NOTE: Changes to programs may require course changes, which must be processed electronically. Any questions should be directed to Associate Provost David Reinhold at 7-4564 or david.reinhold@wmich.edu

DEPARTMENT: BIS **COLLEGE:** HCoB
PROPOSED EFFECTIVE FALL YEAR: 2021

PROPOSED IMPROVEMENTS: *Academic Program Proposed Improvements*

☐ New degree*   ☐ New minor*   ☐ Admission requirements
☐ New major*   ☐ Deletion*   ☐ Graduation requirements
☐ New curriculum*   ☒ Revised major   ☐ Change in Title
☐ New concentration*   ☐ Revised minor   ☐ Transfer
☐ New certificate*

☐ Other (explain**)   **** Other:**

Title of degree, curriculum, major, minor, concentration, or certificate: BUAJ

Chair, Department Curriculum Committee:	**Date**

CHECKLIST FOR DEPARTMENT CHAIRS/DIRECTORS

☐ For new programs and other changes that have resource implications, the dean has been consulted.

☐ When appropriate, letters of support from department faculty are attached.

☐ When appropriate, letters of support from other departments in the same college are attached.

☐ When appropriate, letters of support from other college deans, whose programs/courses may be affected by the change, are attached.

☐ The proposal has been reviewed by HIGE for possible implications for international student enrollment.

☐ The proposal is consistent with the departmental assessment plan, and identifies measurable learning outcomes for assessment.

☐ Detailed resource plan is attached where appropriate.

☐ All questions attached have been completed and supporting documents are attached.

☐ The proposal is written and complete as outlined in the Faculty Senate guidelines and the curriculum change guides.

Chair/Director:	**Date**

CHECKLIST FOR COLLEGE CURRICULUM COMMITTEE

☐ The academic quality of the proposal and the faculty involved has been reviewed.

☐ Detailed resource plan is attached where appropriate.

☐ Consistency between the proposal and the relevant catalog language has been confirmed.

☐ The proposal has been reviewed for effect on students transferring from Michigan community colleges. Detailed information on transfer articulation must be included with undergraduate proposals.

☐ Consistency between the proposal and the College and department assessment plans has been confirmed.

☐ Consistency between the proposal and the College and department strategic plans has been confirmed.

☐ All questions attached have been completed and supporting documents are attached.

☐ The proposal is written and complete as outlined in the Faculty Senate guidelines and the curriculum change guides.

Chair, College Curriculum Committee:	**Date**

NOT FOR USE FOR CURRICULAR COURSE CHANGES **REQUEST FOR PROGRAM IMPROVEMENTS**	

CHECKLIST FOR COLLEGE DEANS

☐ For new programs and proposed program deletions, the provost has been consulted.

☐ For new programs, letter of support from University Libraries Dean indicating library resource requirements have been met.

☐ When appropriate, letters of support from other college faculty and/or chairs are attached.

☐ When appropriate, letters of support from other college deans, whose programs/courses may be affected by the change, are attached.

☐ The proposal has been reviewed for implications for accreditation, certification, or licensure.

☐ Detailed resource plan is attached where appropriate.

☐ All questions attached have been completed and supporting documents are attached.

☐ The proposal is written and complete as outlined in the Faculty Senate guidelines and the curriculum change guides.

Dean:	**Date**

FOR PROPOSALS REQUIRING REVIEW BY:
GSC/USC; EPGC, GRADUATE COLLEGE, and/or FACULTY SENATE EXECUTIVE BOARD

☐ Return to Dean ☐ Forward to:	Curriculum Manager:	Date:
☐ Approve ☐ Disapprove	*needs review by Chair, GSC/USC:	Date
☐ Approve ☐ Disapprove	Chair, EPGC:	Date
☐ Approve ☐ Disapprove	Graduate College Dean:	Date:
☐ Approve ☐ Disapprove	Faculty Senate President:	Date

☐ Approve ☐ Disapprove	*needs review by Provost:	Date

Revised Sept. 2018. All previous forms are obsolete and should not be used.

1. Explain briefly and clearly the proposed improvement:

    Request to add CIS 4100-Internship as an elective course for Business Analytics majors.

2. Rationale. Give your reason(s) for the proposed improvement.

    Adding this course as an elective will help the Business Analytics major students to gain experiences with data analytics tools, skill and applications in the industry world.

3. Effect on other colleges, departments, or programs. If consultation with others is required, attach evidence of consultation and support. If objections have been raised, document the resolution. Demonstrate that the program you propose is not a duplication of an existing one.

    The proposed course change has no effect on other colleges, departments or programs.

4. Effect on your department's programs. Show how the proposed change fits with other departmental offerings.

    Currently all the other BIS department majors offer CIS 4100-Internship course as an elective.

5. Alignment with college's and department's strategic plan, mission, and vision.

    This change aligns with the university, college, and department goal and mission to have strong industry partnership and help students to understand how analytics is used in real world.

6. Effects on enrolled students: Are program conflicts avoided? Will your proposal make it easier or harder for students to meet graduation requirements? Can students complete the program in a reasonable time? Show that you have considered scheduling needs and demands on students' time.

    The proposed change give the students more elective courses to choose and therefore it makes it easier for them to meet the graduation requirements. Students are allowed to take the course in Fall, Spring, or summer semesters after they get the approval from CIS faculty adviser.

7. Student or external market demand. What is your anticipated student audience? What evidence of student or market demand or need exists? What is the estimated enrollment? What other factors make your proposal beneficial to students?

    All the Business Analytics major students are possible audiences of this course.

8. Effects on resources. Explain how your proposal would affect department and University resources, including faculty, equipment, space, technology, and library holdings. If proposing a new program, include a letter and/or email of support from the university libraries affirming that the library resource issues have been reviewed. Tell how you will staff additions to the program. If more advising will be needed, how will you provide for it? What will be the initial one-time costs and the ongoing base-funding costs for the proposed program? (Attach additional pages, as necessary.)

    The BIS department currently offers CIS 4100-Internship course for the other majors. The department has an assigned faculty adviser who help students to take this course.

9. List the learning outcomes for the revised or proposed major, minor, or concentration. The department will use these outcomes for future assessments of the program.

    Under the direction of a CIS faculty adviser, qualified students can engage in a variety of professional experiences that helps them to understand applications of what they learned in the other Business Analytics courses. The change has the following possible benefits:

    -Students would learn how they can use what they learned to solve real business problems.

    -Students would have a chance to explore variety of tools and skills they have learned in the business context/industry they are more interested in.

    -Students would have the opportunity to build up their career path by working for a potential future employer.

10. Describe how this change is a response to assessment outcomes that are part of a department or college assessment plan or informal assessment activities.

