M. G. Science Institute, Ahmedabad

Autonomous | Affiliated to Gujarat University, Ahmedabad

(Managed by The Ahmedabad Education Society)

Department of Computer and Data Science

Bachelor of Science (Hons.) in Artificial Intelligence and Machine Learning

B.S. (Hons.) AI & ML

(Effective from Academic Year 2024-25)

Contents

1.0 Preamble

In a world characterized by unprecedented technological advancements, the bachelor of science program in Artificial Intelligence and Machine Learning (B.S. (Hons.) AI and ML) is crafted with a profound commitment to shaping future leaders and experts in the captivating realms of AI and ML. B.S. (Hons.) AI and ML involves incorporating a balance of foundational knowledge, theoretical concepts, practical skills, and real-world applications. This program serves as a gateway to the frontiers of intelligent systems, computational thinking, and data-driven decision-making.

2.0 Definitions

Bachelor Degree

Bachelor Degree is designed to offer the undergoing students a broad foundation necessary for a science-based career with a special focus on multidisciplinary learning.

Bachelor Degree (Hons.)

Bachelor Degree (Hons.) aims at providing advanced and specialized theoretical and research skills in the chosen science subject, along with the overall knowledge in the sciences, to provide the students a strong platform for an advanced academic or professional career.

Choice Based Credit System

The Choice Based Credit System (CBCS) provides an opportunity for the students to choose courses from the prescribed courses comprising Core, minor, multi-disciplinary, or skill-based courses.

Credit

Credits means the value assigned to a course which indicates the level of instruction:

1 hour lecture per week equals 1 credit

2 hours practical per week equals 1 credit

Credit for a practical could be proposed as part of a course or as a separate practical course.

SGPA

SGPA means Semester Grade Point Average calculated for individual semesters.

CGPA

CGPA means Cumulative Grade Point Average calculated for all courses completed by the students at any point of time. CGPA is calculated for each year for both semesters clubbed together.

Course

A course is a specific subject in the academic programme taught in a particular semester for the specifically assigned number of credits.

Course Announcement

The college shall announce the elective courses it proposes to offer to the students out of the wider course basket. It is not mandatory to offer all the electives. The decision of the principal shall be final in this case. However, in the spirit of Choice Based Credit System, the college should offer choices to the students for the elective courses and not offer only the minimum number of electives.

Course Registration

It is mandatory for every student, to register every semester, for the elective courses opted for that semester. Each student, on admission shall be assigned to a Faculty Advisor who shall advise him/her about the academic programs and counsel on the choice of courses considering the student's profile, career goals and courses taken in the earlier semesters. With the advice and consent of the Faculty Advisor, the student shall register for a set of courses he/she plans to take up for the Semester. Students shall have to register for the courses for the semester within first week of Semester I and immediately after conclusion of the preceding term for subsequent Semesters II, III, IV, V, VI, VII and VIII.

Course Outcomes

Course outcomes are the specific and measurable attributes defining the knowledge, skill and attitude of the learners are expected to demonstrate by the completion of the course.

Grading System

The Grading System is the 10-point standard scale system defined by the UGC comprising of the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA).

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Graduate Attributes

The Graduate Attributes are the generic abilities, attitudes and approaches expected to be demonstrated by the learner in the world around him/her in a longer period of the life time.

Learning Outcomes

Learning outcomes describe the measurable skills, abilities, knowledge, or values that students should be able to demonstrate as a result of completing a course.

Outcome Based Education (OBE) Approach

OBE is the approach focusing on the performance outcome comprising of the following:

a. The performer – the student (learner), not only the teacher.
b. The performable (thus demonstrable or assessable) to perform
c. The performance outcome, not the activity or task to be performed.

Outcome-Based Assessment

An assessment system that asks course teachers to first identify what it is that we expect students to be able to do once they have completed a course or program. It then asks course teachers to provide evidence that they are able to do so. In other words, how will each learning outcome be assessed? What **evidence of student learning** is most **relevant for each learning outcome** and **what standard or criteria** will be used to evaluate that evidence? Assessment is therefore a key part of outcome-based education and used to determine whether or not a qualification has been achieved.

Programme Educational Objectives

Programme Educational Objectives are a set of **broad future-focused student performance outcomes** that explicitly identify what students will be **able to do with what they have learned**, and what **they will be like** after they leave school and are **living full and productive lives**. Thus, PEOs are what the programme is preparing graduates for in their **career and professional life** (to attain within a **few years** after graduation).

Programme Outcomes

Programme Outcomes are a set of **narrow statements** that describe what learners of the programme are expected to know and be able to perform or attain by the time of graduation.

Programme Specific Outcomes

The PSOs are a set of narrow statements that describe what the learners of a particular specialization of the programme are expected to know and be able to perform or attain by the time of graduation. PSOs are also a function of the various course combinations offered by the college.

Semester

The Semester means the one half of the academic year comprising of the teaching days and examination & evaluation days as per the UGC/ University norms.

Teaching and Learning Activities

The set of **pedagogical tools and techniques** or the teaching and learning activities that aim to **help students to attain** the intended learning outcomes and engage them in these learning activities through the teaching process.

3.0 B.S. AI and ML Programme Focus

Programme Educational Objectives (PEOs)

a) Built strong foundations in core areas of Computer Science with a focus on Artificial Intelligence and Machine Learning so that learners can contribute significantly in the area of research and innovation.
b) Develop professionals with high competency in recent tools and techniques related to Artificial Intelligence and Machine learning.
c) Bring out professionals and entrepreneurs to design and develop solutions for real-world interdisciplinary problems having positive societal impacts.

Programme outcomes (POs)

a) Develop knowledge in the field of Artificial Intelligence and Machine Learning courses necessary to qualify for the B.S. (Hons.) AI and ML degree.
b) Acquire a rich basket of skill enhancement courses and soft skill courses instilling self-confidence and moral values.
c) Understand the concepts of core subjects and have the hands-on skills to demonstrate competency in the domain of AI and ML.
d) Students will develop an ability to perform effectively as a leader and perform excellently with a variety of teams in a multidisciplinary environment.
e) Build young minds with a research attitude concerning the needs of society in the field of Artificial Intelligence and Machine Learning.

f) Apply the concepts of computers and practices via emerging technologies and software development tools to solve pragmatic social concerns.
g) Employ to adopt the modern platforms in terms of employability, and entrepreneurship and also to pursue for their higher studies.

Graduate Attributes (GAs)

These attributes reflect the core competencies necessary for graduates to succeed in the field. The common graduate attributes for B.S. AI and ML courses are:

a) Gain a solid understanding of fundamental computer science concepts including programming languages, such as C, C++, and Java, data structures, algorithms, computer organization, and operating systems.
b) Apply mathematical and statistical concepts, including linear algebra, calculus, basic statistics, probability, and statistical inference to solve AI and ML problems.
c) Demonstrate proficiency in programming languages commonly used in AI and ML, such as Python, and R.
d) Understand and implement fundamental machine learning algorithms and techniques.
e) Develop and optimize algorithms for various artificial intelligence applications.
f) Collect, preprocess, and analyse data for AI and ML applications.
g) Implement effective strategies for data cleaning, transformation, and feature engineering.
h) Design and develop machine learning models for solving real-world problems.

4.0 B.S. AI & ML Programme Course Types and Evaluation Pattern

Sr. No.	Course Type	Credits	Nature	CCE Marks	ECE Marks	Total Marks
1	Major Course	4	Compulsory	50	50	100
2	Minor Course	4	Compulsory	50	50	100
3	Multidisciplinary Course	4	Elective	50	50	100
4	Skill Enhancement Course	2	Elective	25	25	50
5	Ability Enhancement Course	2	Elective	25	25	50
6	Indian Knowledge System/ Value Added Courses	2	Elective	25	25	50

Courses Types Definitions:

1. **Major Course (DSC-C)**
   Discipline-specific course core is a course that a student admitted to a particular programme must successfully complete receiving the degree and which cannot be substituted by any other course.
2. **Minor Course (DSC-M)**
   A discipline Specific Minor Course refers to a set of academic courses that form a focused and specialized area of study within a particular discipline. Students have the option to pursue a minor alongside their major allowing them to gain additional expertise in a specific subject.
3. **Multidisciplinary Course (IDC)**
   A multidisciplinary course is a course chosen generally from a related discipline/subject, intending to seek exposure in the discipline relating to the core domain of the student.

4. **Skill Enhancement Course**
   Skill Enhancement Course is designed to provide students with specific skills or knowledge in addition to their primary academic pursuits. The main purpose of the SEC is to provide students with practical skills, life skills, soft skills, hands-on training, etc. to increase their employability.
5. **Ability Enhancement Course**
   The ability enhancement course is designed to improve students' communication, language, and personality development skills. The main purpose of the AEC is to introduce students to the theory, fundamentals, and tools of communication and to develop in them vital communication skills that should be integral to personal, social, and professional interactions.
6. **Indian Knowledge System**
   Indian Knowledge System refers to the rich and diverse heritage of knowledge, wisdom, and traditions that have evolved over millennia within the Indian subcontinent.

