Algorithms	4	0	2	6
Total Credits			22	2	2	26

YEAR - 2	Course	Subjects	L	T	P	Credits
Semester-3	AECC – 1C	Functional English – 3	3	0	0	3
	AECC – 2C	Modern Indian Language (MIL)–3	3	0	0	3
	DSC – 7	Linear Algebra	5	1	0	6
	DSC – 8	Introduction to Big Data & Tools	5	1	0	6
	DSC – 9	Introduction to Python Programming	4	0	2	6
Total Credits			20	2	2	24

YEAR - 2	Course	Subjects	L	T	P	Credits
Semester-4	AECC– 1D	Functional English – 4	3	0	0	3
	AECC-2D	Modern Indian Language (MIL)–4	3	0	0	3
	DSC – 10	Probabilities and Statistics	5	1	0	6
	DSC – 11	Big Data Analytics & Visualization	5	1	0	6
	DSC – 12	Database Management System	4	0	2	6
Total Credits			20	2	2	24

YEAR - 3	Course	Subjects	L	T	P	Credits
Semester-5	DSC – 13	Foundations of AI & Machine Learning	5	1	0	6
	DSC – 14	Introduction to Neural Networks	4	0	2	6
	DSC – 15	Big Data Management	4	0	2	6
	DSE – 1	Elective – I: 1. Software Engineering; or 2. Operational Research	5	1	0	6
Total Credits			18	2	4	24

YEAR - 3	Course	Subjects	L	T	P	Credits
Semester-6	DSC – 16	Deep Learning	5	1	0	6
	DSE – 2	Elective – II: 1. Natural Language Processing; or 2. Introduction to AR Programming	4	0	2	6
	DSE – 3	Elective – III: 1. Data Mining; or 2. Fuzzy Logic and ANN	4	0	2	6
	SEC – 1	Skill Enhancement Course – 1: 1. Business Intelligence & Analytics; or 2. Financial Analytics	2	0	0	2
	SEC – 2	Skill Enhancement Course – 2: 1. Human-Robot Interaction Using Motion Capture; or 2. Autonomous Robots	1	1	0	2
Total Credits			16	2	4	22

YEAR - 4	Course	Subjects	L	T	P	Credits
Semester-7	DSE – 4	Elective – IV: 1. Image Processing; or 2. AI-based VR Programming; or 3. Robots Navigation	4	0	2	6
	DSE – 5	Elective – V: 1. Introduction to Networks and Cloud Computing; or 2. Information Security Systems	5	1	0	6
	DSE – 6	Elective – VI: Mini Project	0	2	4	6
	SEC – 3	Skill Enhancement Course – 3: 1. Predictive Analytics; or 2. Web Analytics	2	0	0	2
Total Credits			11	3	6	20

YEAR - 4	Course	Subjects	L	T	P	Credits
Semester-8	DSE – 7	Main Project Work	0	0	12	12
	SEC – 4	Skill Enhancement Course – 4 SWAYAM online Courses	2	0	0	2
Total Credits			2	0	12	14

OVERALL TOTAL CREDITS FOR THE COURSE: 180

22. **SYLLABUS**

B.Sc. (HON'S)(DS&AI) :: DETAILED SYLLABUS FOR ACADEMIC YEAR 2020-21

Code: BH/101	Year: 1	Semester: 1	AECC-1A	Functional English-1	Credits: 3:0:0

Objectives:

1. To introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills that is integral to personal, social and professional interactions.
2. Inculcate abilities needed to students such as: ability to share thoughts, emotions and ideas through various means of communication: both verbal and non-verbal. In the context of rapid globalization and increasing recognition of social and cultural pluralities, the significance of clear and effective communication has substantially enhanced.
3. Fulfil the above state goals through an interactive mode of teaching-learning process and by focusing on various dimensions of communication skills: language of communication, various speaking skills such as personal communication, social interactions and communication in professional situations such as interviews, group discussions and office environments, important reading skills as well as writing skills such as report writing, note-taking etc.
4. While, to an extent, the art of communication is natural to all living beings, in today's world of complexities, it has also acquired some elements of science. It is hoped that after studying this course, students will find a difference in their personal and professional interactions.

SYLLABUS

UNIT-I: Introduction to grammar – What is grammar – Its importance, etc; – Different approaches to grammar: Traditional – Generative – Transformative – Communicative.

UNIT-II: Articles and Determiners – Forms and Functions of Nouns, Pronouns and Prepositions.

UNIT-III: Verbs (Transitive & Intransitive, Regular & Irregular) – Tense & Aspect – Auxiliaries (Primary & Modal) – Negatives – Questions – Agreement and Concord.

UNIT-IV: Forms and Functions of Adjectives, Adverbs, Agreement and Concord.

Text Books and References:

1. *"A Communicative Grammar of English"*, by G Leech and J Svarvik
2. *"Complete Grammar"*, by J H Pandey
3. *"Advanced English Grammar"*, P C Wren and H Martin

Code: BH/102	Year: 1	Semester: 1	AECC-2A	Modern Indian Languages	Credits: 3:0:0

Objectives: To impart working knowledge on multi-lingual ability to students as part of projecting the composite culture of our country envisaged under Article 351 of the Indian Constitution and for strengthening national integration, MIL in **five** Indian languages viz., Kannada, Tamil, Telugu, Malayalam and Hindi are offered. Students can chose any **one** the above five languages for study.

Syllabus

As stipulated by the University of Mysore

Code: BH/103	Year: 1	Semester:1	AECC-3	Constitution of India	Credits: 2:0:0

Objectives: Students will learn the structure of the Constitution of India and its importance.

Syllabus

UNIT-I : Meaning of the term "Constitution"-Its importance-making of the Indian Constitution 1946-49-Dr.Ambedkar's contribution-Preamble-Method of amending the constitution and its limitation-An over view of constitutional developments.

UNIT-II: The democratic institutions created by the Constitution-bicameral system of legislature and cabinet form of government at the Center and States-Role and Position of President and Prime Minister-Adult Franchise System-Election Commission, Panchayat Raj System.

UNIT-III: Fundamental Rights and Duties- Their content and significance-Special, rights created in the constitution for Dalits, Backwards, Women, Children and the Religious and Linguistic Minorities. Enforcing rights through writs: Certiorari, Mandamus, Quo-Warranto and Habeas Corpus-public interest Litigation-Directive Principles of State Policy-The need to balance.

UNIT-IV: Fundamental Rights with Directive Principles - Constitution and sustainable development. Doctrine of Separation of Powers- Legislative, Executive and Judicial and their composition and functioning in India-Features of Indian Federalism-Center State relations. Measures for national Unit- Public Service Commissions.

Text Books and References:

1. *"The Constitution of India- A Politico-Legal Study"* by J.C. Johari
2. *"Constitutional Law of India",* by J.N.Pandey
3. *"The Indian Constitution-Corner Stone of a Nation"* by Granville Austin

Code:BH/104	Year: 1	Semester:1	DSC-1	Basic Mathematics and Calculus for Science	Credits: 5:1:0

Objectives: Learning the basics of mathematics with applications – Equip students to get started with lab applications and hands-on training

Syllabus

UNIT-I: Basics: Functions and Graphs – Basic of Complex Numbers – Differential Calculus (DIF) Limits – Differentiation – Integral Calculus: Integration – Techniques of Integration – Calculus of Logarithmic – Exponential and Inverse Trigonometric Function – Applications of Integration – Techniques of Differentiation – Logarithmic Differentiation – Applications of Differentiation – implicit Differentiation – Basic Partial Derivatives – Functions of more-than-one Variable: Limits – Continuity – Partial Derivatives – Differentiability and Total Differential – Chain Rule

UNIT-II: Lebnitz Theorem – Mean-value Theorem – Rolle's Theorem – Lagrange's Mean-value Theorem – Maxima and Minima – Calculus of Vector-valued Functions: Implicit Function Theorem – Directional Derivatives – Gradients – Double Integrals – Surface Area – Triple Integrals – Line Integrals – Green's Theorem - Surface Integrals – Gauss' Divergence Theorem – Stokes' Theorem

UNIT-III: Differential Equations – General Concepts – Formulation and Solution of Differential Equations – Solution of Higher Order Linear Differential Equations – Partial Differential Equations – Laplace and Inverse Laplace Transforms

UNIT-IV: Theory of Numbers – Prime Numbers – Unique Factorization Theorem – Euclidean Algorithms – Congruencies – Fermat's Theorem – Wilson's Theorem

Text books for reading & reference:-

1. *"Basic Mathematics"*, Marvin L. Bittinger
2. *"Fundamentals of Calculus"*, Robert M. Stark, Carla C. Morris
3. *"Calculus"*, Ron Larson and Bruce Edwards
4. *"Contemporary Abstract Algebra"*, by Joseph Gallian
5. *"Introduction to Algorithms"*, by Thomas H.Cormen, Leiserson and Rivest
6. *"The Princeton Companion to Mathematics"*, by Timothy Gowers
7. *"Fundamentals of Complex Analysis Applications to Engineering & Science"*, Edward Saff, Snider
8. *"Calculus: An Intuitive and Physical Approach"*, Morris Kline
9. *"The Humongous Book of Calculus Problems"*, W. Michael Kelley
10. *"Calculus: Early Transcendental"*, by James Stewart

Code: BH/105	Year: 1	Semester: 1	DSC-2	Basics of Computers	Credits: 5:1:0

Objectives: At the completion of the course students will gain hands-on experience and be conversant with operations of computers

Syllabus

UNIT-I: Evolution of computers: Classes of computers, Communication and networks, Information processing cycle, Computer Hardware and software, Social Effects of Computers. Computer Components: CPU, Memory, Secondary Storage, Input Devices- Keyboard, mouse, Scanner, Touchscreen, Digital Camera, Output devices – Audio output, Visual Display, Communication Devices, Bus.

UNIT-II: System Software – Operating Systems - Personal operating systems, Smart phones, Utility Programs, Device Drivers, Application software – Productivity software, Classes of Software. Ethical issues related to computer software – Ethical issues for software users and software producers. System Unit: Motherboards, Memory, Instructions and Machine cycle, Cache, ROM & other types, Data representation, Adapter cards, Connectors and ports, Video connectors, Networking - Internet, How the web works.

UNIT-III: Number Systems and Boolean Algebra -Introduction to number systems- Numeric and Non-numeric representation of data - Decimal, Binary (Addition, subtraction, Multiplication, division, 1"s and 2"s complement methods), Octal and hexadecimal number systems. Conversion from one number system to another number system. Excess-3-code and Gray code. Conversion between Gray and binary codes. Logic Gates- AND, OR, NOT, and Universal Gates. Combinational Logic Circuit- Half and Full Adder, Half and Full Subtractors.

UNIT-IV: Introduction to Office Automation - Word Processing, Page, Paragraphs formatting, creating tables, inserting special objects in a documents, mail merge. Spreadsheet - Features, Applications and Advantages, the spread sheet screen display, entering different types of data, Functions - Mathematical, Statistical and Date functions, creating and formatting charts. Presentations - Features, Applications and advantages, creating slides and formatting presentations, customized animation, inserting charts and other objects in a presentation.

Text books for study and reference:

1. *"Introduction to Computers"* by Darrell Hajek, Cesar Herrera (2019)
2. *"Computers Made Easy: From Dummy To Geek"* by James Bernstein
3. *"Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog"*, by M. Morris R. Mano, Michael D. Ciletti, 6th Edition (2018)
4. *"Exploring Microsoft Office 2016"* by Mary Anne Poatsy, Robert T. Grauer, et.al, 1 st Edition
5. *"Computer Systems: A Programmer's Perspective"*, by Randal E Bryant
6. *"Computer Architecture: A Quantitative Approach"*, by John L. Hennessy
7. *"Principles of Secure Processor Architecture Design"*, Jakub Szefer
8. *"Fixing Your Computer: Absolute Beginners' Guide"*, Paul McFedries
9. *"Networking Bible"*, by Barrie Sosinsky

Code: BH/106	Year: 1	Semester: 1	DSC-3	Computer Concepts and Programming in C	Credits: 4:0:2

Objectives: To familiarize the students with the basic concepts and to allow them to write programs using standard language infrastructure.

Syllabus

UNIT-I: Programming Concepts and Introduction to C language: System software, Application software. Program Translators – Assembler, Compiler, and Interpreter. Programming languages -Machine Level language, Assembly level language, High level language. Program development life cycle: Problem definition, analysis, Design, Coding, Testing and debugging, Documentation and maintenance . Algorithm-Features, simple examples. Flowchart –Symbols used in a flowchart, suitable examples, Overview of C: Importance of C, basic structure of C program, executing a C program, sample C program, Constants, variables and data types. C character set, C tokens, identifiers, constants, variables, declaration of variables, assigning values to variables. Data type conversion. Operators in C: arithmetic operators, relational operators. Logical operators, assignment operators, increment and decrement operators, conditional operators, bitwise operators, special operators, precedence of arithmetical expression, relational expression, logical expressions.