    The proposed change is based on:

-Potential benefits to the students

-Business students interest in gaining internship experiences

11. (Undergraduate proposals only) Describe in detail how this change affects transfer articulation for Michigan community colleges. For new majors or minors, describe transfer guidelines to be developed with Michigan community colleges. For revisions to majors or minors, describe necessary revisions to Michigan community college guidelines. Department chairs should seek assistance from college advising directors or from the admissions office in completing this section.

Not Applicable.

12. Please offer both "Current Catalog Language" and "Proposed Catalog Language" if there is to be a change in the catalog description for a given program. For the "current" language, please copy and paste relevant language from the most current catalog and for the "proposed" language, please share the exact proposed new catalog language. As possible, bold or otherwise note the key changes in the new proposed catalog language.

Current catalog copy:

CIS 4100 - Internship

Under the direction of a faculty advisor, qualified

students may engage in a variety of professional

experiences. Scheduled meetings with advisor and

written experience reports required.

Prerequisites & Corequisites: Prerequisite:

Approved application.

Credits: 1 to 4 hours

Notes: May be repeated for a maximum of 4 hours

credit.

Proposed catalog copy:

No change

NOTE: Changes to programs may require course changes, which must be processed electronically. Any questions should be directed to Associate Provost David Reinhold at 7-4564 or david.reinhold@wmich.edu

DEPARTMENT: Business Information Systems **COLLEGE:** Haworth College of Business
PROPOSED EFFECTIVE FALL YEAR: 2021

PROPOSED IMPROVEMENTS: *Academic Program Proposed Improvements*

☐ New degree* ☐ New minor* ☐ Admission requirements
☐ New major* ☐ Deletion* ☐ Graduation requirements
☐ New curriculum* ☒ Revised major ☐ Change in Title
☐ New concentration* ☐ Revised minor ☐ Transfer
☐ New certificate*

☐ Other (explain**) **** Other:**

Title of degree, curriculum, major, minor, concentration, or certificate: Computer Information Systems (CMIJ)

Chair, Department Curriculum Committee:	**Date**

CHECKLIST FOR DEPARTMENT CHAIRS/DIRECTORS

☐ For new programs and other changes that have resource implications, the dean has been consulted.

☐ When appropriate, letters of support from department faculty are attached.

☐ When appropriate, letters of support from other departments in the same college are attached.

☐ When appropriate, letters of support from other college deans, whose programs/courses may be affected by the change, are attached.

☐ The proposal has been reviewed by HIGE for possible implications for international student enrollment.

☐ The proposal is consistent with the departmental assessment plan, and identifies measurable learning outcomes for assessment.

☐ Detailed resource plan is attached where appropriate.

☐ All questions attached have been completed and supporting documents are attached.

☐ The proposal is written and complete as outlined in the Faculty Senate guidelines and the curriculum change guides.

Chair/Director:	**Date**

CHECKLIST FOR COLLEGE CURRICULUM COMMITTEE

☐ The academic quality of the proposal and the faculty involved has been reviewed.

☐ Detailed resource plan is attached where appropriate.

☐ Consistency between the proposal and the relevant catalog language has been confirmed.

☐ The proposal has been reviewed for effect on students transferring from Michigan community colleges. Detailed information on transfer articulation must be included with undergraduate proposals.

☐ Consistency between the proposal and the College and department assessment plans has been confirmed.

☐ Consistency between the proposal and the College and department strategic plans has been confirmed.

☐ All questions attached have been completed and supporting documents are attached.

☐ The proposal is written and complete as outlined in the Faculty Senate guidelines and the curriculum change guides.

Chair, College Curriculum Committee:	**Date**

Revised Sept. 2018. All previous forms are obsolete and should not be used.

CHECKLIST FOR COLLEGE DEANS

☐ For new programs and proposed program deletions, the provost has been consulted.

☐ For new programs, letter of support from University Libraries Dean indicating library resource requirements have been met.

☐ When appropriate, letters of support from other college faculty and/or chairs are attached.

☐ When appropriate, letters of support from other college deans, whose programs/courses may be affected by the change, are attached.

☐ The proposal has been reviewed for implications for accreditation, certification, or licensure.

☐ Detailed resource plan is attached where appropriate.

☐ All questions attached have been completed and supporting documents are attached.

☐ The proposal is written and complete as outlined in the Faculty Senate guidelines and the curriculum change guides.

Dean:	**Date**

FOR PROPOSALS REQUIRING REVIEW BY:
GSC/USC; EPGC, GRADUATE COLLEGE, and/or FACULTY SENATE EXECUTIVE BOARD

☐ Return to Dean ☐ Forward to:	Curriculum Manager:	Date:
☐ Approve ☐ Disapprove	*needs review by Chair, GSC/USC:	Date
☐ Approve ☐ Disapprove	Chair, EPGC:	Date
☐ Approve ☐ Disapprove	Graduate College Dean:	Date:
☐ Approve ☐ Disapprove	Faculty Senate President:	Date

☐ Approve ☐ Disapprove	*needs review by Provost:	Date

1. Explain briefly and clearly the proposed improvement:

   The current CIS Major requires 24 credit hours to complete. The proposed CIS Major will require 30 credit hours to complete.

2. Rationale. Give your reason(s) for the proposed improvement.

   Current CIS Major, according to the input from the department faculty, company representatives and faculty evaluation of job markets and other programs around the Midwest, lacks in-depth skills in computer programming and does not require students to take any course in the Cloud Computing area. There are plenty of jobs available for graduates with advanced programming skills and skills in the Cloud Computing areas. Therefore, the proposed improvement in the CIS major is based on the following objectives:

   a) Make CIS a strong skill-based major to meet the current and future industry and job market demand. The skill-based focus is expected to reverse the downward trend in the number of CIS majors.
   b) Include Cloud-Based courses into the major and take the first-mover advantage in the Cloud Computing area in Michigan
   c) Positively differentiate HCOB CIS program from similar programs in our peer institutions
   d) Change the programming course requirement from a single programming course (choose one of three programming courses) to two required programming courses. In the proposed program, there is no option for students to choose one of three programming courses. So, every CIS major will take CIS 2600 Object-Oriented Programming for Business and CIS 2610 Advanced Programming for Business courses.

   <u>Justification</u>

   Ten (10) CIS/IS/MIS programs in peer and aspiring universities in the Midwest were evaluated. Required skills of job seekers in the latest IT Job Market were also analyzed. Following are the observations:

   a) Java is the leader in the programming job market, however, the current CIS 2600 course only prepares students with the fundamental Java skills. Most programming jobs require advanced Java programming skills including knowledge in Data Structures.
   b) There are plenty of jobs available in the Amazon Web Services (AWS) and Microsoft Azure Cloud Computing platforms.
   c) Certification in Cloud Computing is highly demanded; e.g., AWS, Microsoft, and Cisco certification.
   d) 5 out of 10 programs reviewed have 30 CRH or more

3. Effect on other colleges, departments, or programs. If consultation with others is required, attach evidence of consultation and support. If objections have been raised, document the resolution. Demonstrate that the program you propose is not a duplication of an existing one.