5.0 B.S. Programme Structure

B.S. (Hons.) AIML is a four-year programme divided into eight semesters. A student is required to complete 176 credits for the completion of the programme and the award of B.S. (Hons.) AI and ML degree.

The B.S. (Hons.) AIML programme is aligned with the NEP-2020 structure as given in below Table.

Courses	No. of Papers	Credits Each	Total Credits
1. DSC-Major	23	4	92
2. DSC-Minor	7	4	28
3. IDC-Multi	3	4	12
4. AEC	5	2	10
5. SEC	5	2	10
Internship	1	4	4
6. IKS	4	2	8
OJT/RP	2	6	12
		Total	**176**

Details of Programme

Year	Semester	Course Type (Credits)						
1st Year	Sem-I	Major-1 (4)	Major-2 (4)	Minor-1 (4)	MDC-1 (4)	AEC-1 (2)	SEC-1 (2)	IKS-1 (2)
	Sem-II	Major-3 (4)	Major-4 (4)	Minor-2 (4)	MDC-2 (4)	AEC-2 (2)	SEC-2 (2)	VAC-1 (2)
2nd Year	Sem-III	Major-5 (4)	Major-6 (4)	Major-7 (4)	MDC-3 (4)	AEC-3 (2)	SEC-3 (2)	IKS-2 (2)
	Sem-IV	Major-8 (4)	Major-9 (4)	Major-10 (4)	Minor-3 (4)	AEC-4 (2)	SEC-4 (2)	VAC-2 (2)
3rd Year	Sem-V	Major-11 (4)	Major-12 (4)	Major-13 (4)	Minor-4 (4)	Minor-5 (4)	SEC-5 (2)	-
	Sem-VI	Major-14 (4)	Major-15 (4)	Major-16 (4)	Minor-6 (4)	AEC-5 (2)	Internship (4)	-
4th Year	Sem-VII	Major-17 (4)	Major-18 (4)	Major-19 (4)	Minor-7 (4)	-	OJT/RP-1 (6)	-
	Sem-VIII	Major-20 (4)	Major-21 (4)	Major-22 (4)	Minor-8 (4)	-	OJT/RP-2 (6)	-

6.0 Multiple Entry-Exit Option

The B.S. in AI and ML programme is fully compliant with the Curriculum and Credit Framework for Undergraduate Programmes issued by the UGC. Accordingly, the programme provides the exit option to the learners at the end of the first year with UG Certificate awarded, at the end of the second year with UG Diploma awarded, at the end of the third year with UG Degree awarded and at the end of the fourth year with UG Honors Degree awarded. The learners choosing to exit the programme at the end of the first year or at the end of the second year will be allowed to, subject to successful completion of the relevant portion of the curriculum, shall be allowed to re-enter within a period of three years and complete the degree programme within a period of maximum seven years from the year of the first admission. All the other details are as provided in Sec.3.2.3 of the Curriculum and Credit Framework for Undergraduate Programmes issued by the UGC in December 2022.

7.0 Internship Project

Every learner must undergo and complete the internships/apprenticeships in a firm/ industry/organization or training in labs with faculty or researchers in their own or other college/institute/research institution during the summer term. Completion of the Summer Internship shall be mandatory for every learner choosing to exit at the end of the first year with a UG Certificate or at the end of the second year with a UG Diploma. The Internship Project shall carry the weightage of 4 credits. Since the internship is categorized as Practice, every learner will have to actually produce the work for 120 hours during the internship.

Evaluation of the Internship Project:

It is mandatory for the student to seek advance written approval from the faculty guide and the HOD for the internship and organization before commencing the internship.

a. It is mandatory for the student to seek advance written approval from the faculty guide and the Director of the Institute about the topic and organization before commencing the SIP.
b. Students shall also seek a formal evaluation of their Internship Project from the external guide. The formal evaluation by the external guide shall be done for 50 marks and comment on the nature and quantum of work undertaken by the student, the effectiveness and overall professionalism. The learning outcomes of the Internship Project and utility of the project to the host organization must be specifically highlighted in the formal evaluation by the external guide. The Internship Project evaluation sheet duly signed and stamped by the external guide shall be included in the final Internship report.
c. The completion of the SIP shall be certified by the respective Faculty Guide & approved by the Director of the Institute.
d. The college level evaluation shall be for 50 marks through the Viva-Voce conducted by the faculty guide and HOD of the respective department.
e. Copies of SIP report and records of evaluation shall be maintained by the college for a period of 5 academic years.

8.0 Comprehensive Internal Evaluation (CIE)/Comprehensive Concurrent Evaluation (CCE)

1. The course teacher shall prepare the scheme of Comprehensive Concurrent Evaluation (Formative Assessment) before commencement of the term. The scheme of Comprehensive Concurrent Evaluation shall explicitly state the linkages of each

CCE with the Course Outcomes and define the targeted attainment levels for each CO.

2. The Head of the Department shall approve the scheme of Comprehensive Concurrent Evaluation with or without modifications.
3. The course teacher shall display, on the notice board/ ERP, the approved CCE scheme of the course and the same shall also be hosted on the website, not later than the first week of the term.
4. Each CCE item shall be of minimum 25 marks.
5. For a 4 Credit Course there shall be a MINIMUM of three CCE items. The final scores shall be converted to 50, using an average or best two out of three formulae.
6. For 2 Credit Course there shall be a MINIMUM of two CCE items. The final scores shall be converted to 50.
7. CCE shall be spread through the duration of course and shall be conceptualized, executed, assessed and documented by the course teacher along with student-wise and class-wise attainment levels of the COs and the attainment levels of the course.
8. The assessment outcome of each CCE shall be duly signed by the course teacher & the programme coordinator / HOD of the college.
9. A copy of the duly signed CCE outcome shall be displayed on the notice boards/ ERP, within a week of the assessment and course teachers shall guide the students on a need basis.
10. The college may conduct additional make up / remedial CCE items at its discretion.
11. At the end of the term aggregate CCE scores/grades shall be calculated and the CO attainment levels shall be calculated by the course teacher. The same shall be displayed on the notice board/ ERP.
12. Records of CCE shall be retained for 5 years from the completion of the Academic Year. i.e. Current Academic Year (CAY) + 4 years.

The comprehensive internal evaluation shall be conducted by the college once a semester. The maximum marks for 4 credit courses shall be 50 and for 2 credit courses shall be 25 marks.

9.0 End-Semester Evaluation

1. The End Semester Evaluation (Summative Evaluation) for all the courses shall be conducted by the Examination Department/Committee of the college headed by a full-time regular faculty member nominated by the Principal as Controller of the Examination.
2. The ESE for each course shall have the weightage as follows:
    - For a 4 Credit Course: 50 marks
    - For a 2 Credit Course: 25 marks
3. The ESE for each course shall have 5 questions each of 10 marks. In case of 2 Credit courses the aggregate marks out of 50 shall be converted to the level proportionate to 25 marks.
4. All questions shall be compulsory with internal choice within the questions.
5. The broad structure of the ESE question paper shall be as follows:

Question Number	COGNITIVE ABILITIES EVALUATED	Nature
Q.1	REMEMBERING	Answer any 5 out of 8 (2 marks each)
Q.2	UNDERSTANDING	Answer any 2 out of 3 (5 marks each)
Q.3	APPLYING	Answer 3 (a) or 3 (b) (10 marks)
Q.4	ANALYSING	Answer 4 (a) or 4 (b) (10 marks)
Q.5	EVALUATING	Answer 5 (a) or 5 (b) (10 marks)
	CREATING	

10.0 Passing Standard

A learner shall be said to have earned the credits for a course if he/she earns minimum 36% marks.

Formative Evaluation and Summative Evaluation shall be separate head of passing.

Grading System

The Indirect and Absolute Grading System shall be used, i.e. the assessment of individual Courses in the concerned examinations will be on the basis of marks. However, the marks shall later be converted into Grades by a defined mechanism wherein the overall performance of the learners can be reflected after considering the Credit Points for any given course. The overall evaluation shall be designated in terms of Grade. The 10-point standard scale mandated by UGC shall be used.

The performance of a student will be evaluated in terms of two indices, viz.