UNIT-II: Input and output operations: Input and output statements, reading a character: getchar(), writing a character: putchar(), formatted and unformatted i/o statements. Control structures: Branching: if, if-else, nested if, else-if ladder, switch. Looping: while, do-while and for loop. Jump statements, nested loops.

UNIT-III: Arrays, Strings and Functions : Arrays: Introduction, single dimensional array, two-dimensional arrays, initializing 2-d arrays, multidimensional arrays. Operations on arrays: traversal, insertion and deletion. Searching: linear search & binary search. Sorting: bubble sort, selection sort and insertion Sort. Strings : Declaring and initializing string variables, reading string from terminal, writing string to screen, putting strings together. Comparison of two strings, length of a string, copying a string, string operations using library functions & User defined functions. Functions: Introduction, types of functions, need for user-defined functions, function call, types of arguments, nesting of functions, a multi function program, recursion, storage classes.

UNIT-IV: Structures, Unions Pointers and Files Structures : Definition and declaration of a structure, assigning and accessing the members of a structure, structure initialization, structure elements in memory, comparison of structure variables, structure with in the structure, array within structures. unions: Definition and declaration, accessing the members of a union. comparison of structure and union. Pointers : Advantages of pointers, declaration of pointer variable, pointer expressions, pointers and functions: call by value and call by reference, pointers and arrays, array of pointers, pointer to pointer. Files: Definition, types of files. Creating text file. Modes of opening a file, formatted and unformatted i/o operations, random files.

Texts Books and References:

1. "*C Complete Reference*" by Herbert Schildt (4th Edition)
2. "*The C Programming Language*", by Brian W. Vernighan
3. "*ANSI C Programming*" (PHI 2015) by Brain Verminghan & Dennis M. Ritchie
4. "*Programming with C*" by Byron Gottfried (2nd Edition)

Code: BH/107	Year: 1	Semester: 2	AECC-1B	Functional English-2	Credits: 3:0:0

Syllabus

UNIT-I: Introduction to Linguistics and Phonetics – Air-stream Mechanism – Organs of Speech Mechanism – Classification and description of speech sounds in English a. Vowels and Diphthongs b. Consonants – Elementary Phonetic Symbols in Transcription

UNIT-II: Verbs: linking verbs, auxiliaries, transitive ad-intransitive verbs, negative verbs and infinitives – Tenses, concord, adverbs, confusion of adjectives and adverbs, Degrees of Comparison

UNIT-III: Introduction to the Language of Communication: Theory of Communication, types and modes of Communication; Verbal and Non-verbal (Spoken and Written), Personal, Social and Business, Barriers and Strategies, Intra-personal, Inter-personal and Group communication

UNIT-IV: Speaking Skills: Monologue, Dialogue, Group Discussion, Effective Communication, Interview, Public Speech – Reading and Understanding: Close Reading, Comprehension, Summary, Paraphrasing, Analysis and Interpretation – Writing Skills: Documenting, Report Writing, Making notes, Letter writing, E-mail

Text books for reading & reference:-

1. *"Unlock: Reading and Writing Skills",* BY Sabina Ostrowska
2. *"Soft Skills and Professional Communication",* by Francis Peter SJ
3. *"Basic Communication Skills",* by P Kiranmai Dutt and Geetha Rajeevan
4. *"Language in Use: Students' Self-study Workbooks",* by Adrrian Doff & Christopher Jones
5. *"Oxford Word Skills",* by Ruth Gairns and Stuart Redman
6. *"English Vocabulary in Use: Advanced",* by Michael McCarthy and Felicity O'Dell

Code: BH/108	Year: 1	Semester: 2	AECC-2B	Modern Indian Languages-2	Credits: 3:0:0

SYLLABUS

As stipulated by the University of Mysore

Code: BH/109	Year: 1	Semester: 2	AECC-4	Environmental Science	Credits:2:0:0

Objectives: To impart to students a working knowledge of environmental science since sustainable development is a key to the future of mankind.

Syllabus

UNIT-I: Introduction - Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles – Ecosystems Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids: introduction, types, characteristic features – Structure and function of the following ecosystem :- a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystemd. D. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT-II: Biodiversity and its conservation: Introduction – Definition : genetic, species and ecosystem diversity – Biogeographical classification of India – Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

UNIT-III: Environmental Pollution: Definition – Causes, effects and control measures of :- a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e.Noise pollution f. Thermal pollution g. Nuclear hazards – Solid waste Management : Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management : floods, earthquake, cyclone and landslides – Social Issues and the Environment – From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management Resettlement and rehabilitation of people : its problems and concerns – Case studies.

UNIT-IV: Environmental ethics : issues and possible solutions; – Climate change - Global warming – Acid rain – Ozone layer depiction – Nuclear accidents and holocaust – Case studies – Wasteland reclamation – Consumerism and waste products – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness – Human Population and the Environment – Population growth, variation among nations – Population explosion – Family Welfare Programme – Environment and human health – Human Rights – Value Education – HIV / AIDS – COVID-19 – Women and Child Welfare – Role of Information Technology in Environment and Human Health – Case Studies – Field Work: Visit to a local area hill (Chamundi Hill) and a lake.

Texts Books and References:

1. *"Environmental Science: A Global Concern",* by William Cunningham
2. *"Environmental Science and Engineering",* by N Arumugam and V. Kumaresan
3. *"Environmental Science",* by G Tyler Miller and Scott E Spoolman

Code: BH/110	Year: 1	Semester: 2	DSC-4	Discrete Mathematics	Credits: 5:1:0

Objectives: To introduce students to most of the basic terminologies used in computer science courses; to familiarize the applications of algebraic structures; to make them understand the concepts and significance of lattices and Boolean algebra

Syllabus

UNIT-I: Introduction: Sets and subsets – Operation on sets – Sequences – Division in the integers – Matrices – Mathematical structure – Logic: Proposition and logical operation – Conditional Statement – Methods of proof – Mathematical induction – Mathematical Logic - Statement and notation – Connectivity – Normal Forms - Theory of Inference – Statement calculus – Predicate calculus – Inference theory of the predicate calculus - Counting: Introduction - Permutation, combinations – Pigeon-hole principle – Recurrence relations and digraphs – Product sets and partitions, relations and Digraphs – Paths in relations and digraphs – Properties of relations – Equivalence relations - Computer representation of relations and Digraphs – Manipulation of relations – Transitive closure and Warshall's algorithm – Functions: introduction – Function for computer science – Permutation functions – Growth of functions

UNIT-II: Graph Theory: Basic concepts – Euler paths and Circuits – Hamiltonian paths and circuits – Relation and structure – Partially Ordered Sets – Lattices – Finite Boolean Algebras – Functions of

Boolean algebras – Boolean function as Boolean Polynomials Tress – Undirected trees – Minimal spanning Trees – Semi-Groups and Groups: Binary Operations – Semi-groups, products and quotients of Semi-groups and Groups – Products and quotients of groups – Compatibility Theory – Languages – Finite state Machines – Semi-groups. Machines and languages - Analytical Geometry – Coordinates – Distance Formula – Section Formula – Area of a triangle Formula – Locus of Point – Straight Line: Slope and angles – Equations of Lines – Derivation – Point of intersection – Boolean Algebra: Introduction - Various Boolean Identities Join-irreducible elements – Atoms and Minterms – Boolean Forms and their Equivalence – Minterm Boolean Forms – Canonical Forms – Minimization of Boolean Functions – Applications to Switching Theory – The Karnaugh Map method.

UNIT-III: Graph Theory – Definition of Graphs, Paths, Circuits, Cycles and Subgroups – Induced Sub-graphs – Degree of a vertex – Connectivity – Planar Graphs and their properties – Trees – Duler's Formula for connected Planar Graphs – Bipartite Graphs – Kurtowski's Theorem and its use – Spanning Trees - Cut-sets – Fundamental Cut-sets and Cycles – Minimal Spanning Trees and Kruskal's Algorithm – Matrix Representations of Graphs – Euler's Theorem on the Existence of Eulerian Paths and Circuits – Directed Graphs – Indegree and Outdegree of a Vertex – Weighted undirected Graphs – Dijkstra's Algorithm – Strong Connectivity – Warshall's Algorithm – Directed Trees – Search Trees – Tree Traversals.

UNIT-IV: Computability Theory: Introduction - Finite state machines and their transition table diagrams – Equivalence of finite state machines – Reduced Machines – Homomorphism – Finite automata – Acceptors – Non-deterministic finite automata – Deterministic Finite Automata – Moore and Mealy Machines – Grammar and Languages — Phrase Structure Grammars – Rewriting Rules – Derivations Sentential Forms – Generation of Language – Context Sensitive Grammar and Languages – Regular sets – Regular Expressions – Pumping Lemma, Kleene's Theorem – Notions of Syntax Analysis – Polish Notations – Conversion of Infix Expressions to Polish Notations – Reverse Polish Notation.

Text books for reading & reference:-

1. *"Discrete Mathematics and its Applications"*, Kenneth Rosen
2. *"Introductory Discrete Mathematics"*, V.K.Balakrishnan
3. *"A Beginner's Guide to Discrete Mathematics"*, W.D.Wallis
4. *"Discrete Mathematics with Applications"*, Susanna S. Epp
5. *"Discrete Mathematics for Computer Science"*, David Liben-Nowell

Code: BH/111	Year: 1	Semester: 2	DSC-5	Operating Systems & System Software	Credits: 5:1:0

Objectives: To understand the concepts, core structure, functions and design principles of the domain subject.

Syllabus

UNIT -I: Introduction - What is Operating System, History, Computer Hardware Review, Operating System Zoo, Operating System Concepts, System Calls, Operating System Structure. Processes and Threads: Processes, Threads, Inter-process Communication, Scheduling, Classical IPC Problems Memory Management: No Memory Abstraction, Memory Abstraction, Virtual Memory, Page replacement Algorithms, Design Issues for Paging System, Implementation, Segmentation.

UNIT – II: Files Systems: Files, Directories, File-System Implementation, File-System Management & Optimization, Examples Input/output: Principles of I/O Hardware, Software, I/O Software Layers, Disks, Clocks, User Interfaces, Thin Clients, Power Management. Deadlocks: Introduction, Ostrich Algorithm, Deadlock Detection, Recovery and Avoidance, Prevention

UNIT III: Virtualization and Cloud: Requirements, Types, Techniques, Memory Virtualization, I/O Virtualization, Virtual Appliances, VMs on Multicore CPU, Clouds. Multiple Processor Systems: Multi-Processors, Multi-Computers, Distributed Systems.

UNIT IV: Security: Security Environment, OS Security, Controlling access to resources, Formal Models of Security systems, Cryptography basics, Authentication, Exploiting Software, Attacks, Malware, Defences. Introduction to Android Programming, setting up development Environment, Discovering Kernel, HAL and virtual Hardware, Customizing Android Emulator, Enabling ARM translator and Native bridge

Text books for reading & reference:-

1. *"Modern Operating System"* by Andrew S. Tanenbaum (2015)
2. *"Android System Programming"* by Roger Ye
3. *"Operating System: Three Easy Pieces"* by Andrea C. Arpaci-Dusseau and Remzi H. Arpaci Dusseau (2015)

Code: BH/112	Year: 1	Semester: 2	DSC-6	Data Structures & Algorithms	Credits: 4:0:2

Objectives: To introduce students to data structures and how they are implemented in different programming languages. Students will also learn typical usages through case studies.

Syllabus

UNIT-I: Introduction: – Definitions - Concept Data Structure –Example –Need of Data structure, Advantages of using DS Algorithm & Pseudocode: –Algorithm Definition – Characteristics of algorithm – Elements of algorithm –Pseudocode example –Difference of Algorithm & Pseudocode Function: –What is function –Types of function –How function works –Function recursion and how it works – Array: –Concept of Array –Types of array – Basic Programs –Array with Functions –Single & Two-dimensional array in function argument. Pointer: –Pointer Basics –Pointer with functions –Call by reference –Array of pointers & pointer to array & Programs Structure: –Understanding about Structure –Pointer structure variable – Structure as function argument –using call by member value – hole structure and call by–passing reference of structure. Stack: –Operations on Stack –Array & Linked Representation –Programs on stack – Push & Pop operations –Traversing.