   There is no effect on other colleges, departments, or programs. For the proposed new courses, no other program offers any course completely on the Cloud Computing. Computer Science department's course "CS 5541 - Computer Systems" covers a very small topic on Cloud Computing.

4. Effect on your department's programs. Show how the proposed change fits with other departmental offerings.

   The proposed changes will give students opportunity to acquire appropriate in-dept skill in Java Programming which is the number one programming skill in the job market. As mentioned before, the current introductory Java course 'Object-Oriented Programming for Business' does not provide in-dept programming skills in Java. The new requirements will also allow students to acquire skills in the Cloud Computing area and eventually get certification. The additional courses will allow students to add Cloud Security skills with their skills in the LAN security and get a solid focus in the Networking and Information Security area.

5. Alignment with college's and department's strategic plan, mission, and vision.

   Haworth College of Business is a learner centered college of business that offers intellectual and economic value with quality teaching. Economic value and quality teaching are reflected upon the success of the graduating students. Students without appropriate in-dept skills faces a multitude of challenges in the job market. Therefore, the proposed changes in the CIS major are an attempt to deliver quality teaching and prepare students with in-depth, sought after IT skills demanded by the industry.

6. Effects on enrolled students: Are program conflicts avoided? Will your proposal make it easier or harder for students to meet graduation requirements? Can students complete the program in a reasonable time? Show that you have considered scheduling needs and demands on students' time.

    The proposed changes will not have any effect on enrolled students. Students in the current CIS program will continue their program without interruption. The proposed changes, if approved, will be effective Fall 2021. Courses required by the current CIS curriculum will be offered uninterrupted.

7. Student or external market demand. What is your anticipated student audience? What evidence of student or market demand or need exists? What is the estimated enrollment? What other factors make your proposal beneficial to students?

    a)   Java is the leader in the programming job market, however, the current CIS 2600 course does not adequately prepare students with the Java skills required in the job market. Most programming jobs require advanced Java programming skills including knowledge in Data Structures.

    b)   There are plenty of jobs available in the Amazon Web Services (AWS) and Microsoft Azure Cloud Computing platforms.

    c)   It is expected that the proposed changes in the CIS major will make the major more attractive and reverse that decline trend in the program.

8. Effects on resources. Explain how your proposal would affect department and University resources, including faculty, equipment, space, technology, and library holdings. If proposing a new program, include a letter and/or email of support from the university libraries affirming that the library resource issues have been reviewed. Tell how you will staff additions to the program. If more advising will be needed, how will you provide for it? What will be the initial one-time costs and the ongoing base-funding costs for the proposed program? (Attach additional pages, as necessary.)

    The proposed changes will not have any immediate effect on the department and University resources. Department is already offering the content of CIS 2720 - Cloud Computing Applications (new course) as CIS 5550 - Topics in Computer Information Systems. CIS 2610 is an existing course which will be revised to make it the second required course (Advanced Programming for Business). The other two new courses, CIS 3720 – Cloud-based Business Application Development and CIS 3760 – Cloud-based Networking are electives and will be offered if the demand is adequate. The projection for that to happen is in Fall 2022.

9. List the learning outcomes for the revised or proposed major, minor, or concentration. The department will use these outcomes for future assessments of the program.

    Students, after graduating with Computer Information Systems major, should:

    a)   be able to apply processes that support the delivery and management of information systems within business application environments.

    b)   receive in-depth object-oriented programming skills to use in the development of solutions for businesses.

    c)   be able to use the appropriate tools, techniques, methodologies, and processes, to develop computer-based information solutions that meet the needs of businesses and organizations.

    d)   understand data communications networks and future developments in this area and demonstrate ability to analyze and implement IT security practices.

    e)   be able to utilize database skills to perform data analysis, design, implementation, and administration.

    f)   acquire working knowledge in the development of information technology systems projects from beginning to the end (proposal through analysis, design, development, documentation, testing, and implementation).

    g)   be able to demonstrate the ability to provide Cloud Computing application, networking, and security support.

10. Describe how this change is a response to assessment outcomes that are part of a department or college assessment plan or informal assessment activities.

    This change is a response of the departmental informal assessment activities as mentioned in response for 2.

11. (Undergraduate proposals only) Describe in detail how this change affects transfer articulation for Michigan community colleges. For new majors or minors, describe transfer guidelines to be developed with Michigan community colleges. For revisions to majors or minors, describe necessary revisions to Michigan community college guidelines. Department chairs should seek assistance from college advising directors or from the admissions office in completing this section.

    The proposed change will have no effect on the current transfer articulation for Michigan community colleges. The changes will increase the major requirements all CIS majors from 24 credit hours to 30 credit hours.

12. Please offer both "Current Catalog Language" and "Proposed Catalog Language" if there is to be a change in the catalog description for a given program. For the "current" language, please copy and paste relevant language from the most current catalog and for the "proposed" language, please share the exact proposed new catalog language. As possible, bold or otherwise note the key changes in the new proposed catalog language.

<u>Current Catalog Language</u>

Computer Information Systems Major (CMIJ) (24 hours)

Required Courses [5 courses (15 credit hours)]
<u>Please note:</u>
Sequencing for the required courses must be as follows:
CIS 2600 or CIS 2610 or CIS 2800, (2) CIS 3600, (3) CIS 4600, (4) CIS 4640, (5) CIS 4990
Prerequisite for CIS 4640 is CIS 2700 and (MGMT 2500 or MKTG 2500) or instructor approval.

• CIS 2600 - Business Application Programming **Credits:** 3 hours
  OR
• CIS 2610 - Business Mobile Programming **Credits:** 3 hours
  OR
• CIS 2800 - Internet Programming **Credits:** 3 hours
• CIS 3600 - Systems Analysis and Design **Credits:** 3 hours
• CIS 4600 - Business Database Applications **Credits:** 3 hours
• CIS 4640 - Business Data Mining **Credits:** 3 hours
• CIS 4990 - Enterprise Project **Credits:** 3 hours

Electives [3 courses (9 credit hours)]
Please choose your electives based on the following career pathways you plan to pursue. Electives may be taken at the same time as your required courses subject to their prerequisite requirement. If you are not sure, please make an appointment with the CIS major coordinator or a CIS faculty advisor to seek advice before choosing your electives.