(a) Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester

(b) Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Grade Point (Gi) (10 points scale) = Marks of each paper out of 100 / 10

Marks out of 100	Grade Point Range (Gi)	Letter Grade	Classification
96.0-100	10	O	Outstanding
86.0-95.9	9	A+	Excellent
76.0-85.9	8	A	Very Good
66.0-75.9	7	B+	Good
56.0-65.9	6	B	Above Average
46.0-55.9	5	C	Average
36.0-45.9	4	P	Pass
Below 36.0	0	F	Fail
Absent	0	Ab	Absent

The Semester Grade Point Average (SGPA) is the ratio of the sum of the product of the number of credits with the grade point scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$SGPA\ (Si) = \Sigma\ (Ci \times Gi) / \Sigma\ Ci$$

where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

The cumulative grade point average (CGPA) is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.,

$$CGPA = \Sigma\ (Ci \times Si) / \Sigma\ Ci$$

where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that i^{th} semester.

The SGPA and CGPA shall be rounded off to 2 decimal points.

Scaling Down of the CIE Score

The marks obtained by the student for the CCE shall be scaled down, to the required extent, if percentage of the marks of CCE exceeds the percentage of marks scored in the ESE (End Semester University Examination) by 25% for the respective course.

Degree Requirements

The degree requirements for the B.S. AI and ML programme are completion of minimum 136 credits and 180 credits in case of Honours degree.

Maximum Duration for Completion of the Programme

The program of the study is four years of eight semesters. A candidate shall complete his/her degree within **seven (7)** academic years from the date of his/her admission to the first semester.

Grade Improvement

There shall be a provision for candidates to reappear for the examination for the concerned course of theory papers only (subject) in which the candidate wishes for improvement of his/ her grade point of SGPA in general and CGPA in a total of the program subject to the condition that:

a) The candidate shall be eligible to reappear for improvement of grade points only after successfully passing the program.
b) The candidate may opt for the examination for any number of courses (subject/paper) of the programme for improvement of grade points but not more than three times for each course (subject/paper) as per the prevailing syllabus of the examination conducted in the regular schedule of University examinations.
c) All such provisions are there within 04 years from successful completion of the programme, but not exceeding the period of 08 years of the duration of completion of the programme.
d) In all such cases grade points are considered if there is a progress in such improvements, otherwise, original grade points shall be retained.

e) No such candidates shall be eligible for the award of Rank, Gold Medal, Cash Prize, etc.
f) The validity of credits earned will be for a maximum period of seven years or as specified by the Academic Bank of Credits (ABC).

11.0 Attendance

The student must meet the requirement of 75% attendance per semester per course for grant of the term. The college may condone the shortage in attendance in exceptional circumstances, up to a maximum of 10%. The college shall have the right to withhold the student from appearing for examination of a specific course if the above requirement is not fulfilled.

12.0 Medium of Instruction

The medium of instruction and evaluation shall be English.

13.0 Detailed Course List (Annexure-1)

Detailed course list is available in Annexure-1

14.0 Detailed Syllabus for Each Course (Annexure-2)

Detailed syllabus for each course is available in Annexure-2

Annexure 1: Detailed Course List for B.S. (Hons.) AIML

Detailed Course List for B.S. (Hons.) AIML

Year	Sem	Course Type	Course Code	Course Title	Credits T	Credits P	Total
1	Sem-I	DSC-Core	AIML-MJ-111	Fundamentals of Computers & C Programming	3	1	4
		DSC-Core	AIML-MJ-112	Introduction to Artificial Intelligence	3	1	4
		DSC-M	AIML-MN-113	Python Programming	3	1	4
		IDC/Multi	AIML-MD-114	Linear Algebra & Calculus	3	1	4
		AEC	AEC115	Language Through Literature-I	2	-	2
		SEC	AIMLSEC116	Excel Skills for Data Science	1	1	2
		VAC/IKS	IKS117	Indian Knowledge System	2	-	2
	Sem-II	DSC-Core	AIML-MJ-121	Problem Solving and Programming Fundamentals	3	1	4
		DSC-Core	AIML-MJ-122	Digital Logic Fundamentals	3	1	4
		DSC-M	AIML-MN-123	Object Oriented Programming using C++	3	1	4
		IDC/Multi	AIML-MD-124	Descriptive Statistics and Probability Theory	3	1	4
		AEC	AEC125	Language Through Literature-II	2	-	2
		SEC	AIMLSEC126	Advanced Excel Skills for Data Science	1	1	2
		VAC/IKS	VAC127	Interpersonal Skills	2	-	2

Exit Option: Students exiting the programme after securing **44** credits will be awarded an **Advanced UG Certificate in AIML** provided they secure **4** credits in work-based vocational courses offered by the institute during the summer term.

Year	Sem	Course Type	Course Code	Course Title	Credits T	Credits P	Total
2	Sem-III	DSC-Core	AIML-MJ-231	Data Structures and Algorithm	3	1	4
		DSC-Core	AIML-MJ-232	Operating Systems	3	1	4
		DSC-Core	AIML-MJ-233	Fundamentals of R Programming	3	1	4
		IDC/Multi	AIML-MD-234	Mathematical and Statistical Foundation of ML	3	1	4
		AEC	AEC235	Communicative English	2	-	2
		SEC	AIMLSEC236	***SEC-3 Choose any one from Table 1***	1	1	2
		VAC/IKS	IKS237	Environmental Studies	2	-	2
	Sem-IV	DSC-Core	AIML-MJ-241	Machine Learning Fundamentals	3	1	4
		DSC-Core	AIML-MJ-242	Database Management System	3	1	4
		DSC-Core	AIML-MJ-243	Artificial Neural Network	3	1	4
		DSC-M	AIML-MN-244	Statistical Learning	3	1	4
		AEC	AEC245	Communicative English	2	-	2
		SEC	AIMLSEC246	***SEC-4 Choose any one from Table 1***	1	1	2
		VAC/IKS	IKS247	Understanding India	2	-	2

Exit Option: Students exiting the programme after securing **88** credits will be awarded a **UG Diploma in AIML** provided they secure **4** credits in skill-based courses offered by the institute during 1st year or 2nd-year summer term.

Year	Sem	Course Type	Course Code	Course Title	Credits T	Credits P	Total
3	Sem-V	DSC-Core	AIML-MJ-351	AI and ML Project Management	3	1	4
		DSC-Core	AIML-MJ-352	Advance Topics in Machine Learning	3	1	4
		DSC-Core	AIML-MJ-353	Natural Language Processing (NLP)	3	1	4
		DSC-M	AIML-MN-354	Ethics in AI and ML	3	1	4
		DSC-M	AIML-MN-355	Computer Vision	3	1	4
		SEC	AIMLSEC356	***Choose any one from Table 1***	1	1	2
		IKS	-	-	-	-	-

	Sem-VI	DSC-Core	AIML-MJ-361	Cloud Computing	3	1	4
		DSC-Core	AIML-MJ-362	Advanced Topics in Machine Learning	3	1	4
		DSC-Core	AIML-MJ-363	Neural Network and Deep Learning	3	1	4
		DSC-M	AIML-MN-364	Big Data Technologies	3	1	4
		AEC	AEC365	Business Communication	2	-	2
		SEC	SEC-	Internship	4	-	4
		IKS	-	-	-	-	-

Exit Option: Students exiting the programme after securing **132** credits will be awarded **UG Degree B.S. in AIML** provided they have satisfied the credit requirements.

Year	Sem	Course Type	Course Code	Course Title	Credits T	Credits P	Total
4	Sem-VII	DSC-Core	AIML-MJ-471	Emerging Trends in AI and ML	3	1	4
		DSC-Core	AIML-MJ-472	Distributed System	3	1	4
		DSC-Core	AIML-MJ-473	AI and ML in Business	3	1	4
		DSC-M	AIML-MN-474	***Choose any one from Table 1***	3	1	4
		AEC	-	-	-	-	-
		SEC	-	-	-	-	-
		OJT/RP	OJT/RP-1	On-Job Training/Research Project	6	-	6
	Sem-VIII	DSC-Core	AIML-MJ-481	Advanced AI And ML Techniques	3	1	4
		DSC-Core	AIML-MJ-482	Large Language Models	3	1	4
		DSC-Core	AIML-MJ-483	Prompt Engineering	3	1	4
		DSC-M	AIML-MN-484	***Choose any one from Table 1***	3	1	4
		AEC	-	-	-	-	-
		SEC	-	-	-	-	-
		OJT/RP	OJT/RP-2	On-Job Training/Research Project	6	-	6

Students after securing **176** credits will be awarded a **UG B.S. (Hons.) in AIML** provided they have satisfied the credit requirements.