UNIT-II: Applications of Stack: –Arithmetic Expression Evaluation –Notations, Infix – Postfix, Prefix – Conversion infix to post fix –Conversion postfix to infix –Evaluation of Postfix and Prefix using stack. Queue: –Operations on Queue –Array & Linked Representation –Programs on stack –Insert & Delete operations –Circular queue –representation –Deque – Priority Queue –Application of queue – Case Studies

UNIT-III: Linked List: –Concept of linked list –Difference of linked list & array –Single linked list – Representation –Operations –Traversing –Insertion(first node, last node, at a position, after a node value) –Deletion(first node, last node, at a position, after a node value) –Double linked list –Representation – Operations, traversing –Insertion (first node, last node, at a position, after a node value) –Deletion (first node, last node, at a position, after a node value) –Circular link list & header link list example Tree: –Tree terminology –Binary tree –Complete Binary Tree–Binary search tree –Tree Traversals –Creation of Binary Tree from traversal methods –Expression Tree & expression Manipulation –Binary Search Tree –Insertion & deletion in BST(Program).

UNIT-IV: Graph: –Graph terminology –Representation of graphs –Path matrix –Graph Traversal –BFS (breadth first search) –DFS (depth first search) –Minimum spanning Tree – Kruskal's Algorithm & Prim's Algorithm –Warshall's algorithm (shortest path algorithm). Hashing & Searching: –Linear and binary search methods –Hash functions –Hashing techniques & Chaining. Sorting: –Bubble sort –Selection sort – Insertion sort –Quick sort – Merge sort –Heap sort –Radix sort

Text books for study and reference:

1. *"Data Structures and Algorithms Using C#"* by Michael McMillan (2007)
2. *"Introduction to Algorithms"* by Thomas H Cormen, Charles E Leiserson (2nd Edition)
3. *"Data Structures and Algorithms made easy"*, by Narasimha Kanumanchi

Code: BH/113	Year: 2	Semester: 3	AECC-1C	Functional English-3	Credits: 3:0:0

Syllabus

UNIT-I : Pronunciation : phonemic symbols – consonants – vowels – syllables – word stress – strong and weak forms – intonation – principles of grammar – verbs and nouns – use of thesaurus – Listening skills: Difference between listening and hearing – active listening – barriers – academic listening – listening for details – simultaneous notes taking – listening for sound contents of videos – descriptions – meanings – announcements – news programs.

UNIT-II: Phonology – Received Pronunciation (RP) – General Indian English (GIE) – Syllable and Syllable Structure – Word Accent – Accent and Rhythm in Connected Speech – Intonation – Assimilation and Elision

UNIT-III: Speaking skills – nature of communication – importance of context – formal and informal – expressions in different situations – greeting and introduction – request making – seeking and granting permissions – instructions and directions – agreements and advices – telephonic skills – conversational etiquette.

UNIT-IV: Voice – Direct and Indirect Speech – Sentence Connectors – Guided Paragraph Writing – Dialogue practices – Practice in exhibition of elegances and eloquence – Classroom workshop

Text books for reading & reference:-

1. *"English in Use"*, by T Vijay Kumar, K Durga Bhavani and Y L Srinivas
2. *"Longman Grammar of Spoken and Written English"*, by Douglas Biber
3. *"Practice Makes Perfect Basic English"*, by Julie Lachance
4. *"Word Power Made Easy"*, by Norman Lewis
5. *"English Words and Sentences"*, by Eva Duran Eppler and Gabriel Ozon

Code: BH/114	Year: 2	Semester: 3	AECC-2C	Modern Indian Languages-3	Credits: 3:0:0

Syllabus

As stipulated by the University of Mysore

Code: BH/115	Year: 2	Semester: 3	DSC-7	Linear Algebra	Credits: 5:1:0

Objectives: To familiarize the students with basic concepts of domain subject and its applications.

Syllabus

UNIT – I: Fields, vector spates, subspaces; linear dependence and independence; basis and dimension of a vector space, finite dimensional vector spaces completion theorem. Examples of vector spaces over real and complex fields. Linear equations. Vector spaces with an inner product, Gram-Schmidt orthogonalization process. Orthonormal basis and orthogonal projection of a vector.

UNIT – II: Linear transformations, algebra of matrices, row, and column spaces of a matrix. Elementary matrices, determinants, rank, and inverse of a matrix. null space and nullity; partitioned matrices; Kronecker

product. Hermite canonical form, generalized inverse, MoorePenrose Inverse, Idempotent matrices. Solutions of matrix equations.

UNIT – III: Triangular reduction of a positive definite matrix. Characteristic roots and vectors, Cayley Hamilton theorem, minimal polynomial, similar matrices. Algebraic and geometric multiplicity of characteristic roots, spectral decomposition of a real symmetric matrix, reduction of a pair of real symmetric matrices, Hermitian matrices.

UNIT – IV: Real quadratic forms, reduction and classification of quadratic forms, index and signature. Singular values and singular decomposition, Jordan decomposition, extrema of quadratic forms. Vector and matrix differentiation.

Text books for reading & reference:-

1. "*Linear Algebra and its Applications*", by Gilbert Strang, 5th Edition (2016) Schaum Series
2. "*Elementary Linear Algebra*", by S.F. Andrilli, D. Hecker, 5th Edition, Associated Press (2016)
3. "*Contents of Linear Algebra: Pure and Applied*", by Edgar Goodaire
4. "*Linear Algebra and its Applications*", by David C. Lay, Steven R. Lay and Judi J.

Code: BH/116	Year: 2	Semester: 3	DSC-8	Introduction to Big Data & Tools	Credits: 5:1:0

Objectives: To understand basic concepts, principles and approaches to description of the Big Data landscape and get acquainted with the architectural components and programming models for scalable data analysis. To impart knowledge to students on understanding and analyzing Big Data, that is a fast changing technology, by hands-on experience on analytics, mobile, social and security issues. They get an insight into tools, algorithms and platforms to be employed in real world applications.

Syllabus

UNIT-I: Introduction - Big data: definition and taxonomy - Big data value for the enterprise - Setting up the demo environment - First steps with the Hadoop "ecosystem" – Classroom exercises - The Hadoop ecosystem - Introduction to Hadoop - Hadoop components: MapReduce/Pig /Hive/ HBase - Loading data into Hadoop - Handling files in Hadoop - Getting data from Hadoop – Classroom exercises

UNIT-II: Querying big data with Hive - Introduction to the SQL Language - From SQL to HiveQL Exercises 4 Querying big data with Hive - Introduction to HIVE e HIVEQL - Using Hive to query Hadoop files – Classroom exercisesBig data & Machine learning - Quick into to Machine learning - Big Data & Machine Learning - Machine learning tools - Spark & SparkML - H2O - Azure ML – Big data & Machine learning - Next steps in the big data world – Classroom exercises - A case study

UNIT-III: Big Data Tools: Introduction to Big Data and Hadoop - Big Data Analytics – Hadoop – Apache Hadoop – Analysing Data with Unix tools – Analysing Data with Hadoop – Hadoop Streaming – Hadoop Echo System – IBM Big Data Strategy – IBM Infosphere BigInsights and Big Sheets – HDFS (Hadoop Distributed File System): Design of HDFS – HDFS Concepts – Command Line Interface – Hadoop file system interfaces – Data flow – Data Ingest with Flume and Scoop and Hadoop archives – Class Demos – Hadoop I/O: Compression – Serialization, Avro and File-Based Data structures – Map Reduce: Introduction to anatomy of a Map Reduce Job Run – Failures, Job Scheduling, Shuffle and Sort – Task Execution – Map Reduce Types and Formats – Map Reduce Features – Class Demos

UNIT-IV: Hadoop Eco System PIG : Introduction – Execution Modes of Pig – Comparison of Pig with databases – Grunt – Pig Latin – User Defined Functions – Data Processing operators – Hive : Hive Shell – Hive Services – Hive Metastore – Comparison with Traditional Databases – HiveQL – Tables – Querying Data and User Defined Functions – Hbase : HBasics – Concepts – Clients – Examples – Hbase Versus RDBMS – Big SQL : Introduction –

Data Analytics with R Machine Learning : Introduction – Supervised Learning – Unsupervised Learning – Collaborative Filtering – Big Data Analytics with BigR – Intro to Oozie – Intro to NoSQL Data Management – Case Studies

Text books for reading & reference:-

1. *"Big Data for Beginners"*, by Vince Reynolds
2. *"Big Data Analytics"*, Radha Shankaramani and M.Vijayalakshmi
3. *"Big Data at Work"*, T.H.Davenport
4. *"The Data Revolution: Big Data, Open Data, Data Infrastructures & Consequences"*, Rob Kitchin
5. *"Big Data: Principles and Best Practices"*, by Nathan Marz and James Warren
6. *"Analytics in a Big Data World"*, by Bart Baesens
7. *"Data Science and Big Data Analytics"*, by EMC Education Services
8. *"Big Data: A Revolution that will transform"*, by Viktor Mayer and Kenneth Cukier
9. *"From Big Data to Big Profits: Success with Data and Analytics"*, Russel Walker

Code: BH/117	Year: 2	Semester: 3	DSC-9	Introduction to Python Programming	Credits: 4:0:2

Objective: To introduce students to the programming language and enhance their technical abilities.

Syllabus

UNIT – I: Introduction: What is Python, What is python good for?, What isn't Python good for?, Python Fundamentals: Executing Python program, Script, program or Module. Components of Python Program: Built-in object types, Statements

UNIT – II: Functions: Definition and Execution, Scoping, Arguments, Return Values, Advanced function calling. Modules: Importing modules, Tricks for importing modules, Packages, Creating a module, Python's built-in functions

UNIT – III: Object Orientation: Creating a Class, Exception and Error Trapping: Exception and occurring, Exception Handling, Built-In Exceptions, Rolling your own Exceptions

UNIT – IV: Interfacing to the OS: Working with System, OS, Multithreading. Processing Information: Manipulating numbers and text, Time, Data types and operators. Working with Files: File processing, controlling file I/O, getting file lists, File/Directory management, Access, and ownership, manipulating file paths. Data Management and storage: Managing internal structures, Object Persistence.

Text books for reading & reference:-

1. "*The Complete Reference Python*" by Martin C. Brown (2018)
2. "*Head First Python: A Brain-friendly Guide*", Paul Barry
3. "*Python Automation Cookbook*", Jaime Buelta
4. "*Learn Python The Hard Way*", Zed A Shaw
5. "*Python Crash Course: Hands-on, Project-based Introduction to Programming*", Eric Matthes

Code: BH/118	Year: 2	Semester: 4	AECC-1D	Functional English-4	Credits: 3:0:0

Syllabus

UNIT-I: Interactions in Meetings face-to-face: Opening Greetings – Reply to Greetings – Introduction: Self and others – Welcoming – Bidding farewell – Interview appearance: Maintain Gaiety – Self Introduction – Present oneself; Interaction via phone: Etiquette to maintain during conversation – Taking Messages – Making Enquiries – Seeking/Giving Information – Notes Making

UNIT-II: Address Gatherings: Etiquette to maintain – Public Address – Presentation: Preparation Needed – Techniques: Answering Queries – Offering Opinions – Persuading the audience –Offering Opinions – Presenting Arguments – Promoting Products/Services; Voice Delivery: Modulation – Problems of Voice Quality and Delivery – Categories of Sounds – Accent to maintain – Types of Audience in Mass Communication – Feedback: Nature – Importance – Market-based and Research-based Feedback.

UNIT-III: Conversational Skills: Introduction – Definition – Types of Communication – Barriers; – Interview: Purpose – Homework needed – Writing Questions for Interview – Conducting / Facing an interview – Gait, Dress Sense, Grace and Demeanour – Nuances.

UNIT-IV: Group Discussion Techniques; – Anchoring: Theory behind – Modes of Anchoring; – Class presentations – Power-point Presentations – Webinars Participation

Text books for reading & reference:-

1. *"Communication Skills"*, by M Raman and S Sharma
2. *"Mass Communication in India"*, by K J Kumar
3. *"Media In Development Arena"*, R K Ravindran
4. *"Improve Your Communication Skills"*, by Barker and Alan
5. *"Essential Speaking Skills"*, by Baker, Joanna and Hearher
6. *"Speaking"*, by Bygate Martin

Code:BH/119	Year: 2	Semester: 4	AECC-2D	Modern Indian Languages-4	Credits: 3:0:0

Syllabus

As stipulated by the University of Mysore

Code: BH/120	Year: 3	Semester: 4	DSC-10	Probabilities and Statistics	Credits: 5:1:0

Objectives: To familiarize the students with basic concepts of domain subject and its applications.