Career Pathway: Business Data Analyst 399
• CIS 2640 - Applied Analytics Foundations **Credits:** 3 hours
• CIS 3640 - Visual Analytics **Credits:** 3 hours
• CIS 2650 - Programming for Data Analytics **Credits:** 3 hours
  OR
• CIS 3620 - Practical Project Management **Credits:** 3 hours

Career Pathway: Big Data Analyst
• CIS 2650 - Programming for Data Analytics **Credits:** 3 hours
• CIS 4610 - Database for Business Analytics **Credits:** 3 hours
• CIS 5650 - Big Data Analytics **Credits:** 3 hours

Career Pathway: E-Commerce Developer
• CIS 2800 - Internet Programming **Credits:** 3 hours
• CIS 2900 - User experience Design Credits: 3 hours
• CIS 3900 - Business Web Architecture **Credits:** 3 hours

Career Pathway: Mobile Application Developer

• CIS 2610 - Business Mobile Programming **Credits:** 3 hours

• CIS 3900 - Business Web Architecture **Credits:** 3 hours

• CIS 4700 - Mobile Commerce Development **Credits:** 3 hours

Career Pathway: Networking and Information Security

• CIS 2660 - Networking and Data Communications **Credits:** 3 hours

• CIS 3660 - Information Assurance and Compliance **Credits:** 3 hours

• CIS 5550 - Topics in Computer Information Systems **Credits:** 3 hours
  OR
• CIS 4100 - Internship **Credits:** 1 to 4 hours
  OR
• CIS 4960 - Independent Study **Credits:** 1 to 4 hours

Career Pathway: Consultant/System Architect/Program Analyst

• CIS 3620 - Practical Project Management **Credits:** 3 hours

• CIS 4500 - Customer Relationship Management **Credits:** 3 hours

• CIS 4100 - Internship **Credits:** 1 to 4 hours
  OR
• CIS 4960 - Independent Study **Credits:** 1 to 4 hours

Career Pathway: Custom (individual design based on student's background)

Select any three (3) courses listed in the above Career Pathways. Student is highly encouraged to consult with CIS major coordinator or a CIS major advisor to select his or her elective courses. 400

Additional courses for Custom Career Pathway:

• CIS 5550 - Topics in Computer Information Systems Credits: 3 hours

Proposed Catalog Language

Computer Information Systems Major (CMIJ) (30 hours)

The Computer Information Systems program, with the emphasis on experiential learning, provides students with a strong foundation in business principles combined with extensive training in information technology—a winning combination that employers seek. To succeed in this ever-evolving business technology requirements, our program will instill practical in-dept object-oriented programming skills, database skills, data analysis and mining skills, networking and security skills, and cloud computing skills in you which you will need for a successful career in the IT profession.

Required Courses [7 courses (21 credit hours)]

[1]   CIS 2600 - Object-Oriented Programming for Business Credits: 3 hours*
[2]   CIS 2610 - Advanced Programming for Business Credits: 3 hours*
[3]   CIS 2720 - Cloud Computing Applications Credits: 3 hours**
[4]   CIS 3600 - Systems Analysis and Design Credits: 3 hours
[5]   CIS 4600 - Business Database Applications Credits: 3 hours
[6]   CIS 4640 - Business Data Mining Credits: 3 hours
[7]   CIS 4990 - Enterprise Project Credits: 3 hours

Note: Sequencing for the required courses is provided below:

- 1) CIS 2600, 2) CIS 2610, 3) CIS 3600, 4) CIS 4600, (5) CIS 4990
- CIS 2700 and CIS 2720 can be taken anytime provided the prerequisite requirements are met.

Electives [3 courses (9 credit hours)]
Please choose your electives based on the following career pathways you plan to pursue. Electives may be taken at the same time as your required courses subject to their prerequisite requirement. If you are not sure, please make an appointment with the CIS major coordinator or a CIS faculty advisor to seek advice before choosing your electives.

Career Pathway: Business Data Analyst
• CIS 2640 - Applied Analytics Foundations Credits: 3 hours
• CIS 3640 - Visual Analytics Credits: 3 hours
• CIS 2650 - Programming for Data Analytics Credits: 3 hours
  OR
• CIS 3620 - Practical Project Management Credits: 3 hours

Career Pathway: Big Data Analyst
• CIS 2650 - Programming for Data Analytics Credits: 3 hours
• CIS 4610 - Database for Business Analytics Credits: 3 hours
• CIS 5650 - Big Data Analytics Credits: 3 hours

Career Pathway: Cloud Solutions Practitioner
• CIS 2660 - Networking and Data Communications Credits: 3 hours
• CIS 3720 – Cloud-based Business Application Development Credits: 3 hours**
• CIS 3760 – Cloud-based Networking Credits: 3 hours**
  OR
• CIS 5550 - Topics in Computer Information Systems Credits: 3 hours

Career Pathway: E-Commerce Developer
• CIS 2800 - Internet Programming Credits: 3 hours
• CIS 2900 - User Experience Design Credits: 3 hours
• CIS 3900 - Business Web Architecture Credits: 3 hours

Career Pathway: Networking and Information Security
• CIS 2660 - Networking and Data Communications Credits: 3 hours
• CIS 3660 - Information Assurance and Compliance Credits: 3 hours
• CIS 5550 - Topics in Computer Information Systems Credits: 3 hours
          (Topics in Advanced Computer Networking)
    OR
• CIS 3760 – Cloud Networking Credits: 3 hours**

Career Pathway: Consultant/System Architect/Program Analyst
• CIS 3620 - Practical Project Management Credits: 3 hours
• CIS 4500 - Customer Relationship Management Credits: 3 hours
• CIS 4100 - Internship Credits: 1 to 4 hours
    OR
• CIS 4960 - Independent Study Credits: 1 to 4 hours
    OR
• CIS 5550 - Topics in Computer Information Systems Credits: 3 hours

Career Pathway: Custom (individual design based on student's background)
Select any three (3) courses listed in the above Career Pathways. Student is highly encouraged to consult with CIS major coordinator or a CIS major advisor to select his or her elective courses.

Additional course for Custom Career Pathway:
• CIS 4700 – Mobile Commerce Development Credits: 3 hours

*   Change in Title and Description
** New Course. Please see Appendix B for new Syllabi
Please see Appendix A for new and revised Titles and Course descriptions

Appendix A
Couse Title and Course Description
[Existing and New Courses]

[Current Title & Description]
CIS 2600 - Business Application Programming
This course introduces the fundamental concepts and implementations of modern visual programming language in a business environment. Major topics include general programming tools for business applications, fundamentals of business programming such as data types, expressions, and operators, etc., and basic programming structures of business applications.
Prerequisites & Corequisites: Prerequisite: CIS 1020, CIS 1100, CS 1000, CS 1050, FCS 2250 or MUS 3860.