Table 1: List of Elective Courses

Year	Sem	Course Type	Course Code	Course Title	Credits T	Credits P	Total
2	Sem-III	SEC-3	AIMLSEC236	Logic Programming	1	1	2
			AIMLSEC236	Introduction to Web Technology	1	1	2
			AIMLSEC236	Creative Problem Solving & Critical Thinking	1	1	2
	Sem-IV	SEC-4	AIMLSEC246	Building Interactive Dashboard	1	1	2
			AIMLSEC246	Deep Learning and Image Analytics	1	1	2
			AIMLSEC246	Cyber Security	1	1	2
3	Sem-V	SEC-5	AIMLSEC356	Machine Learning in IOT	1	1	2
			AIMLSEC356	Decision Support System	1	1	2
			AIMLSEC356	Sequence Model	1	1	2
4	Sem-VII	DSC-M	AIML-MN-474	Explainable AI	3	1	2
			AIML-MN-474	Robotics	3	1	2
			AIML-MN-474	Image and Video Processing	3	1	2
	Sem-VIII	DSC-M	AIML-MN-484	Bioinformatics	3	1	2
			AIML-MN-484	Reinforcement Learning for Robotics	3	1	2
			AIML-MN-484	Text Processing	3	1	2

Annexure 2 Detailed Syllabus for Each Course

Detailed Syllabus for Sem-I and Sem-II

AIMLM111 Fundamentals of Computers and C Programming

Semester: I	Course Title: Fundamentals of Computers and C Programming	Credit: 4
Course Code: AIMLM111		(3 T + 1 P)

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Enumerate core concept of C Programming.
CO 2	UNDERSTANDING	Discuss programs using Array and String.
CO 3	APPLYING	Develop Functions for any problem.
CO 4	ANALYSING	Classify Union and Structure to write any program.
CO 5	EVALUATING	Implement the concept of Pointers.
CO 6	CREATING	Predict a real-world problem with the help of c programming.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	2	3	2	2
CO 2	3	2	3	2	2
CO 3	2	2	3	2	2
CO 4	1	1	2	1	1
CO 5	2	3	3	2	2
CO 6	3	2	3	3	1

Unit	Detailed Syllabus	Teaching Hours
I	**Computer Fundamentals and Basic Computer Organization** Computer Fundamentals: Introduction to Computers: Characteristics of Computers, Uses of Computers, Types and Generations of Computers, introduction to operating systems, Types of Software; Application software, and system software. Units of a computer, CPU, ALU, memory hierarchy, registers, I/O devices, number system. Techniques of Problem-Solving: Flowchart, decision table, algorithms, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming.	9
II	**Introduction to C Programming** Introduction to C programming language, Data types, Variables, Constants, Identifiers and keywords, Storage classes. Operators and expressions, Types of Statements: Assignment, Control, jumping, Control statements: Decisions, Loops, break, continue. Dynamic memory allocation (malloc, calloc, realloc, free), recursion-definition, Example-Tower of Hanoi problem, Tail Recursion.	9
III	**Arrays and Functions** Arrays: One-dimensional and multidimensional arrays: Declaration, Initialization and array manipulation Functions: Definition, Declaration/Prototyping and Calling, Types of functions,	9

	Parameter passing: Call by value, Call by reference. Passing and Returning Arrays from Functions, Recursive Functions.	
IV	**Pre-processors and Pointers** Pre-processors: Types, Directives, Pre-processors Operators (#,##,\) Pointer: Introduction, declaration of pointer variables, Operations on pointers: Pointer arithmetic, Arrays and pointers, Dynamic memory allocation. String: Introduction, predefined string functions, Manipulation of text data, Command Line Arguments.	9
V	**User Defined Data Types and File Handling** Structure and Unions: Introduction, Declaration, Difference, Application, Nested structure, self-referential structure, Array of structures, Passing structure in function. Files: Introduction, concept of record, I/O Streaming and Buffering, Types of Files: Indexed file, sequential file and random file, creating a data file, Opening and closing a data file, Various I/O operations on data files: Storing data or records in file, adding records, Retrieving, and updating Sequential file/random file. Industry oriented Question solving, Expert talk on Coding challenges.	9

Practical Component		
Lab.	**Title of the Practical**	**Teaching Hours**
1	Write a program to find out the largest of three numbers by using if-else.	2
2	Write a program to find out the largest of three numbers by using the logical operators.	2
3	Write a program to find the roots of a quadratic equation using function and switch statements.	2
4	Write a program to multiply two matrices.	2
5	Write a program to find out the sum of the digits of a number.	2
6	Write a program to find out whether the entered no is Armstrong or not.	2
7	Write a program in which if and else both blocks get their execution.	2
8	Write a program that takes the input as an integer no. from the user and displays its factorial by using recursion.	2
9	Write a program to concatenate the two strings of different lengths.	2
10	Write a program to find out the largest and second largest no. out of given 50 no. using array. Descriptive statistics: mean, median, mode, variance, standard deviation.	2

Suggested Reference Books:

1. B.S. Gottfried - Programming with C - Schaum's Outline Series - Tata McGraw Hill 2nd Edition - 2004.
2. E. Balagurusamy - Programming in ANSI C - Second Edition - Tata McGraw Hill- 1999.
3. Kernighan, Brian, and Dennis Ritchie. The C Programming Language.

AIMLM112 Introduction to Artificial Intelligence

Semester: I	**Course Title: Introduction to Artificial Intelligence**	**Credit: 4**
Course Code: AIMLM112		**(3 T + 1 P)**

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Recall the basic concepts of AI systems, memorize algorithms and techniques used in AI.
CO 2	UNDERSTANDING	Demonstrate the fundamental understanding and history of AI
CO 3	APPLYING	Apply problem-solving skills using the problem-solving methods of AI.
CO 4	ANALYSING	Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents,
CO 5	EVALUATING	Explain the expert systems, artificial neural networks, and other machine learning models
CO 6	CREATING	Describe the applications of AI and propose innovative applications of AI in various fields (healthcare, education, finance, etc.).

CO-PO Mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	1	2	-	-
CO 2	3	-	2	1	2
CO 3	2	1	-	-	2
CO 4	2	1	2	-	-
CO 5	2	-	3	-	3
CO 6	1	-	1	-	-

Unit	Detailed Syllabus	Teaching Hours
I	**Introduction to AI** Introduction to AI, Application, AI future, Intelligent Agents, Typical Intelligent Agents, Problem-Solving Approach to Typical AI Problems.	9
II	**Problem-Solving Methods** Formulating Problems, Search Strategies, Uninformed and Informed, Heuristics, Local Search Algorithms, and Optimization Problems, Searching with Partial Observations, Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search, Game Playing, Optimal Decisions in Games, Alpha – Beta Pruning, Stochastic Games.	9
III	**Knowledge Representation** Introduction, Formal Logics, Propositional Logic, First order Logic, Rule-based system, Representation in FOL, Logic programming using Prolog, Knowledge Engineering, Ontological Engineering, FOL inference.	9
IV	**Software Agent** Introduction, Reasoning Systems for Categories, Reasoning with Default Information, Software Agents, Architecture for Intelligent Agents, Agent Communication, Negotiation and Bargaining, Argumentation among Agents, Trust and Reputation in Multi-agent Systems.	9
V	**Expert Systems** Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert systems shells.	9

Practical Component		
Sr. No.	**Title of the Practical**	**Teaching Hours**
1	Write a Python program to implement a simple Chatbox.	2
2	Write a Python program to for Text Classification in the given sentence.	2
3	Write a Program to Implement Breadth-First Search using Python.	2
4	Write a Program to Implement the Tic-Tac-Toe game using Python.	2
5	Write a Python script to Verify whether a line segment is horizontal, vertical or oblique.	2
6	Write a Python script to represent the list and perform the basic operations on prolog such as Insert, delete, update, and append.	2
7	Write a Program to Implement the Water-Jug problem using Python.	2
8	Write a Python program to implement a simple Chatbox.	2
9	Implement the five components of the expert systems.	2
10	Case study on MYCIN-An expert system.	2

Suggested Books:

1. S. Russell and P. Norvig (2009), Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition.
2. Bratko (2011), Prolog: Programming for Artificial Intelligence, Fourth Edition, Addison-Wesley Educational Publishers Inc.
3. M. Tim Jones (2008), Artificial Intelligence: A Systems Approach (Computer Science), Jones and Bartlett Publishers Inc.; First Edition.
4. William F. Clocksin and Christopher S Mellish (2003), Programming in Prolog: Using the ISO Standard, Fifth Edition, Springer.
5. Ebook: https://www.cin.ufpe.br/~tfl2/artificial-intelligence-modern-approach.9780131038059.25368.pdf

AIMLE113 Python Programming

Semester: I	**Course Title: Python Programming**	**Credit: 4**
Course No.: AIMLE113		**(3 T + 1 P)**

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Remember the basic data structures, operators, decision-making statements, and loop statements in Python.
CO 2	UNDERSTANDING	Understand the basics of writing Python code.
CO 3	APPLYING	Apply the concepts of decision-making statements, loop constructs, and functions for solving basic programs.
CO 4	ANALYSING	Analyze the concept lists, tuples, and error-handling mechanisms.
CO 5	EVALUATING	Evaluate a program incorporating all the Python constructs.
CO 6	CREATING	Create programs for incorporating the programming constructs.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	-	1
CO 2	1	2	1	-	-
CO 3	3	1	2	1	-
CO 4	2	2	1	-	-