Syllabus

UNIT – I: Sample Spaces - events - probability axioms - conditional probability - independent events - Baye's formula. Random Variables: Discrete, Continuous and Joint probability Distribution, Expectation, Functions of Random Variables.

UNIT – II: Discrete Probability distributions: Binomial and Multinomial, Hypergeometric Distribution, Poisson Distribution. Continuous Probability Distributions - Binomial, uniform, normal, gamma & exponential, beta, chi-squared distributions.

UNIT – III: Random sampling, statistics, Sampling Distributions, Sampling Distribution of Means and the Central Limit Theorem, Sampling Distribution of S2, t-Distribution, FDistribution, Statistical Hypotheses: General Concepts, Testing a Statistical Hypothesis, PValues for Decision Making in Testing Hypotheses, Single and Two Sample tests concerning mean and variance

UNIT – IV: Correlation - Regression - The Simple Linear Regression Model, Least Squares and the Fitted Model, Properties of the Least Squares Estimators, Inferences Concerning the Regression Coefficients, Prediction, Choice of a Regression Model, Analysis-of-Variance Approach, Test for Linearity of Regression, Correlation.

Text books for reading & reference:-

1. *"Probability & Statistics for Engineers & Scientists"* by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers
2. *"Probability and Statistics - Schaum's Outline+"* 4th Edition by John Schiller, R. Alu Srinivasan, Murray Spiegel

3. *"Probability, Statistics and Random Processes"*, by A L Garcia
4. *"Intuitive Probability and Random Processes using MATLAB"*, by S M Kay

Code: BH/121	Year: 2	Semester: 4	DSC-11	Big Data Analytics & Visualization	Credits: 5:1:0

Objectives: To understand the Big Data Platform and its applications; to identify business applications.

Syllabus

UNIT-I: HDFS (Hadoop Distributed File System) – Design of HDFS – Concepts – Command-line Interface – Data Ingest – Map Reduce: Map Reduce Job Run – Failures – Job Scheduling – Shuffle and Sort – Task Execution – Map Reduce Types and Formats – Map Reduce Features – Hadoop Eco System Pig: Modes of Pig – Comparison of Pig with Databases – Grunt – Pig Latin – User Defined Functions – Data Processing operators – Introduction to BigSQL – Data Analytics with R Machine Learning: Introduction – Supervised Learning – Unsupervised Learning – Collaborative Filtering – Big Data Analytics with BigR.

UNIT-II: Applications on Big Data using Pig and Hive: Introduction – Data processing in Pig – Hive Services – HiveQL – Predictive Analytics – Simple Linear Regression – Multi-Linear Regression – Regression Coefficients – Visual Data Analysis – Interaction techniques – Systems and applications – NoSQL Databases: Schema-less Models – Flexibility for Data Manipulation – Key Value Stores – Document Stores – Tabular Stores – Object Data Stores– Graph Databases Hive– Sharding- Hbase – Analyzing big data with twitter – Big data for E-Commerce Big data for blogs – Review of Basic Data Analytic Methods using R – Marketing Process: Introduction – Strategic Challenge – Strategy with Data – Text Analytics – Improving marketing strategy with data and analytics – Brand Assets – Snapple and Brand Value – Brand Personality – Developing Brand Architecture – Brand Pyramid – Measurement of Brand Values – Revenue Premium – Calculation of Brand Value – Case Studies

UNIT-III: Customer Life-time Value (CLV): Introduction – Methodology for CLV – CLV Formula and its application and its extension – Decisions based on CLV – Case Studies – Marketing Experiments: Spreadsheet with formulas – Cause and Effects Study – Designing experiments – Analyzing experiments – Projecting Lift and its calculation – Pitfalls in experiments – Measures for maximizing effectiveness – Case Studies - Regression Analysis: Basics – Regression Properties – Multivariable Regressions – Bias – Price Elasticity – Log-Log – Marketing Mix Models – Analytic in different fields: HR Analytics – Web Analytics – Healthcare Data Analytics – Financial Risk Analytics – Next Generation of Databases

UNIT-IV: Data Visualization: Introduction – Types – Visual Encoding – Bar Chart – Pie Chart – Line Chart – Multiple Chart – Highlight Tables – Scatter Plot – Heat-Map – Geographic Mapping – Gnatt Chart – Circle View – Tableau – Data Import – Data Extraction – Relationship to Data Management – Pivot – Hierarchy – Decision Analytic Thinking: Introduction – Expected Value Framework – Structuring business problems – Fitting a Model: Introduction – Characteristics of a good model – Evaluation Process – Plain Accuracy – Confusion Matrix – Unbalanced Classes – Frame Classifier Evaluation – Performance – Data Visualization using Tableaus – Classroom Exercises

Text books for reading & reference:-

1. *"Business Analytics: The Science of Data-Driven Decision Making"*, U. Dinesh Kumar
2. *"Too Big to Ignore: The Business Case for Big Data"*, Phil Simon
3. *"The Data Revolution: Big Data, Data Infrastructures and consequences"*, Rob Kitchin
4. *"Big Data at Work"*, T. H. Davenport
5. *"Analytics in A Big Data World"*, Bart Baesens
6. *"Big Data and Analytics"*, Seema Acharya and Subhashini Chellappan

Code: BH/122	Year: 2	Semester: 4	DSC-12	Database Management Systems	Credits: 4:0:2

Objectives: To impart in-depth knowledge on Structured Query Language, bring capability to build database and write database triggers, cursors and index.

Syllabus

UNIT – I: Introduction to Database System Concepts and Architecture Databases and Database Users, Characteristics of the Database Approach, Actors on the Scene, Advantages of Using a DBMS Data Models, Schemas and Instances, DBMS Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment Data Modelling Using the Entity-Relationship Model Entity Types, Entity Sets, Attributes, and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types, ER Diagrams, Naming Conventions and Design Aspects

UNIT – II: Transaction- Transaction Concepts, States, ACID properties, Concurrent executions, Serializability Relational Data Model, Relational Constraints, and Relational Algebra Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Basic Relational Algebra Operations, Additional Relational Operations, Examples of Queries in Relational Algebra. Normalization- Functional Dependencies, Transitive and Multivalued dependency, First Normal form, Second Normal Form, Third Normal Form and Boyce Codd Normal Form

UNIT – III: Advantages of RDBMS- Codd's Rules. SQL-The Relational Database Standard Data Definition, SQL Data Types and Schemas, Constraints, Basic Queries in SQL, Insert, Delete, and Update Statements in SQL, Set Operations, Aggregate functions, Views (Virtual Tables) in SQL, Joins – Inner, Outer and Self, Additional Features of SQL,DCL-commit, Rollback, Save-point, Grant privileges.

UNIT – IV: Storage Strategies – Indices, B-Trees, Hashing. Transaction Processing, Transaction and System Concepts, Properties of Transactions Locking Techniques for Concurrency Control, Timestamp based schedules, Database Recovery Techniques Introduction – Object-Oriented and Object Relational Databases, Logical Database, Web Databases, Distributed Databases, Data Warehouse and Data Mining

Text books for reading & reference:-

1. "*Principles of Database Management*" by Wilfried Lemahieu, Seppe vanden Broucke, Bart Baesens (2018).
2. "*SQL: The Complete Reference*", Groff and James (3rd Edition)

Code: BH/123	Year: 3	Semester: 5	DSC-13	Foundations of Artificial Intelligence and Machine Learning	Credits: 5:1:0

Objectives: To introduce to students AI and ML concepts and gain application of the principles in real-world scenario.

Syllabus

UNIT -I: Introduction to AI: What is AI, Foundations of AI, History of AI, State of the Art Intelligent Agents: Agents and Environment, Good Behaviour, Nature of Environments, The structure of agents. Logical Agents, First order logic, Inference in First order logic.

UNIT – II: Introduction to ML: Machine Perception, Pattern Recognition systems, Design Cycle, Learning and Adaptation. Bayesian Decision Theory: Minimum error rate classification, Classifiers, Discriminant functions & Decision surfaces, Discriminant functions for Normal Density, Maximum-Likelihood estimation, Bayesian Estimation – Gaussian Case, PCA, Fisher Discriminant Analysis. Expectation Maximization

UNIT- III: K-Nearest Neighbor Estimation and Rule, Metrics and Nearest Neighbor Classification, Support Vector Machines - linear SVM, Slack variables, nonlinear SVMs, Kernel trick, multi-class SVMs.

UNIT –IV: Hidden Markov Models – First order HMM, Evaluation, Decoding & Learning, Discrete HMMs and Continuous HMMs, Combining Classifiers: boosting.

Text books for reading & reference:-

1. *"Pattern Classification"* by Richard O Duda, Hart, Start (2nd Edition)
2. *"Artificial Intelligence: A Modern Approach"* by Stuart Russell, Peter Norvig (4th Edition)
3. *"Pattern Recognition"* by Sergios Theodoridis, Konstantinos Koutroumbas (4th Edition)
4. *"Machine Learning using Python"* by U Dinesh Kumar Manaranjan Pradhan (2019)

Code: BH/124	Year: 3	Semester: 5	DSC-14	Introduction to Neural Networks	Credits: 4:0:2

Objectives: To introduce the students basic neuron models, network models, basic learning algorithms and applications.

Syllabus

UNIT – I: Introduction: What is Neural Network, Human Brain, Models of Neuron, Neural Networks Viewed as Directed Graphs, Feedback, Network Architecture, Knowledge Representation, Learning processes and tasks.

UNIT – II: Filtering Structure of the LMS Algorithm, Perceptron and its Convergence theorem, The Batch Perceptron Algorithm, The Least-Mean-Square Algorithm, Virtues and Limitations of the LMS Algorithm

UNIT – III: Multilayer Perceptron: Preliminaries, Batch Learning and On-Line Learning, The Back-Propagation Algorithm, XOR Problem, Back Propagation and Differentiation, The Hessian and Its Role in On-Line Learning, Optimal Annealing and Adaptive Control of the Learning Rate, Generalization, Approximations of Functions, Cross-Validation, Complexity Regularization and Network Pruning, Virtues and Limitations of Back-Propagation Learning.

UNIT – IV: Radial-Basis-Function Networks, Boltzmann Machine. Two Basic Feature Mapping Models, Self-Organizing Map, Properties of the Feature Map

Text books for reading & reference:-

1. "*Neural Networks and Learning Machines*" by Simon Haykin (3rd Edition)
2. "*Neural Networks – A Visual Introduction for Beginners*" by Michael Taylor (2017)
3. "*Neural Network Design*" by Martin T. Hagan, Howard B. Demuth, Mark Hudson Beale, Orlando De Jesús

Code: BH/125	Year: 3	Semester:5	DSC-15	Big Data Management	Credits: 4:0:2

Objectives: Through this advanced level course students will get imbibed with real-world cutting-edge data management technologies that help them acquire the skills to handle vast amounts of complex data in practice. The students will also be exposed to nuances for presenting research papers in the field.

Syllabus

UNIT-I: Advanced topics in Big Data Management – Distributed and Parallel Data Management Framework - Data Management in Cloud – Programming Models and Declarative languages – Managing high velocity data

streams - Distributed data management: Using Specialized Processors – Big Data Cleaning – Data Science in the current Century – Application of Big Data Management principles in real-world.