[Proposed Title & Description]
CIS 2600 - Object-Oriented Programming for Business Credits: 3 hours
This course is an introduction to basic concepts in computer programming with an emphasis on business applications. In the course, students learn the fundamentals of the object-oriented programming paradigm, programming structures, and develop skills to provide business solutions by using object-oriented programming. The object-oriented approach to application development is in high demand as it allows for improved reusability, maintenance, and security of business applications. Major topics covered in this course include data structures, methods, objects, classes, decision, and control flow structures. This course also introduces advanced data types (e.g., strings, arrays), inheritance property, exception handling, and file input-output for object-oriented applications. Upon completion of this course, students will develop both console-based and graphical user interface-based business applications using an object-oriented programming language.
Prerequisites & Corequisites: Prerequisite: CIS 1020, CIS 1100, CS 1000, CS 1050, FCS 2250 or MUS 3860.

[Current Title & Description]
CIS 2610 - Business Mobile Programming Credits: 3 hours
This course introduces the fundamental concepts and implementation of modern visual programming language in a mobile business environment. Major topics include general mobile programming tools for business mobile applications; fundamentals of business programming such as data types, expressions, and operators, etc.; and basic programming structures of business mobile applications.
Prerequisites & Corequisites: Prerequisite: CIS 1020, CIS 1100, CS 1000, CS 1050, FCS 2250 or MUS 3860.

[Proposed Title & Description]
CIS 2610 - Advanced Programming for Business Credits: 3 hours*
This course introduces advanced programming techniques for business. Main topics include but not limited to data structures, application programming interface (API), manipulation of data (e.g., databases, JSON, XML, and other data formats), web services (e.g., REST, SOAP, etc.), advanced GUI, design patterns and other related topics. Students also learn advanced knowledge and skills needed to implement applications expected for computing architectures and standards in the business environment.
Prerequisites & Corequisites: Prerequisite: CIS 2600

CIS 2720 – Cloud Computing Applications Credits: 3 hours [New Course]
Cloud computing is the latest paradigm shift in information technology (IT). It has seen the fastest adoption into the mainstream IT than any other technology in the domain. The core objectives of cloud-based services are to provide the highest level of agility, performance and efficiency, thus completely dominating IT service delivery. With this unique paradigm shift, cloud computing brings in new opportunities and challenges for businesses, as well as for the system administrators who manage the IT-related activities. This course covers several cloud-based models that comprise the modern concept of cloud computing, such as SaaS, PaaS, IaaS, and XaaS. Topics also include cloud computing infrastructure, datacenter architecture, cloud-based network, cloud storage, virtualization, and cloud-based services. Students receive experiential learning on popular cloud service platform like Amazon AWS. The goal is to prepare students to obtain entry-level AWS cloud certification.
Prerequisites & Corequisites: **Prerequisite:** CIS 2700 OR instructor's permission for BBA degree candidates other than CIS, BA, DM&E majors.

CIS 3720 – Cloud-based Business Application Development Credits: 3 hours [New Course]
The cloud has become a key enabler for development and delivery of IT services due to advantages such as high availability, unlimited storage capacity, on-demand scalability and resilience. This course begins with fundamentals of cloud computing. Gradually, students are introduced to computing power, security, storage, networking, messaging, and Amazon Web Services (AWS) platform. The topics also include the fundamental concepts of designing and deploying scalable, extendable, and maintainable cloud-based applications using modern cloud architecture. This course also explores server less technologies that improve the speed of application development and discusses the cost of running a cloud infrastructure. Experiential learning includes integration of components from AWS platform to prepare students for associate-level AWS developer certification.
Prerequisites & Corequisites: Prerequisite: CIS 2720

CIS 3760 – Cloud-based Networking Credits: 3 hours [New Course]
This course focuses on developing cloud-based network, including the foundational knowledge of communication networks for a modern large-scale cloud computing environment. The course explores in-depth concept and identifies challenges for cloud networking. The emphasis is on building a network infrastructure that provides the agility to deploy virtual networks on a shared infrastructure, providing both efficient transfer of big data and low latency communication. In addition, the course provides operational and design rationale. The topics include switching, packets routing, interdomain networking, flow control, congestion control, Quality of Service (QoS), virtualized networks, datacenter network architecture, cloud network requirements and traffic patterns. The course also covers the emerging idea in advancing the current network architecture, the Software-Defined Networking (SDN) to be more specific. Experiential learning includes integration of components from AWS platform to prepare students for AWS advanced networking specialty certification.
Prerequisites & Corequisites: Prerequisite: CIS 2660

<u>Appendix B</u>
New Course Syllabi

<u>CIS 2720 Cloud Computing Applications</u>

Learning Goals and Objectives
CIS 5550 is directly related to a student's ability to meet four (5) of the seven (7) goals for undergraduate/graduate students receiving a degree from the Haworth College of Business:
1. Students will be effective communicators
2. Students will have effective team skills
3. Students will acquire global business understanding
4. Students will understand information technology systems
5. Students will understand ethical business practices
6. Students will be critical thinkers
7. Students will have common business knowledge

Course Theme
Develop core knowledge of the field of Cloud Computing and an in-depth study into its enabling technologies and main building blocks.

Prerequisites
CIS 2700 OR instructor's permission for BBA degree candidates other than CIS, BA, DM&E majors.

Course Description
Cloud computing is the latest paradigm shift in information technology (IT). It has seen the fastest adoption into the mainstream IT than any other technology in the domain. The core objectives of cloud-based services are to provide the highest level of agility, performance and efficiency, thus completely dominating IT service delivery. With this unique paradigm shift, cloud computing brings in new opportunities and challenges for businesses, as well as for the system administrators who manage the IT-related activities. This course covers several cloud-based models that comprise the modern concept of cloud computing, such as SaaS, PaaS, IaaS, and XaaS. Topics also include cloud computing infrastructure, datacenter architecture, cloud-based network, cloud storage, virtualization, and cloud-based services. Students receive experiential learning on popular cloud service platform like Amazon AWS. The goal is to prepare students to obtain entry-level AWS cloud certification.