CO 5	3	1	1	-	1
CO 6	-	1	-	1	-

Unit	Detailed Syllabus	Teaching Hours
I	**Introduction, Data types** Introduction to Python – Advantages of using Python – Executing Python Programs – Python's Core data types – Numeric Types – String Fundamentals.	9
II	**Lists, Tuples, Dictionaries** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension.	9
III	**Control Flow, Functions, Modules** Python Statements: Assignments – Expressions – If condition – While and For Loops. Functions: Definition, Calls – Scopes – Arguments – Recursive Functions– Functional Programming tools. Classes and Object-Oriented programming with Python - Modules and Packages: Purpose, using packages– Exception Handling with Python.	9
IV	**Packages** Packages: NumPy, Pandas, Scikit learn - Machine learning with Python – Cleaning up, Wrangling, Analysis, Visualization - Matplotlib package – Plotting Graphs.	9
V	**File Handling** Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions	9

Practical Component		
Sr. No.	**Title of the Practical**	**Teaching Hours**
1	Exchange the values of two variables.	2
2	Finding minimum among n variables.	2
3	Perform Simple sorting.	2
4	Generate Student's marks statement.	2
5	Find square root, GCD, exponentiation.	2
6	Sum the array of numbers.	2
7	Perform linear search, binary search.	2
8	Perform Matrix operations using NumPy.	2
9	Perform Dataframe operations using Pandas.	2
10	Use Matplotlib on the dataset and visualize.	2
11	Perform Word count, copy file operations.	2

Suggested Reference Books:

1. Mark Lutz, "Learning Python", Fifth Edition, O'Reilly, 2013.
2. Daniel Liang, "Introduction to programming using Python", Pearson, First edition, 2021.
3. Wes Mc Kinney, "Python for Data Analysis", O'Reilly Media, 2012.
4. Tim Hall and J-P Stacey, "Python 3 for Absolute Beginners", Apress, First Edition, 2009.
5. Magnus Lie Hetland, "Beginning Python: From Novice to Professional", Apress, Second Edition, 2005.
6. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second edition, Updated for Python 3, Shroff O'Reilly Publishers, 2016

7. John V Guttag, ―Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013.
8. Timothy A. Budd," Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
9. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
10. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley India Edition, 2013

AIMLMDC114 Linear Algebra and Calculus

Semester: I	Course Title: Linear Algebra and Calculus	Credit: 4
Course No.: AIMLMDC114		4 T

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Apply the Matrix Methods to solve the system of linear equations.
CO 2	UNDERSTANDING	Test the convergence and divergence of the infinite Series.
CO 3	APPLYING	Determine the extreme values of functions of two variables.
CO 4	ANALYSING	Apply the vector differential operator to scalar and vector functions.
CO 5	EVALUATING	Solve line, surface & volume integrals by Green's theorem.
CO 6	CREATING	

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1					
CO 2					
CO 3					
CO 4					
CO 5					
CO 6					

Unit	Detailed Syllabus	Teaching Hours
I	**Matrices** Rank of a matrix, Echelon form, consistency of linear System of equations, Linear dependence of vectors, Eigenvalues, Eigenvectors, Properties of Eigenvalues, Cayley-Hamilton theorem, Quadratic forms, Reduction of quadratic form to canonical form by a linear transformation, Nature of quadratic form.	12
II	**Infinite Series** Definition of Convergence of sequence and series. Series of positive terms – Necessary condition for convergence, Comparison tests, limit form comparison test, D'Alembert's Ratio test, Raabe's test, Cauchy's root test, alternating series, Leibnitz's rule, absolutely and conditionally convergence.	12
III	**Partial Differentiation and Its Applications** Functions of two or more variables, Partial derivatives, Higher order partial derivatives, Total derivative, Differentiation of implicit functions, Jacobians,	12

	Taylor's expansion of functions of two variables, Maxima and minima of functions of two variables.	
IV	**Vector Differential Calculus** Scalar and vector point functions, vector operator Del, Gradient, Directional derivative, Divergence, Curl, Del applied twice to point functions, Del applied to the product of point functions (vector identities). Applications: Irrotational fields and Solenoidal fields.	12
V	**Vector Integral Calculus** Line integral, Surface integral, and Volume integral. Green's theorem in the plane, verifications of Stroke's theorem (without proof) and Gauss's divergence theorem (without proof).	12

Suggested Reference Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015
3. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.
4. R.K. Jain, S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th edition, 2016.

AEC115 Language Through Literature-I

Semester: I	**Course Title: Language Through Literature-I**	**Credit: 2**
Course Code: AEC115		**Hours: 2/week**

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	
CO 2	UNDERSTANDING	Students will develop an appreciation for diverse literary forms, demonstrating an ability to analyze and interpret stories and poems in English.
CO 3	APPLYING	Students will exhibit improved grammatical competence, applying correct grammar and syntax in written and spoken communication.
CO 4	ANALYSING	Students will acquire the ability to understand and critically evaluate scientific articles, research papers, and lab reports, demonstrating improved scientific literacy.
CO 5	EVALUATING	Students will showcase overall language proficiency, enabling effective communication in various contexts.
CO 6	CREATING	

Unit	Content	Teaching Hours
I	Text: *Sparkles* (Macmillan Publication) Section – I	10
II	Text: *Sparkles* (Macmillan Publication) Section – II	10

III	Grammar **A)** BE, HAVE and DO as Lexical Verbs **B)** Tenses: • Simple Present Tense • Simple Past Tense • Simple Future Tense • Present Continuous Tense • Past Continuous Tense • Present Perfect Tense • Past Perfect Tense • Present Perfect Continuous Tense	5
IV	**A)** Comprehension of Scientific articles, scientific texts • The passage should be of 200-300 words. • The questions should measure the student's ability to comprehend the main ideas, relevant facts and arguments, and the logical relationship between various ideas and facts presented in the passage. • A total of four questions will be asked from the passage. B)Vocabulary(Textual Glossary)	5
V	PRACTICAL Speaking: To enable the students to • Greeting and formulae of everyday conversation • Introduce themselves • Making a request, saying no politely	10

References Books:

• *Oxford Practice Grammar (Advanced)* - George Yule – OUP.
• *Advanced Grammar in Use* - Martin Hewings - Cambridge University Press.
• *English Grammar for Students* - Anne Seaton and Y H Mew - Learner's Publishing.
• *A Practical English Grammar* - A J Thomson and A V Martinet – OUP.
• *Better English* - Betty Kirkpatrick - Geddes and Grosset.
• *Contemporary English Grammar Structures and Composition* – David Green - Trinity Press.

AIMLSEC116 Essential Excel Skills for Data Science

Semester: I	**Course Title: Essential Excel Skills for Data Science**	**Credit: 2**
Course Code: AIMLSEC116		**Hours: 3/week**

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Remember Excel shortcuts
CO 2	UNDERSTANDING	Understand Excel formulas (relative and absolute). Understand the basic functions of Excel.
CO 3	APPLYING	Describe the sample data with suitable Excel functions like

		sum, average, median, var, stdev, etc.
CO 4	ANALYSING	Analyze the sample data from various domains using Excel.
CO 5	EVALUATING	Summarize the data using suitable charts and graphs. Summarize the data using Excel basic functions.
CO 6	CREATING	Students can visualize the data graphically and summarize the data numerically for real-life data analysis problems.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	1	1	1	-
CO 2	2	1	-	1	-
CO 3	-	2	3	-	-
CO 4	1	1	2	2	1
CO 5	1	1	2	1	-
CO 6	1	1	2	3	1

Unit	Detailed Syllabus	Teaching Hours
I	**Introduction to MS Excel** • Importance of MS Excel. Understand workbooks and worksheets. Entering and editing data. Formatting cells. Creating and managing cell styles. Formatting numbers and labels. • Editing worksheet and cells. Add, edit, and delete comments. Lock and protect cells. • Enter basic formulas. Absolute and relative references. Basic functions. • Working with range names. • Create charts and graphs. Format charts and graphs. • Filtering, sorting, and conditional formatting • Calculations and functions: sum, average, min, max, and, or, not, if	15
II	**Practical Based on Unit-I** 1. Understanding spreadsheet elements. Data Entering and editing. 2. Basics of formulas in Excel. Relative and Absolute referencing. 3. Basic Functions in Excel. Working with range names. 4. Creating formatting Charts and graphs. 5. Use of various functions like sum, average, min, max, and, or, not, if 6. Filtering, sorting of the data 7. Use of conditional formatting.	30

Suggested Reference Books:

1. Microsoft Excel: Data Analysis and Business Model, PHI, Wayne, WL, 2019.
2. Microsoft Excel Formulas and Functions Dummies, Ken Bluttman, 2020.