UNIT-II: Big Data Tools: SAS: Introduction – Cloud-source Proprietary software – Statistical modelling – Statistical Libraries – Usages – Apache Spark: Introduction – Batch Processing and Stream Processing – Comparison with MapReduce – Spark for real-time data – Conjunction with Scala – Speed in Spark

UNIT-III: BigML: Introduction – Processing ML Algorithms – Usages in Forecasting, Risk Analytics and Product Innovation – Rest APIs – Visual Charts on IoT devices – D3.js: Introduction to Java-script Library – Animated transitions – Combination with CSS – MATLAB: Introduction – Processing mathematical information – Usage in scientific disciplines – Neural Networks – Fuzzy Logic – Limitations – MS Excel: Introduction – Connecting with SQL – Analyzing data – Usages - ggplot2: Introduction – tidyverse – Library for creating & customizing visualizations – Styles of Maps (choropleths, cartgrams, hexbins, etc) – Tableau: Introduction – Usages – Interface with databases, spreadsheets, Online Analytical Processing, etc – Plotting in maps – Jupyter: Introduction – Applications – Julia, Python and R – Jupyter Notebooks – Collaboratory – Google Drive

UNIT-IV: Matplotlib: Introduction – Pyplot – Data Visualization with Python – Natural Language Tool Kit (NLTK): Introduction – Collection of libraries in Python – SciKit Learn: introduction – Supporting features – Usages – TensorFlow: Introduction – Multidimensional arrays – Processing advanced ML Algorithms – WEKA: Introduction – GUI Software – Usages – Pandas: Applications – Usages – NumPy: Applications – Usages – Plotly: Introduction – Applications – Visualization of data – Usages

Text books for reading & reference:-

1. *"Big Data: Techniques and Technologies in Geo-informatics"*, Hassan A. Kanmi
2. *"Designing Data-intensive Applications: The Big Ideas"*, Martin Kleppmann
3. *"Practical Statistics for Data Scientists"*, Peter Bruce and Andrew Bruce
4. *"Python for Data Analysis"*, Wes McKinney
5. *"Python Machine Learning by Example"*, Yuxi Liu (Kindle version)
6. *"Inflection Point: How the Convergence of Cloud, Mobility, Apps and Data Will Shape the Future of Business"*, Scott Stawski
7. *"The Big Data Handbook: Advice and Insights"*, Carl Shan and William Chen

Code: BH/126	Year: 3	Semester: 5	DSE-1	Software Engineering	Credits: 5:1:0

Objectives: At the end of this course, the students will be able to:

- Appreciate the importance of having a process for software development;
- Understand the various activities undertaken for a software development project following the Function Oriented Design & Object Oriented Design;
- Understand the issues in code design and development;
- Test software developed using SSAD and OOAD methodologies
- Have in depth knowledge about the different OOAD Themes and compare them with SSAD.

Syllabus

UNIT-I : SOFTWARE PROCESS: Introduction –S/W Engineering Paradigm – life cycle models (water fall, incremental, spiral, prototyping, object oriented) - system engineering – computer based system – verification – validation – life cycle process – development process –system engineering hierarchy.

UNIT-II: SOFTWARE REQUIREMENTS: Role of Management in Software Development, Role of Metrics and Measurement, Problem Analysis, Requirement Specification, Validation, Metrics, Monitoring and Control. Software Prototyping – Prototyping in the software process – Rapid prototyping techniques – User interface prototyping -S/W document. Analysis and modelling – data, functional and behavioural models – structured analysis and data dictionary.

UNIT-III: DESIGN CONCEPTS AND CODING: System Design, Problem Partitioning, Abstraction, Top-down and bottom-up Design, Structured Approach, Functional v/s Object-Oriented Approach, Design specification & verification, metrics. Coding: Top-down & Bottom-up, Structured Programming, Information Hiding, Programming Style, Internal Documentation, Verification, Metrics, monitoring &control

UNIT-IV: TESTING AND PROJECT MANAGEMENT: Taxonomy of software testing – levels – test activities – types of s/w test – black box testing – testing boundary conditions- Functional Testing, – structural Testing, Levels of Testing-Structural Testing, Test Plan, Test Cases Specification, Reliability assessment. Testing – integration tests – validation testing – system testing and debugging. Software Project Management, Cost Estimation, Project Scheduling, Staffing. Software Configuration Management, Quality Assurance. Measures and measurements – S/W complexity measure – size measure – data and logic structure measure – information flow measure. Software cost estimation COCOMO model- Delphi method.- software maintenance

Text books for study and reference:

1. *"Fundamentals of Software Engineering"*, by Ghezo
2. *"Software Engineering: Concepts and Practices"*, by Ugrasen Suman
3. *"A Textbook of Software Engineering"*, by Nazeer Shaik
4. *"Patterns of Enterprise Application Architecture"*, by Martin Fowler
5. *"The Art of Computer Programming"*, by Donald Knuth

Code: BH/126	Year: 3	Semester: 5	DSE-1	Operational Research	Credits: 5:1:0

Objectives: To equip the students with the capabilities for formulating and solving problems; construct linear programming models and discuss solution techniques; set-up decision models and propose best strategy using decision-making methods under uncertainty and game theory.

Syllabus

UNIT-I: Definition of the term Operation Research – Nature , Management Application , Modelling , Principles of modelling , features , Different Phases , scope , Advantages and Limitations of O.R. General method for solving O.R models and Role of O.R in decision making. Some important definitions – Solutions to LPP, Feasible solution, Basic solutions, Basic feasible solution, Optimum basic feasible solution, Unbounded solution. Assumptions in LPP, Limitations of LPP, Applications of LPP and advantages of LPP Standard Linear Programming – Formulation of a Linear Programming Solving L.P.P. by Graphical Method Problem and Simplex Method.

UNIT- II: Artificial Variable Technique – two phase method and Big M method, Duality – Meaning, definitions of primal problem , General rules for converting any primal problem into its dual . Characteristics of Dual problem – Advantages of Duality – Dual formulation procedure and Problems to obtain the dual of LPP. Fundamental Duality theorems – Primal and Dual correspondence.

UNIT III: Transportation Problems – Method of finding initial basic feasible solution to Transportation problem- North West Corner, Least Cost Method and Vogel's Method – Method of finding initial basic feasible solution to Assignment Problem using Hungarian Method.

UNIT-IV : Sequencing Problems – Definitions, terminology and notations, Principle assumptions, Processing _n' jobs through two machines Travelling Salesman (Routing) Problems - Formulations of TSP as an assignment problem

Text books for study and reference:

1. *"Introduction to Operations Research"*, by Prem Kumar Gupta
2. *"Operations Research"*, by S D Sharma

3. *"Operations Research"*, by P Shankar Iyer
4. *"Essentials of Operations Management"*, by Nigel Slack
5. *"Operations Management: Theory and Practice"*, by B Mahadevan
6. *"Operations Research: Applications and Algorithms"*, by W L Winston

Code: BH/127	Year: 3	Semester: 6	DSC-16	Deep Learning	Credits: 5:1:0

Objectives: To introduce the students with neural networks and state-of-the-art approaches to deep learning; to train students to design neural network architectures.

Syllabus

UNIT – I: Deep Feed Forward Networks: Gradient based learning, Hidden units, Architecture Design, Back-propagation, and other differentiation algorithms. Regularization for Deep Learning: Parameter Norm Penalties, Norm penalties as constrained optimization, Regularization and Under constrained problems, Dropouts, Adversarial Training.

UNIT – II: Optimization for training Deep models: Challenges in NN optimization, Basic Algorithms, Parameter Initialization strategies, Algorithms with adaptive learning rates, approximate second-order methods. CNN: Basic concepts of Convolutional Neural Networks, Convolution and pooling operation, variants of basic convolution function, structured outputs, Efficient convolution algorithm. Discussions on famous convnet architectures.

UNIT – III: Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder sequence to sequence architecture, Deep recurrent network, Long-Short Term Memory. Performance Metrics, Baseline models, data size, hyperparameters, debugging strategies, digit recognition.

UNIT – IV: Autoencoders & GANs: Introduction, Architecture, Implementation, Denoising Autoencoders, Sparse Autoencoders, Use Cases, Introduction to Generative Adversarial Networks.

Text Books and References:

1. "*Deep Learning*" by Bengio, Yoshua, Ian J.Goodfellow, and Aaron Courville. An MIT Press book in preparation. (2016).
2. *"Neural Networks and Deep Learning"* by Michael Nielsen, Determination Press, 2015.
3. *"Deep Learning with Python"* by Francois Chollet, 1/e, Manning Publications Company, 2017.
4. *"GANs in Action"* by Jakub Langr and Vladimir Bok (Manning, 2019)

Code: BH/128	Year: 3	Semester: 6	DSE-2	Natural Language Processing	Credits: 4:0:2

Objectives: To prepare students to cope with high volume of data and give them ability in applying the techniques to real-world applications.

Syllabus

UNIT-I: Language Processing: Text and words, simple statistics, Automatic natural language understanding, text corpora, conditional frequency distribution, lexical resources and wordnet. Accessing Text, text processing with Unicode, regular expression for detecting word patterns and applications, normalizing text, tokenizing text, segmentation.

UNIT-II: Categorizing and tagging words: Tagger, tagged corpora, automatic tagging, NGram tagging, transformation-based tagging, determining category of word. Supervised classification - Gender Identification, Choosing the Right Features, Document Classification, Part-of-Speech Tagging, Exploiting Context, Sequence Classification, Sentence Segmentation, Identifying Dialogue Act Types, Recognizing Textual Entailment.

UNIT-III: Information Extraction, chunking, development and evaluating chunkers, recursion in linguistic structure, named entity recognition, relation extraction. Context free grammar and parsing, dependencies, grammar development, grammatical features, processing feature structures, extending feature-based grammar. Semantics of English sentences.

UNIT-IV: Building Chatbots: Rasa NLU, training and building chatbot from scratch, dialog management using rasa core, writing custom actions of the chatbot, data preparation for training and testing the bot.

Text books for reading & reference:-

1. *"Natural Language Processing with Python"*, by Steven Bird, Ewan Klein & Edward Loper
2. *"Building Chatbots with Python"* by Sumit Raj A Press Pub.
3. *"Natural Language Processing in Action"* by Hobson Lane, Hannes Max Hapke, Cole Howard (Manning, 2019)
4. *"Speech and Language Processing"*, Daniel Jurafsky and James Martin

Code: BH/129	Year: 3	Semester:6	DSE-2	Introduction to AR Programming	Credits: 4:0:2

Objectives: To establish a broad and comprehensive understanding of the domain by the students in preparing them to participate in the production of highly integrative immersive applications, immersive social platforms, cross-disciplinary research projects and leading developments in industry applications.

Syllabus

UNIT-I: Introduction – Overview of Immersive Technologies – Current Trends – Future Applications – Best Practices in VR, AR and MR – Design – Prototyping – Ethical Code of Conduct – Overview of Human Physiology and Psychology.

UNIT-II: Emerging Immersive Reality Technologies – Applications – Design and Technological Foundations – Input Devices: Controllers – Motion Trackers – Motion Capture Technologies for tracking, navigation and gestural control

UNIT-III: Output Devices: Head Mounted VR Displays – Augmented and Mixed Reality Glasses – 3D Interactive and Procedural Graphics – Class Workshops – Immersive Surround Sound – Haptic Devices – Vibrotactile Devices – Systems Architecture – Integrative Immersive Media Platforms – Rapid Prototyping and Physical Computing

INIT-IV: VR Programming: Introduction to Java 3D – Loading and Manipulating External Models – 3D Sprites – Animated 3D Sprites – Particle Systems – Case Studies: Manufacturing (Smart Sensor Dashboard) – Automotive UI (Interactive HUD) – Aerospace (VR Cockpit) – Robotics.

Text books for reading & reference:-

1. *"Virtual Reality Technology"*, by Gregory C Burdia
2. *"Killer Game Programming in Java"*, by Andrew Davison
3. *"Learning Virtual Reality"*, by Tony Parisi
4. *"Ethics and Information Technology"*, by Philip Brey

Code: BH/130	Year: 3	Semester: 6	DSE-3	Data Mining	Credits: 4:0:2

Objectives: To equip students both in theory and practical applications of different methods of extracting processed information from data by using appropriate tools and evaluate derived end-results.