Expectations and Goals

After taking this course, student will be able to:
1) Understand the fundamental Cloud Computing knowledge, the evolution of cloud computing, its applicability, and benefits
2) Discuss the concept of cloud and cloud computing
3) Understand the concepts and characteristics of different types of cloud-based services
4) Explain the basic ideas and principles in datacenter design, cloud management techniques and cloud software deployment considerations
5) Understand the different CPU, memory and I/O virtualization techniques supported by cloud computing
6) Discuss various innovative cloud-based networking technologies, such as Software-Defined Networking (SDN) and Network Function Virtualization (NFV)
7) Identify different types of cloud storage technologies, including object storage, block-level storage, archival storage, and Big Data file systems
8) Identify security and privacy issues in cloud computing

Required Materials

The following items are the required:
1) Textbook: There is no textbook required for this class. Each module is based on recent conference/journal papers as well as documentation from cloud providers.
2) A form of media storage (or use a personal laptop):
a. USB Flash Drive
b. Google Drive
c. OneDrive
3) Access to a computer with Internet access, microphone, and a webcam device
4) Access to latest version of Chrome, Firefox, and IE
5) Access to e-Learning https://elearning.wmich.edu/ for various items, such as lecture slides, discussions, points, lab assignments, quizzes, and exams.
6) Supplemental materials, such as websites and software (available on e-Learning)

Course Contents

The objective of this course is to provide a strong, fundamental understanding of Cloud Computing through lectures, exercises, and projects. Students will learn how to create, access, and manipulate cloud computing services provided by Amazon Web Services cloud provider, as well as how to incorporate cloud computing technologies into business.

The exercises and projects are designed to teach students how to utilize the cloud services into daily business functions, as well as the basic understanding on what hardware needs to be used for supporting cloud computing. In this course, we will also spend a good deal of time studying cloud computing infrastructures, and concepts. Students will find that this information applies to any cloud computing technologies no matter what cloud provider they choose.

a. Hands-on Labs (200 points): We will complete eight (8) hands-on labs throughout the semester. Lab assignments and due dates will be posted on e-Learning.
b. Exams (400 points): There will be two (2) exams: One throughout the semester and one final exam. The final exam will be comprehensive (cumulative); we will discuss the exams in detail in class.
c. Knowledge quizzes, in-class tasks, and exercises (100 points): Throughout the semester, brief unplanned knowledge quizzes, in-class tasks, and exercises will be planned to measure a student's skill and knowledge base. Students must be present to partake of them. These cannot be made up in any case (even a pre-excused absence), but more than the allotted number will be given so students have the possibility to reach the 100 points. If a student is present and does well on all of them, any amount over the 100 points will be considered extra credit.
d. Semester-long Project (300 points): A semester-long project will be given to students as the team project (max. 2 member per team). The example topics of the project will be discussed during the class. With the approval from the instructor, the students can propose their own project topic that utilizes cloud computing technologies and services.
e. Extra Credit: Please see the knowledge quizzes and exercises section.

Assignments:
All work must be the student's own. Students are encouraged to ask questions, discuss concepts, etc. with each other and on the discussion board, but the final product must be each student's work. Students are also expected to have read the assigned materials before the class meeting.

Due Dates:
All due dates are set on the course calendar and will be adhered to unless there are unanticipated issues (e.g., e-Learning down during an assignment turn-in period). All due dates are firm.

Hand-on Exercises:
Late assignments are permitted, but not encouraged. An assignment can be submitted up to three (3) days after the due date. Each late day incurs a 10% penalty. For example, an assignment that would have received an 85% but is turned in two (2) days late would instead receive a 65% (not passing). Late assignments will not receive as much feedback as those turned in on time. If an emergency arises that prevents a student from completing work on time, the instructor should be contacted as soon as possible. The late policy may be waived at the instructor's discretion in case of an emergency. Emergencies are defined as serious and unexpected events. Emergencies cannot be planned. Examples of emergencies are: a serious health crisis of the student or in the student's immediate family. Examples of non-emergencies are: family weddings, vacations, conferences, work travel, or any other event that can be anticipated.

Knowledge Quizzes, In-class tasks, and Exercises:
Knowledge quizzes, in-class task, and exercises cannot be made up in any situation (even pre-excused absences), but more than the allotted number of points will be offered during the semester.

Exams:
Students are required to take the exams on the assigned days and times online (proctored via LockDown browser with a webcam). A computer with a webcam device is strictly required. Please check the course calendar on e-Learning for this information. Missed exams may only be handled with a documented excuse. A documented excuse consists of letterhead from a medical doctor. This letter must include the statement "I have advised the student to stay home on the following dates: [DATES], for medical reasons." Other documentation will not be considered. Documentation not on letterhead will not be considered. Documentation that does not contain the statement above will not be considered. If a student must miss an exam due to university-sponsored event or legal mandate, documentation to this effect must be presented IN ADVANCE of the exam date. Any student who has not received a WRITTEN (email) notice from the instructor concerning missing an exam in advance will not be allowed to receive credit for that exam.

Scheduled Work:
This class requires work on numerous assignments throughout the semester. To be successful, it is important for students to keep up with the schedule and check it frequently. While the instructor reserves the right to make changes as the semester progresses, the class will always discuss and agree to major changes in the schedule.

Amount of Work:
This class will place great demands on a student's time OUTSIDE OF CLASS. Students will need to be able to access a computer system and have time in their schedule for projects and completing other assignments.
This is all in addition to completing the readings and making sure that students understand and can apply concepts and theories.

Turning in Work:
All class work is digital in nature. Resisting the temptation to "change one last item" after a deadline has passed will be paramount to a student's success. If an item (no matter how small) is changed after the due date and time AND before an evaluation is received, it is considered late.
a. DO ORIGINAL WORK. Do not work on an entire assignment step-by-step with other students (unless directed by the instructor). Identical errors or copying in any work will result in a grade of zero for all involved. (See Academic Integrity.)
b. DO ASK QUESTIONS. Make sure to ask questions in class, on the discussion board, in the chat area, email, and come to office hours. We are here to learn and that means a great deal of coding, recoding, and asking questions.
Finally, all students are treated equally and fairly. There will be no make-up work or extra projects for any individual student.

Attendance:

Sessions are premised on each student's presence. Class sessions include information far beyond that found in the texts. Therefore, the instructor expects each student to:

1. Attend class,
2. Read the assignments prior to each class session.
3. Prepare for knowledge quizzes, and
4. Complete all required work.

Missing any of these items will have an impact on a student's learning and ultimately the course grade.

To ensure a positive learning experience and productivity in this course, students are expected to show up on time at each class meeting throughout the entire semester. No matter whether excuses are legitimate or not, the maximum absences permitted in the semester is two (2). If a student has more than two (2) absences (based on the collected data) in this class, their grade will automatically be an "E". Except emergencies, any class absence due to critical reasons must be pre-approved by the instructor at least 24 hours in advance. Such approval may be easily obtained by sending an email to the instructor. If necessary, students will need to prove the legitimacy of their absence.

In addition, if a student comes to class ten (10) or more minutes after the class start time, they will be considered "late," and if they leave the class ten (10) or more minutes before the class ending time (or dismissal), they will be considered "truant." Two counts of late/truant will be treated as one "absence."