IKS117 Indian Knowledge Systems

Semester: I	Course Title: Indian Knowledge Systems	Credit: 2
Course Code: IKS117		Hours: 2/week

Unit	Topic	Teaching Hours

I	**Introduction to IKS** o Introduction to IKS& Its importance ▪ Introduction &importance ofI KS ▪ Various IKS Systems o Shashtra – Foundational Literature of Bharatvarsha ▪ What is Shashtra? ▪ Importance of Shashtra ▪ Classification of Shashtra – Vaidic & Avaidic (with examples of imp. Literature) o Base of IKS proliferation ▪ Bhartiya Education System and its philosophy ▪ History of BES from Ancient to Modern ▪ Domains of Education: Gurukul, Pathshala, Vidyalay, Vishva vidyalay	**15**
II	**Contribution of IKS to the World** ▪ Mathematics &Astronomy ▪ Number System ▪ Algebra & Arithmetic ▪ Geometry ▪ Trigonometry ▪ Planetary System ▪ Speed of Light ▪ Eclipse o Life sciences ▪ Physics ▪ Chemistry ▪ Botany o Metal Technology ▪ Mining Techniques ▪ Types of Metals ▪ Tools & Techniques for Metal Smelting with examples o Town planning &Temple Architecture ▪ Indigenous tools & technologies for town planning & Temple Architecture ▪ Science of Architecture ▪ Lothal, MohanJoDaro, Dholavira o Angkorvat, Lepakshi Temple,J agannath Puri Temple, Thanjavur Temple, Modhera and Konark Sun Temple, Hampi Temple Etc. o Ayurveda ▪ Introduction of Ayurveda- Definition, Branches of Ayurveda, Books and Pioneers ▪ Concept of Tri Dosh and the importance of its Balance in the body ▪ Indic Medical Science Achievement: Tools & Technology o Art &Traditions ▪ History and Origin ▪ SkillEnhancementwith64Kala ▪ Science behind our traditions and rituals	**15**

Reference Books:

- Introduction to Indian Knowledge System-Concept and Application by B. Mahadevan, Vinayak Rajat Bhat, Nagendra Pavan R.N.
- R.M.Pujari, Pradeep Kolhe, N.R. Kumar, 'Pride of India: AGlimpse into India's Scientific Heritage', Samskrita Bharati Publication.
- 'Indian Contribution to science', compiled by Vijnana Bharati.
- 'Knowledge Traditions and Practices of India', Kapil Kapoor, Michel Danino, CBSE, India.

- Dr. Subhash Kak, Computation in Ancient India, Mount, Meru Publishing (2016)
- Dharampal, Indian Science and Technology in the Eighteenth Century, Academy of Gandhian Studies, Hyderabad, 1971, republ. Other India Bookstore, Goa, 2000
- Robert Kanigel, The Man Who Knew Infinity: A Life of the Genius Ramanujan, Abacus, London, 1999
- Alok Kumar, Sciences of the Ancient Hindus: Unlocking Nature in the Pursuit of Salvation, CreateSpace Independent Publishing, 2014
- B.V. Subbarayappa, Science in India: A Historical Perspective, Rupa, New Delhi, 2013
- S. Balachandra Rao, Indian Mathematics and Astronomy: Some Landmarks, Jnana Deep Publications, Bangalore, 3rd ed., 2004

AIMLM121 Problem Solving and Programming Fundamentals

Semester: II	Course Title: Problem Solving & Programming Fundamentals	Credit: 4
Course Code: AIMLM121		(3 T + 1 P)

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Remember basic data types and basic concepts of programming language.
CO 2	UNDERSTANDING	Understand the basic concepts of programming languages, including syntax and semantics.
CO 3	APPLYING	Apply programming constructs like loops, conditionals, and functions in practical scenarios.
CO 4	ANALYSING	Analyze code to identify and fix errors using debugging techniques.
CO 5	EVALUATING	Create and implement logic using operators and control statements.
CO 6	CREATING	Create modular programs using functions and procedures, emphasizing good programming practices.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	2	1
CO 2	2	3	3	2	-
CO 3	2	2	2	3	-
CO 4	2	3	2	2	-
CO 5	3	3	2	2	1
CO 6	2	3	2	3	-

Unit	Detailed Syllabus	Teaching Hours
I	**Introduction to Computer Problem-Solving** The Problem-solving Aspect - Top-down Design - Implementation of Algorithms - Program Verification - The Efficiency of Algorithms - The	9

	Analysis of Algorithms	
II	**Basic programming constructs** Basic Data types (Numerical, String) – Variables – Expressions – statements -I/O statements for keyboard handling, Editing, compiling/ interpreting/running programs - Syntax errors and runtime errors - Comparison of language model with von Neumann architecture.	9
III	**Decision Making – Branching & Looping** Decision making within a program – Conditions - Relational Operators - Logical Connectives - if statement, if-else statement. Loops: while loop - do while - for loop - Nested loops - Infinite loops - Switch statements.	9
IV	**Array Techniques** One-dimensional array: Array Manipulation - Different operations on one-dimensional arrays - two-dimensional array - operations on two-dimensional arrays - multi-dimensional array - dynamic arrays - Character Arrays and Strings.	9
V	**Modular solutions** Introduction to functions - Importance of design of functions -Rewriting earlier solutions using functions - Arguments – Parameters - return values – signature - local and global scope - Modular code - Recursion	9

Practical Component		
Sr. No.	**Title of the Practical**	**Teaching Hours**
1	Program to array counting, array order reversal & find the maximum number in a set.	2
2	Program for removal of duplicates from an ordered array & to partition an array.	2
3	Program to find the kth smallest element.	2
4	Program to exchange the values of two variables without using a third variable	2
5	A program that takes a list of numbers as input and counts the total number of elements in the list.	2
6	Program to calculate the sum of a set of numbers entered by the user.	2
7	Program to compute the factorial of a given integer.	2
8	Program to compute the sine of an angle (in degrees) using a series expansion.	2
9	Program to generate the Fibonacci sequence up to a specified limit.	2
10	A program that takes an integer as input and reverses its digits.	2
11	Program that converts a number from one base to another (e.g., binary to decimal, decimal to binary).	2

Suggested Reference Books:

1. E. Balaguruswamy, “Programming In ANSI C”, 4th edition, TMH Publications, 2007.
2. R. G. Dromey, “How to solve it by Computer”, Pearson Education, 2007.
3. Yashwant Kanetkar, “Let Us C”, 13th Edition, PHP, 2013.
4. Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.

AIMLM122 Digital Logic Fundamentals

Semester: II	Course Title: Digital Logic Fundamentals	Credit: 4
Course Code: AIMLM122		(3 T + 1 P)

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Remembering the digital systems and performing arithmetic operations.
CO 2	UNDERSTANDING	Understanding the postulates of Boolean algebra and minimizing combinational functions.
CO 3	APPLYING	Use Boolean simplification techniques to design a combinational hardware circuit.
CO 4	ANALYSING	Design and analyze combinational and sequential circuits.
CO 5	EVALUATING	Evaluate the techniques for the design of digital circuits.
CO 6	CREATING	Design and analysis of a given digital synchronous hardware circuit.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	2	3	1	1
CO 2	2	1	1	2	2
CO 3	1	1	-	2	-
CO 4	2	1	2	1	1
CO 5	3	2	3	-	1
CO 6	1	2	1	3	-

Unit	Detailed Syllabus	Teaching Hours
I	**Digital Systems and Binary Numbers** Digital Systems - Binary Numbers - Number-Base Conversions - Octal and Hexadecimal Numbers - Complements of Numbers - Signed Binary Numbers - Binary Codes - Binary Storage and Registers - Binary Logic - Axiomatic Definition of Boolean Algebra - Basic Theorems and Properties of Boolean Algebra - Boolean Functions Canonical and Standard Forms - Other Logic Operations - Digital Logic Gates - Integrated Circuits	9
II	**Gate-Level Minimization** Introduction - The Map Method - Four-Variable K-Map - Product-of-Sums Simplification - Don't-Care Conditions - NAND and NOR Implementation – Other Two-Level Implementations - Exclusive-OR Function - Hardware Description Language	9
III	**Combinational Logic** Introduction - Combinational Circuits - Analysis Procedure - Design Procedure - Binary Adder–Subtractor - Decimal Adder - Binary Multiplier - Magnitude Comparator – Decoders – Encoders – Multiplexers - HDL Models of Combinational Circuits.	9
IV	**Synchronous Sequential Logic** Introduction - Sequential Circuits - Storage Elements: Latches - Storage Elements: Flip-Flops - Analysis of Clocked Sequential Circuits - Synthesizable HDL Models of Sequential Circuits - State Reduction and Assignment - Design Procedure	9

V	**Registers and Counters** Registers - Shift Registers - Ripple Counters - Synchronous Counters - Other Counters - HDL for Registers and Counters	9

Practical Component		
Sr. No.	**Title of the Practical**	**Teaching Hours**
1	Binary to Decimal and vice-versa in Python.	2
2	Decimal to Hexadecimal and Vice-Versa in Python.	2
3	Digital Logic Gates in Python.	2
4	Simplification of Boolean Functions in Python.	2
5	Combinational Logic Circuits in Python i. Code Converters ii. Arithmetic (Adders, Subtractors, Multipliers, Comparators) iii. Data Handling (Multiplexers, Demultiplexers, Encoders & Decoders).	2
6	Combinational Logic Circuit Design in Python.	2
7	Binary Adder-Subtractor Simulation in Python.	2
8	Decimal Adder Simulation in Python.	2
9	Binary Multiplier Simulation in Python.	2
10	Sequential Circuit Storage Elements: Flip-Flop Simulation in Python.	2

Suggested Reference Books:

1. M. Morris Mano, Michael D. Ciletti, Digital Design With an Introduction to the Verilog HDL, Pearson, Fifth Edition, 2013, ISBN-13: 978-0-13-277420-8, ISBN-10: 0-13-277420-8.
2. M. Rafiquzzaman, Fundamentals of Digital Logic and Microcomputer Design, John Wiley & Sons, Inc., Fifth Edition, 2005.