Syllabus

UNIT-I: Introduction –Terminologies used – Process involved – Applications – Classes of techniques – Databases and data warehousing – Exploratory Data Analysis and Visualization – Data Mining Algorithms

UNIT-II: Modelling for Data Mining: Principles – Model Scoring – Search and Optimization – Descriptive Modelling – Predictive Modelling – Case Studies

UNIT-III: Text Mining and Natural Language Processing – Information Visualization – Crowd Sourcing and Active Learning – Bayesian Data Mining – Observational Studies – Cluster Analysis

UNIT-IV: Data Mining in different industries: Healthcare – Humanities – Case Studies – Classroom Workshops

Text books for reading & reference:-

1. *"Introduction to Data Mining"*, Pang-Ning Tan, Michael Steinbach & Vipin Kumar
2. *"Data Mining: The Textbook"*, Charu C Aggarwal
3. *"Data Mining: Practical ML Tools & Techniques"*, Iam H Witten, Elbe Frank & Mark Hall
4. *"Programmer's Guide to Data Mining"*, Ron Zacharski
5. *"Data Mining: Concepts and Techniques"*, Jiawei Han
6. *"Data Mining and Analysis: Fundamental Concepts & Algorithms"*, Zaki and Meira
7. *"Predictive Analytics and Data Mining"*, Vipin Kotu Bala, Deshpande

Code: BH/131	Year:3	Semester:6	DSC-3	Fuzzy Logic and ANN	Credits: 4:0:2

Objectives: To inculcate in students the knowledge of principles of fuzzy logic, models of Artificial Neural Networks and their application to design and manufacturing sectors

Syllabus

UNIT-I: Introduction – Basic Concepts of Fuzzy Set Theory – Fuzzy Sets Operations and Properties – Crisp Relations – Fuzzy Related Equations – Fuzzy Systems – Propositional Logic – Inference – Predicate Logic – Inference in Predicate Logic – Fuzzy Logic Principles – Fuzzy Quantifiers – Fuzzy Inference – Fuzzy Rule-based Systems – Fuzzyfication – Defuzzyfication – Types

UNIT-II: Fuzzy Logic Controllers (FLC) – Principles – Control Systems Theory – Industrial Applications of FLC – Fuzzy Decision-making – Fuzzy Classifications – Clustering – Fuzzy Pattern Recognition – Applications for Image Processing – Fuzzy Optimization

UNIT-III: Artificial Neural Networks (ANN): Introduction – Model of Artificial Neuron – Architectures – Learning Methods – Supervised Learning – Neuron as a Computing Element – Perceptron – Back-propagation Networks – Multilayer Perceptron – Back-propagation Learning Input Layer – Accelerated Learning – Hopfield Networks – Bi-directional Associate Memories – Unsupervised Learning: Hebbian Learning – Hebbian Learning Algorithms – Competitive Learning – Computational Maps – Kohonen Networks

UNIT-IV: Taxonomy of Neural Networks Architecture –Standard Back Propagation Algorithms – Selection of various Parameters – Variations Applications of Back Propagation Algorithms – Genetic Algorithms: Introduction to concepts – Encoding – Fitness Function – Convergence of Genetic Algorithms – Applications of Genetic Algorithms – Basic Concepts of Genetic Programming – Case Studies

Text books for reading & reference:-

1. *"Fuzzy Logic for Beginners"*, by Masao Mukaidono
2. *"Introduction to Fuzzy Sets, Fuzzy Logic and Fuzzy Control Systems"*, by Guanrong Chen and Trung Tat Pham (Free PDF Book)
3. *"Neural Networks, Fuzzy Logic and Genetic Algorithms"*, by S Rajasekaram & Vijayalakshmi Pai
4. *"Fuzzy Set Theory, Fuzzy Logic & Their Applications"*, by A K Bhargava
5. *"Introduction to Artificial Neural Systems"*, by G Klir & B B Yuan
6. *"Genetic Algorithm and Engineering Design"*, by M Gen and R Cheng

Code: BH/132	Year: 3	Semester:6	SEC-1	Business Intelligence & Analytics	Credits: 2:0:0

Objectives: To impart to students the knowledge and skills for using data-warehouses for purposes of business intelligence and enhance their visualization capabilities.

Syllabus

UNIT-I: Introduction – Definitions – BI Segments – Difference between Information and Intelligence – BI Value Chain – Factors of BI System – BI Applications; – BI Environment creation – BI Landscape – Types – Platform – Dynamic Roles; – Types: Multiplicity of BI Tools – Types of BI Tools – Applications; – Architecting Data: Types of Data – Enterprise Subject Area Model – Enterprise Conceptual Model – Enterprise Conceptual Entity Model – Granularity – Data Reporting – Query Tools – Data Partitioning – Metadata – Total Data Quality Management; – Brief on Data Mining: Definitions – Working of Data Mining – Architecture – Functionalities – Classifications – Risks Perceived – Ethical Issues in Data Mining – Global Issues; – Data Mining Techniques: Introduction – Statistical Perspective – Statistical Needs – Similarity Measurement – Decision-Tree illustrations – Neural Networks vs Conventional Computers – Kohonen's Self-organizing Maps –Genetic Algorithms; Data Warehousing: Introduction – Advantages and Disadvantages – Data Mart – Online Analytical Processing (OLAP) – Characteristics – OLAP Tools – OLAP Data Modelling – Comparison of OLAP with OLTP – Data Modelling using Star Schema and Snowflake Schema; – Ways of Data Warehousing: Types of Business Models – B2B BI Model – EDI and E-Commerce Models – Systems for Improving Models – B2C BI Model – Needs – Types; – Knowledge Management (KM): Introduction – Characteristics – Knowledge Assets – Generic Knowledge Management Process – KM Technologies – Essentials of KM Process.

UNIT-II: Data Extraction: Introduction – Importance of Source Identification – Techniques Involved – Logical Extraction Methods – Physical Extraction Methods – Change Data Capture; – BI Life Cycle: Introduction – Enterprise Performance Life Cycle (EPLC) Framework – Life Cycle Phases – Human Factors in BI Implementation – BI Strategy – Objectives and Deliverables – Transformation Roadmap – Building Transformation Roadmap – BI Development Stages – BI Steps – Parallel Development Tracks – BI Framework; – BI User Model: Introduction – Opportunity Analysis – Content Management System – End-user Segmentation – Basic Reporting – Querying – OLAP Techniques – OLAP Applications – OLAP to Data Warehousing – Dashboard – Advanced BI Technologies – Future opportunities in BI; – Issues & Challenges in BI: Introduction – Critical Challenges – Cross-organizational Partnership – Business Sponsors – Dedicated Business Representation – BI Application Development Methodology – Planning the BI Projects – Business Analysis – Data Standardisation – Dirty Data – Meta Data Importance – Silver Bullet Syndrome – Customer Pain Points – Creation of Cost-effective BI Solutions; – Strategy and Road-map: Introduction – Planning Process – Limitations of BI – Usages of BI – Advantages of BI – Organization Culture – Total Cost of Ownership (TCO) – Factors affecting TCO; – Implementation Phase: Introduction – BI Platform Capability Matrix – BI Target Database – Data Mart – BI Products and Vendors – Business Performance Management (BPM) – Six Sigma usages – Levels of BI Maturity – Critical Success Factors – Peer-evaluated classroom exercise.

Text books for reading & reference:-

1. *"Business Intelligence, Analytics and Data Science"*, by Ramesh Sharda and Dursun Delan
2. *"Business Intelligence Guide Book: From Data Integration to Analytics"*, by Rick Sherman
3. *"Business Intelligence Roadmap: The Complete Project Lifecycle"*, by Larissa T Moss
4. *"Data Strategy: How to Profit from a World of Big Data"*, by Bernard Marr

Code: BH/133	Year:3	Semester:6	SEC-1	Financial Analytics	Credits: 2:0:0

Objectives: To inculcate competency in students to solve real-world problems in Finance & Accounts value-chain by applying data and analytics skills.

Syllabus

UNIT-I: Financial Analytics: Introduction and overview – Changing Finance & Accounts Landscape – Techniques to analyze Time Series Data – Application of Statistics for Business - Application of Analytics in F&A – Application of Analytics in Financial Services; – R for Analytics: Introduction – Programming basics – Assembling Data – Calculating Results – Logical Types and Relational Operators – Conditional Statements – Stacking Data – Loops

UNIT-II: Advanced Analytics Techniques: Tree Models – Time Series Analysis – Advanced SQL and best practices – Advanced Excel – Structured Problem Solving using Frameworks – Hypothesis Formulation – Business Problem Tasks – Revenue and Operational Cost Modelling – Effective Communication Strategies – Classroom case study; – Data Visualization: Introduction – Data Mapping – Charts – Glyphs – Coordinates – Stacked Graphs – Tufte's Design Rules – Use of Colour; – Visualization Dash Board: Introduction – Systems – Information Visualization – Database Visualization – System Design – Future Technologies in F&A – Classroom exercises (Data Reporting; Forecasting Techniques; Risk Assessment; Product Costing Analysis)

Text Books and References:

1. *"Financial Analytics with R: Building a laptop Laboratory"*, by Mark J Bennett
2. *"Global Business Analytics Models: Concepts & Applications"*, by Hokey Min
3. *"Analytics for Insurance: The Real Business of Big Data"*, by Tony Boobler

Code: BH/134	Year: 3	Semester: 6	SEC-2	Human Robot Interaction using Motion Capture	Credits: 1:1:0

Objectives: To introduce the students to the functionality and usability of Robots by making their interactions more natural and compatible with human capabilities, expectations and behavior.

Syllabus

UNIT – I: Configuration space: Degree of Freedom – Rigid body and robot, Configuration space & velocity constraints, Task space and workspace. Rigid body motions, rotations, angular velocities, twists, wrenches.

UNIT – II: Forward Kinematics: Product of exponentials, Universal robot description, Manipulator Jacobian, Statics of open chains, singularity analysis, Manipulability. Inverse Kinematic: Analytic Inverse Kinematic, Numerical IK, Inverse velocity kinematics. Introduction to HoloSuit motion capture technology: HoloSuit interfacing and programming, Mapping robot joints with HoloSuit, Robot control using HoloSuit – Introduction to MS Hologram Technology.

Text Books and References:

1. *"Modern Robotics: Mechanics, Planning, and Control"* by Kevin M. Lynch, Frank C. Park
2. *"Introduction to Robotics: Mechanics and Control"* by John J. Craig (3rd Edition)

Code: BH/135	Year: 3	Semester: 6	SEC-2	Autonomous Robots	Credits: 1:1:0

Objectives: To introduce students into the world of Robotics and apply modern software development and deployment strategies.

Syllabus

UNIT – I: Path Planning – Map Representations, Path-planning algorithms – Robot Embodiment, Dijkstra's, A* Algorithm, Sampling based planning path. Robotic Sensors, sensors using light, sound, Inertia based sensors, Beacon based sensors.

UNIT – II: Feature detection, line fitting using least square, RANSAC algorithm, scale invariant feature transforms, RGBD- SLAM: converting range data into point cloud data, ICP algorithm, RGB-D mapping.

Text Books and References:

1. *"Introduction to Autonomous Robots: Kinematics, Perception, Localization and Planning"* by Nikolaus Correll
2. *"Engineering Autonomous Vehicles and Robots"* by Shaoshan Liu

Code: BH/135	Year:4	Semester: 7	DSE-4	Image Processing	Credits: 4:0:2

Objectives: After completion of the course, the students will have understood: (a) the basic image enhancement techniques in spatial and frequency domains; (b) various kinds of noise and how to restore the noisy image; (c) basic multi-resolution techniques; and (d) application of the concepts for image handling.

Syllabus

UNIT – I: Digital Image Fundamentals: What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships Between Pixels, Linear and Nonlinear Operations.

UNIT – II: Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters. Frequency Domain: Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering.

UNIT – III: Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.

UNIT – IV: Morphology and segmentation: Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms. Segmentation: Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation, Segmentation Using Morphological Watersheds. Representation and Description: Multiresolution Expansions Representation, Boundary descriptors.

Text books for reading & reference:-

1. *"Digital Image Processing"* by Rafael C. Gonzalez, Richard E. Woods (4th Edition)
2. *"Principles of Digital Image Processing"*, by Burger, Wilhelm, Burge, Mark J.
3. *"Mastering OpenCV4 with Python"* by Alberto Fernandez Villan

Code: BH/136	Year:4	Semester: 7	DSE-4	AI-Based VR Programming	Credits: 4:0:2

Objectives: To provide knowledge for the students on game development using AI and application of cutting-edge tools employed in the process.

Syllabus

UNIT-I: Model of Game AI, Complexity Fallacy, AI in games, Basics of movement algorithms, kinematic movement algorithm, steering behaviour, combining steering behaviours, Predicting physics, Movement in 3D.

UNIT – II: Decision Trees, State machines, Behavior trees, Goal-oriented behaviour.

UNIT – III: Waypoint tactics, tactical analyses, tactical path finding, coordinated actions.

UNIT – IV: Designing game AI: Design, shooters, driving, real time strategy, sports, turnbased strategy games, teaching characters, flocking and herding games.

Text books for reading & reference:-

1. *"AI for Games"* by Ian Millington (3rd Edition)
2. *"Game A.I. Made Easy: Designing Agents"* by Rui Jiang (1st Edition)
3. *"Unity Artificial Intelligence Programming"* by David Aversa, Aung Sithu Kyaw, Clifford Peters

Code: BH/137	Year:4	Semester: 7	DSE-4	Robots Navigation	Credits: 4:0:2

Objectives: To provide students the basic concepts on the technology involved in mobility and use techniques for sensor, location and maps generation for robot navigation in real-world applications.

Syllabus

UNIT-I: Recursive state estimation: Basic concepts, Robot environment interaction, Bayes filters, Kalman filter, extended Kalman filter.

UNIT – II: Histogram filter, particle filter. Robot motion preliminaries, velocity motion model, odometry motion model, motion and maps, Beam models and range finders, likelihood fields and range finders, correlation and feature based measurement models.

UNIT – III: Localization – Markov, EKF localization, occupancy grid mapping algorithm, SLAM with EKF.

UNIT – IV: Quadrotor Mathematical description, time optimal trajectory generation, UAV routing problem, trajectory problem, obstacle avoidance algorithm.