Remember, if students miss a class they are still responsible for any material and class work that they miss. The instructor encourages all students to form class contacts to learn of items missed. Please do not e-mail the instructor or come to office hours expecting to learn about everything we covered in a missed class.

Ultimately, the class needs everyone here, and each student needs to be here. There is no way to duplicate class instruction and discussion. Missing classes can result in serious problems that show up in assignments.

Participation:

To participate, students must be present and pay attention to the class task or discussion. Class comments are assessed on quality, not quantity, to a point.

Professional Written and Oral Communication Standards Guideline:

Effective communication skills are critical to Haworth College of Business students' personal and professional success. In accordance with the College's learning goal that students must be effective communicators, business students must practice professional standards in written and oral communications. Students' assignments, therefore, must meet minimum standards to be acceptable. Standards for written work address errors in form including spelling, punctuation, format, and basic grammar, as well as technical English errors. Standards for oral work include professionalism in demeanor and dress, presentation delivery skills, quality of graphic support, and the above standards for written work. If these standards are not adhered to, the student's grade may be adjusted accordingly. Students are encouraged to seek assistance through the Haworth College of Business Communication Center.

Respect and Intellectual Freedom:

Opportunities for debate and discussion will also provide opportunities to interact with classmates who espouse different views and opinions. While we can always discuss ideas and issues openly, we must also respect one another as human beings. As such, we will adhere to WMU's policy on Civility (see below).

Responsibility:

Students are responsible for their own individual work in this class. This includes doing the work and maintaining standards of academic integrity.

Academic Integrity:

Students are responsible for making themselves aware of and understanding the policies and procedures in the Undergraduate Catalog http://catalog.wmich.edu/ that pertain to Academic Integrity.

These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. If there is reason to believe students have been involved in academic dishonesty, they will be referred to the Office of Student Conduct http://www.wmich.edu/conduct/. Students will be given the opportunity to review the charge(s). If students believe they are not responsible, they will have the opportunity for a hearing.

Consult with the instructor prior to the submission of an assignment if uncertain about an issue of academic honesty. In particular for this class, please note the University's policy on computer misuse http://www.wmich.edu/it/policies/: "Computer misuse is disruptive or illegal use of computer resources." The instructor may pursue any evidence of computer misuse.

Other Important Policies:
- Civility: http://wmich.edu/sites/default/files/attachments/u370/2016/Civility%20Stmt.7-27-16_0.pdf
- Diversity: http://wmich.edu/diversity
- Religious Observance: http://www.wmich.edu/policies/religiousobservances-policy
- Sexual Assault and Misconduct Policy: http://www.wmich.edu/sexualmisconduct/
- Student Disabilities: http://www.wmich.edu/disabilityservices/

Communication
Students are responsible for reading the postings and announcements on eLearning and on WMU email accounts. Students should also check eLearning for resources, schedule updates, special instructions on assignments, etc. Keeping up to date with material is extremely important.
The instructor will also post all announcements to e-Learning.

E-Learning Discussion Board
Use the discussion board to ask questions concerning the course work, pose ideas about technology, share useful Websites, etc.
The instructor will check the board on a daily basis and answer questions.

Email
Students who leave email in most cases will have a response within 24 hours after the instructor receives the email. Sometimes the response may be to simply set up an appointment.
Use the subject line to alert the instructor to an email from this course. Identify it by putting CIS 2600 at the beginning for the quickest reply. For example: Subject: [CIS 5550-T 1830 ~ 2100] What is the exam date?
Use WMU email for individual course correspondence. The instructor guarantees replies to @wmich.edu

Problems
If a student is having trouble in this class, the student is responsible for talking about the nature of the difficulty while there is still time in the course to do something about it.

Questions
Questions about this syllabus or other class matters should be directed to the instructor.

Course/Exam Schedule: This information is on e-Learning.

Assignments and Evaluations
Students are responsible for keeping track of assignments and progress in this course. Save all graded assignments (including email) to have a complete record of scores. All assignment evaluations will be uploaded into e-Learning. Grades will be posted periodically on e-Learning. Students are responsible for checking grades and reporting (and proving) any errors in the record within one week of the posting. Students will be notified via e-Learning when points are posted. Students are responsible for knowing what happened in class, including changes in assignments or due dates. Students are responsible for reading the textbook and Web readings, and for asking questions about material that is not understood.

Grading
Students will be evaluated based on various assignments and exams created throughout the semester that demonstrate comprehension and application of various programming concepts, approaches, and techniques.

Assignments
Hands-on Exercises	200 points
Quizzes, tasks, and Exercises	100 points
Midterm Exam	150 points
Final Exam	250 points
Semester-long Project	300 points
Total Points	1000 points

Final Grade

Final grades will be based on accumulated points.

A	940 ~ 1000	C	700 ~ 759
BA	880 ~ 939	DC	650 ~ 699
B	820 ~ 879	D	600 ~ 649
CB	760 ~ 819	E	Below 600

Incomplete Policy

An "incomplete" is a temporary grade that the instructor may give to a student when illness, necessary absence, or other reasons beyond the control of the student prevent completion of course requirements by the end of the semester or session. This grade will not be given as a substitute for a failing grade. A grade of "I" must be removed by the instructor who gave it or, in exceptional circumstances, by the department chairperson. If the unfinished work is not completed and the "I" grade removed within one calendar year of the assignment of the "I," the grade shall be converted to an "E" (failure). Students who receive an incomplete grade in a course must not re-register for the course in order to remove the "I."

Current COVID-19 Statement and Guidelines

Due to the current COVID-19 Pandemic, and consistent with the State of Michigan* requirements and the WMU Safe Return plan (https://wmich.edu/safereturn), safety requirements are in place to minimize exposure to the Western Michigan University community. These guidelines apply to all in-person or hybrid classes held either inside or outside a WMU building. Facial coverings (masks), over both the nose and mouth, are required for all students while in class, no matter the size of the space. This includes outdoor class settings where social distancing is not possible (i.e., at least six feet of space between individuals). Following this recommendation can minimize the transmission of the virus, which is spread between people interacting in close proximity through speaking, coughing, or sneezing. During specified classes in which facial coverings (masks) would prevent required class elements, students may remove facial coverings (masks) with instructor permission, in accordance with the exceptions in the Facial Covering (mask) Policy** ("such as playing an instrument, acting, singing, etc."). Facial coverings (masks) must remain in place throughout the class. Any student who removes the mandatory facial covering (mask) during class will be required to leave the classroom immediately. Facial coverings (masks) are not a substitute for social distancing. Students shall observe current social distancing guidelines in all instructional spaces, both indoors and outdoors. Students should avoid congregating around instructional space entrances before and after class sessions. Students should exit the instructional space immediately after the end of class to help ensure social distancing and to allow for those attending the next scheduled class session to enter. Students who are unable to wear a facial covering (mask) for medical reasons must contact Disability Services for Students (https://wmich.edu/disabilityservices) before they attend class. These guidelines are in place to ensure the safety of all students, faculty, and staff during the pandemic. Noncompliance is a violation of the class requirements and the Student Code of Honor (https://wmich.edu/conduct/expectations-students).