AIMLM123 Object-Oriented Programming Using C++

Semester: II	**Course Title: Object-Oriented Programming Using C++**	**Credit: 4**
Course Code: AIMLM123		**(3 T + 1 P)**

Course Outcomes: On successful completion of the course the learner will be able to

CO	**COGNITIVE ABILITIES**	**COURSE OUTCOMES**
CO 1	REMEMBERING	Describe the procedural and object-oriented paradigm with concepts of streams, classes, functions, data, and objects.
CO 2	UNDERSTANDING	Demonstrate the various basic programming constructs like decision-making statements. Looping statements and functions.
CO 3	APPLYING	Explain object-oriented concepts like overloading, inheritance, polymorphism, virtual functions, constructors, and destructors.
CO 4	ANALYSING	Explain the various file stream classes; file types, usage of templates, and exception-handling mechanisms.
CO 5	EVALUATING	Compare the pros and cons of procedure-oriented language with the concepts of object-oriented language.
CO 6	CREATING	Develop programs incorporating the programming constructs of object-oriented programming concepts.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	1	1	2
CO 2	3	2	2	-	3
CO 3	3	2	1	-	2
CO 4	3	2	3	-	3
CO 5	2	3	3	-	3
CO 6	2	3	1	-	1

Unit	Detailed Syllabus	Teaching Hours
I	**Introduction** Introduction to C++ - key concepts of Object-Oriented Programming – Advantages - Object Oriented Languages - I/O in C++ - C++ Declarations. Control Structures: - Decision Making and Statements: If-else, jump, goto, break, continue, Switch case statements - Loops in C++: for, while, do - functions in C++ - inline functions - Function Overloading	9
II	**Classes And Objects** Classes and Objects: Declaring Objects - Defining Member Functions -Static Member variables and functions - array of objects - friend functions - Overloading member functions - Bit fields and classes - Constructor and destructor with static members.	9
III	**Operator Overloading** Operator Overloading: Overloading unary, binary operators - Overloading Friend functions - type conversion - Inheritance: Types of Inheritance - Single, Multilevel, Multiple, Hierarchal, Hybrid, Multi path inheritance - Virtual base Classes - Abstract Classes.	9
IV	**Pointers** Pointers - Declaration - Pointer to Class, Object - this pointer - Pointers to derived classes and Base classes - Arrays - Characteristics - array of classes - Memory models - new and delete operators - dynamic object - Binding, Polymorphism and Virtual Functions.	9
V	**File Stream Classes** Files – File stream classes - file modes - Sequential Read/Write operations - Binary and ASCII Files - Random Access Operation - Templates - Exception Handling - String - Declaring and Initializing string objects - String Attributes - Miscellaneous functions.	9

Practical Component		
Sr. No.	**Title of the Practical**	**Teaching Hours**
1	Write a C++ Program to create a class to implement the data structure STACK**.**	2
2	Write a C++ Program to create a class ARITHMETIC which consists of a FLOAT and an INTEGER variable.	2
3	Write a C++ Program to read an integer number and find the sum of all the digits until it reduces to a single digit using constructors, destructors, and inline member functions.	2
4	Write a C++ Program to create a class FLOAT that contains one float data	2

	member.	
5	Write a C++ Program to create a class STRING.	2
6	Write a C++ Program to create a class, which consists of EMPLOYEE Details like E_Number, E_Name, Department, Basic, Salary, and Grade.	2
7	Write a C++ Program to create a class SHAPE which consists of two VIRTUAL FUNCTIONS.	2
8	Write a C++ Program to create two classes each class consists of two private variables, an integer, and a float variable.	2
9	Write a C++ Program using Function Overloading to read two Matrices of different Data Types such as integers and floating point numbers.	2
10	Write a C++ Program to check whether the given string is a palindrome or not using Pointers.	2
11	Write a C++ Program to create a File and to display the contents of that file with line numbers.	2
12	Write a C++ Program to merge two files into a single file.	2

Suggested Reference Books:

1. Cay S. Horstmann, Gary Cornell, Core Java Volume-I Fundamentals, 9th Edition, Prentice Hall, 2013.
2. Herbert Schildt, Java The complete reference‖, 8th Edition, McGraw Hill Education, 2011.
3. Paul Deitel, Harvey Deitel, —Java SE 8 for programmers, 3rd Edition, Pearson, 2015.
4. Steven Holzner, —Java 2 Black book‖, Dreamtech press, 2011.

AIMLMDC124 Descriptive Statistics & Probability Theory

Semester: II	**Course Title: Descriptive Statistics & Probability Theory**	**Credit: 4**
Course Code: AIMLMDC124		**(3 T + 1 P)**

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Recall the types of data and when to use which type of data. Remember when to use which type of charts and graphs.
CO 2	UNDERSTANDING	Understand various measures of central tendency, dispersion, skewness, and kurtosis. Summarize the information in the data using different charts and summary measures. Understand the measures of correlation.
CO 3	APPLYING	Apply the theory of descriptive statistics and probability theory to various real-life situations. Apply various probability distributions to real-life situations.
CO 4	ANALYSING	Explain the definition of independence of events, the concept of conditional probability, and Bayes' theorem.
CO 5	EVALUATING	Evaluate the relationship between the variables and apply regression analysis to the real-life data.
CO 6	CREATING	Formulate univariate and bivariate probability distributions.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	2	1
CO 2	2	3	3	2	1

CO 3	2	2	2	3	2
CO 4	2	3	2	2	1
CO 5	3	3	2	2	1
CO 6	3	3	2	3	1

Unit	Detailed Syllabus	Teaching Hours
I	**Descriptive Statistics** Classification of data: Qualitative, Quantitative: Discrete, Continuous; Chronological (Time series) data. Data Types: Nominal, Ordinal, Interval, and Ratio data. Frequency: grouped and ungrouped data; Construction of frequency and cumulative frequency distribution. Presentation of qualitative data: Tabulation (up to four attributes). Graphical representation of grouped data: Histogram, frequency curve, frequency polygon, ogives (cumulative frequency curves), Diagrammatic representation of data: Bar diagrams- simple Bar, multiple bars, sub-divided bar, and percentage bar diagrams. Pie diagrams. Stem - Leaf plot. Bivariate: Frequency distribution, Marginal and Conditional frequency distributions	9
II	**Measures of Central Tendency** Concept of central tendency, various measures of central tendency, and their interrelationship. Their merits and demerits. The empirical relation between mean, median, and mode. Properties and applications of measures of central tendency. Partition values (quartiles, deciles and percentiles.) **Measures of Dispersion and Moments** Concept of variation/dispersion, quartile deviation, Absolute and relative measures of dispersion with their merits, demerits, and applications. Moments: raw moments, central moments, factorial moments, and their interrelationship. Skewness, Kurtosis and their measures.	9
III	**Introduction to Probability** Random Experiment, trial, sample point, sample space, definitions of equally likely, mutually exclusive, and exhaustive events. Definition of probability: classical, relative, and axiomatic approach and its properties. Conditional probability, multiplicative law of probability. Independence of events, law of total probability, Bayes theorem and its applications. **Random Variables (Univariate & Bivariate)** Random Variable (rv) with its types, probability mass function (pmf), probability density function (pdf), cumulative distribution function (cdf) with illustrations. The expectation of Random variables with properties, Expectation of a function of random variable, moment generating function (mgf), cumulant generating function (cgf), probability generating function (pgf) and their properties. Measures of location, skewness and kurtosis. Concept of Joint Distributions, Joint probability mass function, and Joint probability density function. Marginal and conditional distributions,	9

	independence of random variables.	
IV	**Discrete Probability Distributions:** Discrete Uniform, Bernoulli's, Binomial, Poisson, Hypergeometric distributions and their properties. **Continuous Probability Distributions:** Rectangular, Normal, and Exponential distributions and their properties. Chebyshev's Theorem and Empirical Rule, Z-scores and Percentiles	9
V	**Correlation and Regression** Bivariate data, Scatter diagram, and interpretation. Concept of correlation between two variables, positive correlation, negative correlation, no correlation. Covariance between two variables: Definition, computation, effect of change of origin and scale. Karl Pearson's coefficient of correlation and its properties. Computation for ungrouped data and grouped frequency distributed data with interpretation. Correlation Ratio, Spearman's rank correlation coefficient, Kendall's Tau. Meaning of regression, the difference between correlation and regression. Concept of error in regression, error modeled as a continuous random variable. Simple linear regression model. Estimation of unknown constants by the method of least squares. Interpretation of parameters.	9