Text books for reading & reference:-

1. *"Probabilistic Robotics"* by Sebastian Thrun, Wolfram Burgard, Dieter Fox, MIT Press
2. *"A Systematic Approach to Learning Robot Programming with ROS"* by Wyatt Newman
3. *"Mobile Robots: Navigation, Control and Sensing, Surface Robots and AUVs"* (2020 Edition) by Gerald Cook and Feitian Zhang
4. *"Indoor Navigation Strategies for Aerial Autonomous Systems"* by Pedro Castillo-Garcia, Laura Elena Munoz Hernandez, Pedro Garcia Gil

Code: BH/138	Year:4	Semester: 7	DSE-5	Introduction to Cloud Computing & Net Works	Credits: 5:1:0

Objectives: To introduce students the domain and cover the topics of cloud, virtualization, networks, cloud storage and programmes. It covers also the technological benefits of the cloud paradigm and concepts behind its deployment.

Syllabus

UNIT-I: Computing Paradigm: Introduction – Current trends in computing: Grid computing, Cluster computing, Utility computing, and Cloud computing – Evolution of Cloud computing – Cloud computing: History – Service providers – Properties, Characteristics and Constraints – Open Standards - Cloud computing Architecture: Cloud computing Stack – How Cloud computing Works – Role of Net Works in Cloud computing, Protocols and Role of Web Services – Service Models: IaaS (Infrastructure as a Service) – PaaS (Platform as a Service) – SaaS (Software as a Service) – Deployment Models.

UNIT-II: IaaS (Infrastructure as a Service): Introduction: Definition – Virtualization – Different approaches to Virtualization – Hypervisors – Machine Image – Virtual Machine – Resource Virtualization: Server – Storage – Network – Data Storage in Cloud Computing – Examples – Amazon EC2 – Eucalyptus – PaaS (Platform as a Service): Introduction: Definition – Cloud Platform and Management – Examples (Google App Engine, MS Azure, Force.com Platform) – PaaS (Platform as a Service): Introduction – Web Services – Web 2.0 – Web OS – Case studies.

UNIT-III: Service Management in Cloud Computing: Service Level Agreements (SLAs) – Billing and Accounting – Comparing Scaling Hardware – Economics of a Scaling – Managing Data: Data, Scalability and Cloud Services – Database and Data Stores in Cloud – Large Scale Data Processing.

UNIT-IV: Cloud Security: Infrastructure Security – Data Security and Storage – Identity and Access Management – Access Control – Trust, Reputation and Risk – Authentication in Cloud Computing – Client Access in Cloud – Cloud Contracting Model – Commercial Consideration – Case Studies on Open Source and Commercial Clouds

Text books for study and reference:

1. *"Computer Networking: A Top-down Approach"*, by Kurose & Ross (6th Edition)
2. *"Introduction to Networking"* by Charles R Severance
3. *"Cloud Computing"*, by M.Ray Rafaels
4. *"Cloud Foundry: The Definitive Guide: Develop, Deploy & Scale"*, by Duncan C E Winn
5. *"Cloud Computing Security: Foundations and Challenges"*, by John R Vacca
6. *"Hands on Virtual Computing"*, by Ted Simpson and Jason Novak
7. *"Cloud Computing: Business Trends and Technologies"*, by Igor Faynberg

Code: BH/139	Year:4	Semester: 7	DSE-4	Information Security Systems	Credits: 5:1:0

Objectives: To enable students assess the security landscape, appraise the interrelationships among elements forming part of a modern current system and design information security system for an information-driven enterprise.

Syllabus

UNIT-I: Introduction – Concepts of information security – Terminologies used – Human aspects involved – information security for server systems: Types of attacks to web-servers - information security for client devices: Attacks for PCs and smart phones – Counter-measures – Malicious software intrusions and their effects – information security risk management: Processes involved – Information assets – Evaluation of security risk – Mitigation of risks – Classroom exercises

UNIT-II: Security Risk Management: Information Security governance in an organization – Information Security Management Systems – Information Security Policy, Standards and Procedures – Information Security Evaluation – Security Incident Response: Overview – Computer Security incidents and responses.
UNIT-III: Information Security and Cryptography: Basic Concepts – Secure communication – Definitions – Types of Cryptography: Classic Cryptography – Modern Cryptography – Common Key Cryptography – Public Key Cryptography – Classroom exercises

UNIT-IV: Common Key Cryptography: Algorithms involved – DES – Triple DES – AES – Encryption modes – Key Distribution – Public Key Cryptography: RSA – Hybrid Encryption – Data Integrity – Hash Function – Digital Signature – Public Key Certificate – Public Key Infrastructure (PKI) – Certification Authority – Laws in India governing – Classroom exercises

Text books for reading & reference:-

1. *"Introduction to Information Security and Cyber Laws"*, by Surya Prakash Tripathi & Ritendra
2. *"Cyber Security for Beginners"*, by Raef Meeuwisse

3. *"Cryptography and Information Security"*, by V K Pachghare
4. *"Network Security: The Complete Reference"*, by Bragg
5. *"Practical Malware Analysis"*, by Michael Sikorski
6. *"Understanding Cryptography"*, by Christof Paar and Jan Pelzi

Code: BH/140	Year:4	Semester:7	DSE-6	Mini Project Work	Credits: 0:2:4

Objectives: To advance the skills of students in chosen areas of interest and at the same time test their current level of knowledge. During the duration of the course students are expected to work in collaborative groups. The Students will form a group comprising not less than 5 persons in choosing any **one** of the following mini projects (list is only inclusive, liable to change):-

1. Colour of Emotion
2. Ball tracking Robot
3. Intelligent Robot Conversation (Alexa)
4. Global Pandemic Visualization
5. Predicting Cost of Real Estate
6. Twitter sentiment Analytics
7. Library Bot
8. Chat Bot
9. Security Bot
10. Swarm Robots

A brief on the topics

1. Colour of Emotion embraces mainly three components – Evolutionary Connections, Cultural Connections and Personal Connections. For example a good web design forges emotional connection between the end-user and the product.
2. Ball tracking Robot is a mechanism of estimating the position of an object over a pattern of images. It plays important role in applications such as video surveillance, human-computer interface, auto-navigation of vehicles and robot control.
3. Intelligent Robot Conversation (Alexa) is an application of human-computer interaction. With conversational AI systems, voice user interface voice services like Alexa can communicate with people in many ways.
4. Global Pandemic Visualization is a Data Scientist project. Taking the recent case of COVID-19, it rose from being an epidemic to a global pandemic in a short time. The project involves using a mathematical model to stimulate how the pandemic spreads and its economic/demographic effect on humanity.
5. Predicting Cost of Real Estate is a machine language project in which the predictive power of a model trained and tested on data collected from Registration Authorities in say Mysore City are studied. In this project students will be able to predict real estate prices using python. The project helps both the buyers and the sellers to have an overview of the market conditions.
6. Twitter sentiment Analytics involves python and usage of libraries such as twitter. It is usage of advanced text mining techniques to analyze the sentiment of the tweet in the form of positive, negative and neutral.
7. Library Bot is a virtual agent offering self-service option in the context of information services to clients. Libraries offer wide range of automation and testing capabilities for Robot framework. The necessary components to run the project are on GitHub Repository and other open-source libraries.
8. Chat Bot is intelligent software capable of communicating and perform tasks like a human being. Chatbots are widely employed for customer interaction, business marketing, etc. Some of the Python libraries for

Chatbots such as spaCy (for NLP in Python language), Natural Language Tool Kit (NLTK) (for building programs in Python language) etc are open-source libraries which can be employed for the project.

9. Security Bot intends to replace human surveillance with a surveillance Robot. Being miniature in size, these bots can move in different harsh and hazardous locations. Such Robots can traverse both in vertical and horizontal directions with camera mounted on top for surveillance purpose. For the project the students can try night vision patrolling using Raspberry pi technology.

10. Swarm Robots consist of many individual intelligent agents working with no central controls but acting based on simple and local behaviour pattern. Swarm Robots adapt to changes in operational environments. Individual Robots exhibit behaviour ranging from simple reactive mapping between sensor inputs to elaborate swarm algorithms. Industrial application of Swarm Robots is still in its nascent stage and therefore offers wide range of challenging opportunities to the students.

Code: BH/141	Year:4	Semester:7	SEC-3	Predictive Analytics	Credits: 2:0:0

Objectives: To impart working knowledge to students on Predictive Analytics using Python, ML, Data Visualisation etc techniques whereby they learn to apply predictive analytics and business intelligence to tackle and solve business problems in real-world applications.

Syllabus

UNIT – I: Predictive Data Analytics, The Predictive Data Analytics Project Lifecycle, Data Explorations - Data Quality Report, Getting to Know the Data, Identifying Data Quality Issues, Handling Data Quality Issues, Data Exploration & Preparations. Information based Learning - Fundamentals

UNIT – II: Similarity-based Learning – Fundamentals, Probability-based Learning – Fundamentals, Error-based Learning – Fundamentals, Evaluation – Fundamentals, The Art of Machine Learning for Predictive analysis - Different Perspectives on Prediction Models and Case Studies.

Text books for reading & reference:-

1. "*Fundamentals of Machine Learning for Predictive Data Analytics*" by John D. Kelleher, Brian Mac Namee, Aoife D'Arcy
2. "*Hands-On Predictive Analytics with Python*" by Alvaro Fuentes

Code: BH/142	Year:4	Semester:7	SEC-3	Web Analytics	Credits: 2:0:0

Objectives: To impart knowledge to students on the key concepts, diagnostic techniques and practices for understanding how web analytics can be employed to achieve greater ROI and higher level of customer satisfaction.

Syllabus

UNIT-I: Introduction – Definitions – Terminology used – Needs, Usages, Advantages and Limitations – Categories: Off-site Web; On-site Web –Evolution – Web Analytics Platform – Data Collection – Web Logs – Web Beacons – JavaScript Tags – Packet Sniffing – Outcomes Data: E-commerce – Lead Generation – Brand Support; – Research data: Mindset – Organizational structure – Timing; – Competitive Data: Panel-Based Measurement – ISP-based Measurement – Search Engine Data; – Qualitative Analysis: Heuristic evaluations: Conducting a Heuristic Evaluation – Benefits of Heuristic Evaluations; – Site Visits: Purpose for a Site Visit and its benefits; – Surveys: Benefits – Website Surveys – Post-visit Follow-up Surveys – Creating and Running a Survey; – Web Analytic fundamentals: Capturing data: Web logs or JavaScript's tags – Separate data serving and data capture – Type and size of data – Innovation – Integration – Optimal Web Analytic Tool – Click Stream Data Quality – Identifying Unique Page Definition – Using Cookies – Link Coding.

UNIT-II: Web Metrics: Common metrics: Hits – Page views – Visits – Unique Visitors – Unique Page Views – Bounces – Bounce rate – Page/visit – Average time on site – New visits; – Optimization: Improving Bounce Rates – Optimizing ad-words campaigns; – Real-Time Report – Audience Report – Traffic Source Report – Custom campaigns – Content Report – Basics of Google analytics – Key Performance Indicators (KPI) – Characteristics – Need for KPI – Perspectives and Uses of KPI; – Relevant Technologies: Internet & TCP/IP – Client / Server Computing – HTTP (Hypertext Transfer Protocol) – Server Log Files & Cookies – Web Bugs; – Web Analytics 2.0: Web Analytics 1.0 vis-à-vis Web Analytic 2.0; – Competitive Intelligence (CI) Analysis: CI Data Sources – Toolbar Data – Panel Data - Internet Service Provider (ISP) Data – Search Engine Data – Hybrid Data; – Website Traffic Analysis: Comparing Long-term Traffic Trends – Analyzing Competitive Site Overlap and opportunities; – Google Analytics: Its Working – Google Analytics Set-up – Terminology – Navigation – Overview and Full Reports – Sharing – Setting-up Dash Boards and Shortcuts; – Basic Reports: Audience Reports – Acquisition Reports – Behaviour Reports; – Categories of Traffic – Google Website Optimizer – Implementation Technology – Limitations – Performance Concerns – Privacy Issues.

Text books for reading & reference:-

1. *"Web Analytics 2.0"*, by Avinash Kaushik
2. *"Google Analytics: A Complete Guide"*, by Gerardus Blokdyk (2020 edition)
3. *"Google BigQuery: The Definitive Guide"*, by Valliappa Lakshmanan

Code: BH/143	Year:4	Semester:8	DSE-7	Main Project Work	Credits: 0:0:12

Objectives: To expose students to industry-standard project practices, through a real-life project work under time and deliverable constraints, applying the knowledge acquired through various courses.