*For current State of Michigan Executive orders, see: https://www.michigan.gov/whitmer/0,9309,7-387-90499_90705---,00.html

**For the WMU Facial Covering (Mask) Policy, see: https://wmich.edu/policies/facial-covering-mask

CIS3720: Cloud-based Business Application Development
Master Syllabus

Course Description

The cloud has become a key enabler for development and delivery of IT services due to advantages such as high availability, unlimited storage capacity, on-demand scalability and resilience. This course begins with fundamentals of cloud computing. Gradually, students are introduced to computing power, security, storage, networking, messaging, and Amazon Web Services (AWS) platform. The topics also include the fundamental concepts of designing and deploying scalable, extendable, and maintainable cloud-based applications using modern cloud architecture. This course also explores serverless technologies that improve the speed of application development and discusses the cost of running a cloud infrastructure. Experiential learning includes integration of components from AWS platform to prepare students for associate-level AWS developer certification.

Prerequisites & Co-requisites: Prerequisite: CIS2600 or CIS2650; Minimum Grade of C

Learning Outcomes

- Understand what cloud computing is and why it is important
- Discover many fundamental technologies that enable cloud computing, including software defined architectures, virtualization, and containers
- Discuss the applications and services provided by AWS, including AWS SDK
- Explore multiple "glue" technologies that enable cloud integration, such as web middleware, JSON, REST API, RPC, etc.
- Evaluate various approaches to representing data in API requests and responses, and errors notification to users
- Utilize secure mechanisms for users authentication and authorizing the use of specific portions of an API
- Understand the concepts of serverless computing and learn how to build and deploy the serverless applications
- Develop and deploy the cloud-based applications

Topic Coverage (14 Week Course)

Week	Main Topic	Topic Detail including Sub-Topics
1	Cloud Overview	The basics of cloud computing, including cloud deployment models, and benefits. Explore services provided by Amazon Web Services (AWS)
2	Cloud Compute Services	The needs for servers, compute power, and security. Explore AWS compute services including Elastic Cloud Compute (EC2), Virtual Private Cloud (VPC), and Lambda for serverless framework and Elastic Beanstalk in action.
3		
4	Cloud Storage and Content Delivery	The need for storage and content delivery in the cloud. Explore storage services such as S3, DynamoDB, RDS, and CloudFront. Utilize DynamoDB table, launch MySQL database instance, and create CloudFront distribution.
5		
6	Networking and Security	Learn the basics of networking and resilience in the cloud. Explore services like Route 53, EC2 Auto Scaling, and Elastic Load Balancing
7		
8	Developing Cloud Application Basics	Explore key terminology and building blocks of cloud system. Understand design paradigm of modern cloud applications, including AWS SDK. Explore various "glue" technologies that enable the integration of cloud computing
9	Consume and Deploy Cloud Services	Using cloud-based relational database for storing user data. Implement filestore to store media like image using AWS S3. Consume cloud storage services within the application. Deploy the application to the AWS platform using AWS SDK
10		
11	User Authentication and Security	Understand the cloud-based authentication mechanisms. Implement authentication mechanisms in the application.
12	Serverless Computing	Understand the main components of a serverless application. Develop simple application using the concept of Function as a Service (FaaS). Build a simple REST API using serverless technologies including API Gateway, AWS Lambda, and AWS DynamoDB.
13		
14	Application Scalability and Elasticity	Explore tools and process to reduce growing pains.

CIS3760: Cloud-based Networking
Master Syllabus

Course Description
Computer communication networks are among the most important and influential Information Technology (IT) infrastructures that humanity has ever built. Cloud based networking provides network connectivity between applications and resources deployed on a cloud.

This course focuses on developing cloud-based network, including the foundational knowledge of communication networks for a modern large-scale cloud computing environment. The course explores in-depth concept and identifies challenges for cloud networking. The emphasis is on building a network infrastructure that provides the agility to deploy virtual networks on a shared infrastructure, providing both efficient transfer of big data and low latency communication. In addition, the course provides operational and design rationale. The topics include switching, packets routing, interdomain networking, flow control, congestion control, Quality of Service (QoS), virtualized networks, datacenter network architecture, cloud network requirements and traffic patterns. The course also covers the emerging idea in advancing the current network architecture, the Software-Defined Networking (SDN) to be more specific. Experiential learning includes integration of components from AWS platform to prepare students for AWS advanced networking specialty certification.

Prerequisites & Co-requisites: Prerequisite: Junior standing and CIS2660; Minimum Grade of C

Learning Outcomes
• Understand the layered architecture of the computer network, including its capabilities and limitations.
• Understand the concept of the switched networks.
• Discuss the concept of routing algorithms, including static routing, dynamic routing, NAT, and access control list.
• Explain the basics of Quality of Service (QoS) in computer networks, including flow control, congestion control, firewalls, network policies, and security measures.
• Gain fluency in the concept of network virtualization, including network functions and network services.
• Understand standard datacenter network architecture.
• Describe common cyber-attacks and apply appropriate defenses at multiple layers of the network architecture.
• Understand the concept of the software-defined networking with its protocols.
• Gain practical experience with network programming by implementing software-defined network using Python.
• Handson experience that involves integration of components on AWS platform.

Topic Coverage (14 Week Course)

Week	Main Topic	Topic Detail including Sub-Topics
1	Computer Networking Basics	Layered architecture. Networking devices capabilities and limitations.
2	The Switched Networks	Packet switching in data plane, including forwarding tables and queues. Routing algorithms and protocols in control plane. Distance vector, link state, and OSPF protocol
3		
4		Border Gateway Protocol (BGP), and Interdomain structure and policies.
5	Traffic Control in Network	Flow control, Congestion control Reliable connection concepts, and Queueing mechanism Quality of Service (QoS) Firewalls and network policies
6		
7	Virtualization in Network	Understand the Network Service Virtualization. Understand the Network Function Virtualization (NFV) technology
8	Network Security	Understand the crypto basics. Certificate authorities. Cyber-attacks: DNS poisoning, BGP hijacking, DDoS, botnet
9		
10	Traffic Patterns in Cloud-based Network	Discuss applications running on top of cloud-based network. Traffic patterns in cloud-based network.
11	Introduction to SDN	Discuss SDN architecture. Programmability in networking. SDN management.
12		
13	Programming with SDN	Discuss network emulation software: Mininet
14		Python programming in SDN