Practical Component		
Sr. No.	**Title of the Practical**	**Teaching Hours**
1	Methods of Classification and Construction of Frequency Distribution. (One-way and Two-Way).	2
2	Present the data using various diagrams and graphs.	2
3	Computation of measures of central tendency & dispersion.	2
4	Computation of partition values and their applications.	2
5	Computation of moments and their applications.	2
6	Computation of coefficient of skewness and kurtosis and its interpretation.	2
7	Computation of correlation coefficient and its interpretation.	2
8	Computation of Spearman's and Kendall's Tau coefficient and its interpretation.	2
9	Fitting of a simple linear regression model.	2

Suggested Reference Books:

1. Introduction to the Practice of Statistics, Moore, S. David; McCabe, P. George W. H. Freeman and Company, New York.
2. Basic Statistics, Agarwal, B. L., New Age International (P) Ltd.
3. Introduction to the theory of Statistics, Mood, A. M., Greybill, F.A., Boes, D.C., Mc Graw Hill.
4. Probability and Statistics for Engineers and Scientists. Devore, J.L. Cengage Learning, New Delhi 8th Edition, 2014.
5. Mathematical Statistics, P. Mukhopadhyay, New Central Book Agency (P) Ltd, Calcutta
6. An Introduction to Probability and Statistics, V. K. Rohatgi and A.K.Md. Ehsanes Saleh, Wiley Series.

AEC125 Language Through Literature-II

Semester: II	Course Title: Language Through Literature-II	Credit: 2
Course Code: AEC125		Hours: 2/week

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	
CO 2	UNDERSTANDING	Students will demonstrate an increased interest in reading stories and poems in English, developing a habit of literary exploration.
CO 3	APPLYING	Students will exhibit proficiency in identifying and using different sentence types, articles, and question tags in written and spoken English
CO 4	ANALYSING	Students will apply learned grammatical concepts effectively in communication, showcasing improved language precision
CO 5	EVALUATING	Students will be adept at constructing grammatically correct sentences in English, and understanding and implementing English syntax principles.
CO 6	CREATING	Students will demonstrate the ability to choose and use appropriate words and expressions in various contexts, enhancing their communication skills in English

Unit	Content	Teaching Hours
I	Text: *Sparkles* (Macmillan Publication) Section – III	10
II	Text: *Sparkles* (Macmillan Publication) Section– IV	10
III	Grammar **A)** Articles **B)** Types of Sentences • Question Tags	10
IV	Practical **A)** Jumbled Sentences **B)** Cloze Test • The passage for the Cloze Test will contain a total of four blanks (one mark each) and for each blank three options will be given. Describing scientific processes/ experiments	10

References Books:

• Oxford Practice Grammar (Advanced) - George Yule – OUP.
• Advanced Grammar in Use - Martin Hewings - Cambridge University Press.
• English Grammar for Students - Anne Seaton and Y H Mew - Learner's Publishing.
• A Practical English Grammar - A J Thomson and A V Martinet – OUP.
• Better English - Betty Kirkpatrick - Geddes and Grosset.
• Contemporary English Grammar Structures and Composition – David Green - Trinity Press.

AIMLSEC126 Advanced Excel Skills for Data Science

Semester: II	Course Title: Advanced Excel Skills for Data Science	Credit: 2
Course Code: AIMLSEC126		Hours: 2/week

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Remember Excel functions, data validation tools.
CO 2	UNDERSTANDING	Understand Advanced Excel formula and other data validation tools.
CO 3	APPLYING	Apply pivoting technique to summarize the real-life data. Apply slicers to the data in excel. Applying page layout to excel worksheet.
CO 4	ANALYSING	Analysing data using advanced excel functions and techniques.
CO 5	EVALUATING	Summarize the data using suitable filtering and pivot table techniques.
CO 6	CREATING	Students can visualize the data using charts and slicers.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	1	1	1	-
CO 2	1	1	1	2	-
CO 3	1	1	3	1	-
CO 4	2	1	3	1	-
CO 5	1	1	2	1	-
CO 6	1	1	2	3	1

Unit	Detailed Syllabus	Teaching Hours
I	**Advanced MS Excel** • Advance functions: ifs, sumif, sumifs, averageif, averageifs, lookup, vlookup and hlookup • Data Validation • Create and modify pivot tables, value field settings, Sorting and filtering pivot tables. • Charts and Slicers. • Page layouts, and page setup.	15
II	**Practical Based on Unit-I** 1. Use of advanced Excel functions: ifs, sumif, sumifs, averageif, averageifs. 2. Use of lookup, vlookup, hlookup functions 3. Creating and modifying pivot tables. 4. Use of data validations. 5. Charts and slicer	30

Suggested Reference Books:

1. Microsoft Excel: Data Analysis and Business Model, PHI, Wayne, WL, 2019.
2. Microsoft Excel Formulas and Functions Dummies, Ken Bluttman, 2020.

VAC127 Interpersonal Skills

Semester: II	Course Title: Interpersonal Skills	Credit: 2
Course Code: VAC127		Hours: 2/week

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Identify and analyze different communication styles and understand their strengthsand weaknesses
CO 2	UNDERSTANDING	Demonstrate active listening skills and questioning styles to explore issues andenhance understanding
CO 3	APPLYING	Identify conflict response styles; approach and effectively mediate workplaceconflicts.
CO 4	ANALYSING	Determine ways to build and maintain trust and increase your influence and eminence in the workplace
CO 5	EVALUATING	
CO 6	CREATING	

Unit	Topics	Teaching Hours
I	➢ Effective Communication 1. Art Of Listening • Introduction • What is listening? • Benefits of active listening • Factors that hamper listening • Common poor listening habits. 2. Art Of Speaking • Art of public speaking • Importance of public speaking • Public speaking tips • Overcoming fear of public speaking 3. Art Of Writing E -mail • Introduction • The mail magic • Use appropriate salutations • Make the subject matter significant • Reread before pressing the "send" button – Be polite,and reciprocate good deeds	15
II	➢ Team Building and Conflict Management 1. Body Language 2. Body language in building interpersonal relations – Body language in building industrial relations 3. Interpreting body language Developing confidence with correct body language. ➢ Skill needed for teamwork	15

Reference

1. Soft Skills Know Yourself And Know The World, Author: Dr. K. ALEX, Publication: S.CHAND, First Edition: 2009, Reprint: 2023
2. Barnlund, Dean C. "A Transactional Model of Communication," in Foundations of Communication Theory, eds. Kenneth K. Sereno and C. David Mortensen (New York, NY: Harper and Row, 1970), 83–92.
3. Burleson, Brant R. Sandra Metts, and Michael W. Kirch, "Communication in Close Relationships," in Close Relationships: A Sourcebook, eds. Clyde Hendrick and Susan S. Hendrick (Thousand Oaks, CA: Sage, 2000).
4. Dance, F. E. X. (1972). Speech Communication; Concepts and Behavior. New York:Holt, Rinehart, and Winston.
5. Frank E. X. Dance and Carl E. Larson, The Functions of Human Communication:A Theoretical Approach (New York, NY: Holt, Reinhart, and Winston, 1976)
6. Ellis, Richard and Ann McClintock, You Take My Meaning: Theory into Practice in Human Communication (London: Edward Arnold, 1990).
7. Robert H. Gass and John S. Seiter, Persuasion, Social Influence and ComplianceGaining (Boston, MA: Allyn and Bacon, 1999)
8. Erving Goffman, The Presentation of Self in Everyday Life (New York, NY: Anchor Books, 1959)
9. Greene, Kathryn, Valerian J. Derlega, and Alicia Mathews, "Self-Disclosure in Personal Relationships," in The Cambridge Handbook of Personal Relationships, eds. Anita L. Vangelisti and Daniel Perlman (Cambridge: Cambridge University Press, 2006).
10. Hargie, Owen. Skilled Interpersonal Interaction: Research, Theory, and Practice (London: Routledge, 2011).
11. National Association of Colleges and Employers, Job Outlook 2011 (2010): 25.