1. To provide an opportunity to apply the knowledge gained through various courses in solving a real life problem
2. To provide an opportunity to practice different phases of software/system development life cycle
3. To introduce the student to a professional environment and/or style typical of a global IT industry
4. To provide an opportunity for structured team work and project management
5. To provide an opportunity for effective, real-life, technical documentation
6. To provide an opportunity to practice time, resource and person management.

Guidelines and preparations for the project work:

a. Selection of Team: To meet the stated objectives, it is imperative that Major Project is done through a team effort. Though it would be ideal to select the team members at random (drawing lots) and this should be strongly recommended, due to practical considerations, students may also be given the choice of forming themselves into teams with maximum of 3 members. A gender mix should also be strongly suggested. A team leader shall be elected through drawing lots. Teams shall maintain team meeting minutes and ensure that every team member has tasks assigned in writing. Team meeting minutes shall form a part of the Project Report. Even if students are doing projects as groups, each one must independently take up different modules of the work and must submit the reports also independently (though, in such cases, some common materials is permissible). Evaluation will also be done independently.

b. Selection of Tools: No restrictions shall be placed on the students in the choice of platforms/tools/languages to be utilized for their project work, though open source is strongly

recommended, wherever possible. No value shall be placed on the use of tools in the evaluation of the project.

c. Selection of Organisation & Guide: No restrictions shall be placed on the students in the choice of organization where project work may be done, in terms of locality, type of organization (public/private) etc. It is the duty of the Head of Institution or the Principal of College to ensure that the Aims, Objectives and full project guidelines are communicated to the external organization. The guide should ideally be a post-graduate with minimum 2 years of work experience.

d. Students may also choose to do project in the college/institute (or partially in the college and partially in an external organization), especially product-based work, but in such cases the supervisors must ensure that (i) industry practices are followed (ii) the students undertake a planned visit to an IT industry with international operations to make up for the loss of experience and (iii) the services of an external guide with industry experience is obtained.

e. Head of Institution or the Principal of College should publish a list of students, projects topics, internal guide and external organization (if any) and teams agreed, before the end of semester VI. Changes in this list may be permitted for valid reasons and shall be considered favourably by Head of Institution or the Principal of College any time before commencement of the project. Any request for change after commencement should considered by a committee of 3 teachers and their recommendation shall be accepted by Head of Institution or the Principal of College.

f. Gantt-chart of proposed activities and a draft statement of project deliverables (which may subsequently be altered if justified) should be prepared before the commencement of the project. The actual completion of each phase should be noted on the chart in the course of the project work. Students should submit a fortnightly report of progress which could be indication of percentage of completion marked on the original Gantt-chart, with any notes attached. Students should ideally keep a daily activity log sheet. Team meetings should be documented in the format given at the end. Changes in the submitted documents are possible, as project development is essentially an evolutionary process. The Project Guide must ensure that changes are necessary due to the knowledge gained in succeeding phases of the project. The date of completion of a phase should be brought forward if the changes made are deemed to be errors and not due to additional knowledge gained from a succeeding phase.

Project Guidelines (subject to alteration to suit different industries):-

1. Group size : Not over three members.
2. Number of records: One copy to each participant and one copy to the Department.
3. Certificate will contain the names of all participating member and of the Project Guide.
4. Minimal phases for the project work: Project search, finalization and allocation, Investigation of system requirements, Data and Process Modelling, System Design, Program design, Program coding and unit testing, System integration, System implementation and acceptance testing.
5. Planning the Project: The Major Project is an involved Exercise that has to be planned well in advance. The topic should be chosen in Semester IV itself and the case study of Course in Semester IV should as far as possible, be based on the project topic, though on exceptional cases and for valid reasons, the Project Guide may waive this condition. Related reading, training and discussions should start from Semester V itself.
6. Suggestive project work are three in nature:

Code: BH/144	Year:4	Semester:8	SEC-4	SWAYAM ON-LINE	Credits: 2:0:0

SWAYAM is India's national Massive Online Open Courses (MOOC) platform. It offers over 2,150 courses taught by close to 1,300 instructors from over 135 Indian universities and IITs. It allows students in India to earn academic credit online. Since the platform was launched in 2017, over 10 million learners have taken courses on SWAYAM.

SWAYAM is a program initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy. This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere at any time.

SWAYAM offers:

- Best in class Instructors drawn from high-ranked Universities and IITs.
- Weekly Assignments to ensure students' progress in a timely manner.
- Easy Credit Transfer by complementing students' program
- Systematic Approach enabling students towards learning goals

Qualifying Certificates may, in turn, be used by students enrolled in India's higher education to earn academic credit for completing SWAYAM courses earmarked as credit-eligible by their universities. SWAYAM is supported by various industries such and as such the students undertaking the courses will have added advantage of ranking for placements. Laboratory facility will be allotted by the Course Coordinator depending on the available time-slots. For further information about how India is leveraging SWAYAM at the university level, please contact the Course Coordinator in the College and taking his guidance, register for the same.

Some of the suggested courses under **SWAYAM** for students to choose from are listed below:

1. Design and Analysis of Algorithms
2. Python for Data Science
3. Scalable Data Science
4. Cloud Computing
5. Big Data Computing
6. Predictive Analytics
7. Data Science for Engineers
8. Data Mining
9. Deep Learning
10. Deep Learning for Visual Computing
11. Deep Learning for Computer Vision
12. Artificial Intelligence: Search Methods for Problem Solving
13. Introduction to Internet of Things
14. Business Analytics & Data Mining Modeling Using R
15. Robotics
16. Practical Machine Learning with Tensorflow
17. Principles of Management

- Program function Explanation
- Data entry screen (reproduced from system documentation).
- Report layout (reproduced from system documentations)
- Program level pseudo code or flowchart.
- Decision tables, decision trees, with English Explanation where necessary.
- Program listing
- Test data
- Test results.

Project Methodology: Wherever applicable, object oriented approach should be used for software development. The project report should generally contain details of the following steps (though students should not attempt to fit every kind of project into this format):

(a) Analysis

- Study of existing systems and its drawbacks (general)
- Understanding the functionalities of the system (detailed)
- Preparation of requirement
- Conduct of Feasibility study
- Identification of relevant Objects
- Abstraction of each object (attributed and methods)
- Relationship between objects

(b) Design

- Design of each subsystems
- Design of each classes
- Design of communications between objects
- Design of Algorithms for problem solving
- User interface Design
- Any other steps if necessary

(c) Coding and Impletion

(d) Testing

(e) Security, Backup and Recovery Mechanisms

(f) On line help and User Manuals

(g) Upgradability Possibilities

Intellectual Property Rights: The intellectual property rights in all project work done by the students shall vest jointly with the University of Mysore and Sarada Vilas College, except in cases where some external organizations seek undertaking from students to concede IPR in all work done in their organization or under their guidance. Where possible, students should attempt to obtain at least a joint IPR for the College and the University. In cases where project works are of public utility, students shall be asked to publish their work including source code and documentation, in so far as their rights are clear.

Evaluation of Project

- Documentation – 30 marks
- Content & Methodology - 50 marks
- Viva Voce - 20 marks

d. Certificate should be in the format: "Certified that this report titled..... is a bonafide record of the project work done by Sri/Kum..... under our supervision and guidance, towards partial fulfilment of the requirements for the award of the Degree of B.Sc.(Hon's)(DS&AI) of the University of Mysore" with dated signatures of Internal Guide, External Guide and also Head of Institution or the Principal of the College.

e. If the project is done in an external organization, another certificate on the letterhead of the organization is required: "Certified that this report titled..... is a bonafide record of the project work done by Sri/Kum..... under any supervision and guidance, at the .....Department of..... (Organization) towards partial fulfilment of the requirements for the award of the Degree of B.Sc.(Hon's)(DS&AI) of the University of Mysore".

f. References shall be IEEE format (see any IEEE magazine or transaction). Take care in use of italics and punctuation. While doing the project, keep note of all books you refer, in the correct format, and include them in alphabetical order in your reference list. (Eg: A book is cited as: *"Understanding Neural Networks and Fuzzy Logic"*, Author:Kartalopoulos, S V Publishers: BPB Publishers, 1996 Edn., pp. 21-27. (pp.21-27 indicates that pages 21-27 have been referred.) If the whole book is being referred, this may be omitted. If a single page is referred, say page 47, it may be cited as p.47.

g. Report writing is NOT a hasty activity done after finishing the project. Students must try to develop the report along with the work, so as to give it flesh and blood. Drafts should be read, modified, spell checked and grammar checked at least thrice during the course of the project and before a final printout is taken, the same may be got approved from the internal guide. The students should send two interim reports to internal guides. This will also help the students in their report writing.

h. The Gantt chart, fortnightly progress reports, and team meeting minutes mentioned above should appear as appendix to the project report. Regarding the body of the report, as an indicative example, is as follows:-

– Organizational overview (of the client organization, where applicable)
– Description of the present system
– Limitations of the present system
– The Proposed system- Its advantages and features
– Context diagram of the proposed system.
– Top level DFD of the proposed system with at least one additional level of Expansion
– Structure Chart of the System
– System flowchart
– Menu Tree
– Program List
– Files or tables (for DBMS projects) list. Class names to be entered for each file in OO systems.
– List of fields or attributes (for DBMS projects) in each file or table.
– Program – File table that shows the files/tables used by each program and the files are read, written to, updated, queried or reports were produced from them.
– Reports List with column headings and summary information for each report.
– System Coding and variable/file/table naming conventions
– System controls and standards
– Screen layouts for each data entry screen.
– Report formats for each report.

Program documentation is suggested on the following lines:
– Program id
– Program level run chart

a. Developing solution for a real-life problem: In this case, a requirement for developing a computer based solution already exists and the different stages of system development life cycle is to be implemented successfully. Examples are Accounting Software Package for a particular organization, Computerisation of administrative functions of an organization, Web-Based Commerce, etc. The scope for creativity and Exploration in such projects is limited, but if done meticulously, valuable Experience in the industrial context can be gained.

b. Innovative Product development: These are projects where a clear-cut requirement for developing a computer based solution may not be existing but a possible utility for the same is conceived by the proposer. Example are: a Kannada Language Editor with Spell Checker, Computer Music Software for Indian Music, Heat Engines Simulation Software for e-Learning, Digital Water Marking Software.

c. Research level project: These are projects which involve research and development and may not be as structured and clear cut as in the above cases. Examples are Kannada Character Recognition, Neural Net Based Speech Recogniser, Biometric Systems, Machine Translation System etc. These projects provide more challenging opportunities to students, but at the student level is a difficult choice. If any student identifies proper support in terms of guidance, technology and references from external organizations and also the supervisors are convinced of the ability of the student(s) to take up the project, it shall be permitted. The methodology and reporting of such projects could be markedly different from type (a) and is left to the proposer/external supervisor of the projects.

Documentation Guidelines:

1. The final outer dimensions of the report shall be 21cm X 30 cm. The colour of the flap cover shall be light Blue. Only hard binding should be done, with title of the thesis and the words "<BRIEF TITLE> BSC(HONS)(DS&AI) Project Report 20...." displayed on the spine in 20 point, Bold, Times New Roman, as in example below. In case the title is too long, a shorter version of it may be used (Like "Image Pro" instead of" Image Pro – An Interactive Image Processing package").
2. It is highly recommended that Latex be used for documentation.
3. The text of the report should be set in 12 pt, Times New Roman, Single Spaced.
4. Headings should be set as follows: CHAPTER HEADINGS 20 pt, Times New Roman, Bold, All Caps, and Centred. Example: "HUMANOID ROBOTS": BSC(HONS)(DS&AI) PROJECT 2023;
5. SECTION HEADINGS 12 pt, Times New Roman, Bold, All Caps, Left Adjusted.
6. Section Sub-headings 12 pt, Times New Roman, Bold, Left Adjusted.
7. Titles of Figures, Tables etc are done in 12 point, times New Roman, Italics, and Centred. <PROJECT TITLE> <STUDENT'S NAME> <SARADA VILAS COLLEGE> PROJECT REPORT :: Submitted in partial fulfilment of the requirements for the award of B.Sc.(Hon's)(DS&AI) degree of University of Mysore :: 2024
8. Some general guidelines on documentation stylistics are:
   a. Double quotes and single quotes ("", ") should be used only when essential. In most cases words put in quotes are better highlighted by setting them in italics. This process is known as "morphing".
   b. Page numbers shall be set at right hand top corner, paragraph indent shall be set as 3.
   c. Only single space need be left above a section or sub-section heading and no space may be left after them.