Minutes of the 22nd Meeting of the Board of Studies Faculty of Engineering Sciences held on 2nd November and 3rd November, 2020 through VLC

Bahria University Islamabad

Contents

Minutes of the 22nd Meeting of Faculty Board of Studies Engineering Sciences held on 2nd & 3rd Nov, 2020 through Video Conferencing

Attendance:

BUIC		
Prof. Dr. Atif Raza Jafri	Dean ES	Chair
Snr. Prof. Dr. Said Akbar Khan	HoD(E&ES)	Member
Snr. Assoc. Prof. Dr. Muhammad Muzammal	HoD(CS)	Member
Snr. Assoc. Prof. Dr. Awais Majeed	HoD(SE)	Member
Snr. Asst. Prof. Dr. Khalid Javed	HoD(CE)	Member
Snr. Asst. Prof. Dr. Junaid Imtiaz	HoD(EE)	Member
BUKC		
Snr. Asst. Prof. Dr. Najam M. Amin	HoD(EE)	Member
Prof. Dr. Syed Shahid Ali	HoD(E&ES)	Member
Assoc. Prof. Dr. Syed Safdar Ali	HoD(CS)	Member
Assoc. Prof. Dr. Sohaib Ahmad	Associate Dean	Member
Snr. Asst. Prof. Dr. Rizwan Iqbal	HoD(CE)	Member
Snr. Asst. Dr. Osama Rehman	HoD(SE)	Member
BULC		
Snr. Asst. Prof. Dr. Khawaja Qasim Maqbool	HOD(CS)	Member

Proceedings

Preliminaries

FBoS-ES meeting took place on two days; in first session, with the quorum complete, the proceedings commenced at 1030 hrs, with recitation from the Holy Quran on 2nd November, 2020.

The second session of FBoS took place on 3rd November, 2020, with the quorum complete; the proceedings commenced at 0930 hrs.

In his opening remarks, the Chair stressed the importance for participation in the proceedings while staying focused on the point under deliberation.

New Items:

Item 2201: HEC Undergraduate Policy – Revised Roadmaps of BS Environmental Sciences, BS Geophysics and BS Geology

Sponsor: HOD (E&ES) BUIC & BUKC Referral Authority: DBoS E&ES BUIC &BUKC

Summary of the Case

- HEC has issued new Undergraduate Education Policy 2020 for all Higher Education Institutes to align their Undergraduate programs with this new Policy.
- Following under graduate programs are offered in BU at different campuses under FoES:
    - Earth and Environmental Sciences
        - BS ES
        - BS Geology
        - BS Geo Physics
        - BS Geosciences (to be started w.e.f Spring-21)
    - Computer Sciences
        - BS CS
        - BS IT
    - Engineering
        - BEE
        - BCE
        - BSE
- Dean ES asked all HoDs at all campuses to align all undergraduate road maps to HEC undergraduate policy while taking input from accreditation bodies.
- For computer sciences domain programs NCEAC was consulted on subject policy. They are working on it and they have asked to follow current curriculum till further intimation.
- For engineering programs PEC has sent new curriculum for BCE and BSE (will be presented in another agenda item) which are not based on subject undergraduate policy. It is therefore we need to wait till next intimation.

Discussion

The sponsor presented and reiterated the agenda point. During deliberations in FBoS meeting there were certain differences of opinion between E&ES BUIC and BUKC on revised road map.

- There was no consensus amongst E&ES BUIC and BUKC on the roadmap of BS (Geophysics). Since BS Geophysics is offered at BUIC only, roadmap presented by E&ES BUIC was finalized after slight modifications.
- There was consensus between E&ES BUIC and BUKC on the roadmap of BS (Geology).
- E&ES BUKC did not send revised roadmap for BS ES. Hence, Revised Roadmap of BS ES proposed by E&ES BUIC is deliberated in 22nd meeting of FBoS-ES and finalized.
- BS (Geosciences) is to be offered in BUKC and updated road map is finalized.

The revised roadmaps of BS Geology, Geophysics, Geosciences and Environmental Sciences programs based on HEC new undergraduate policy are attached at appendage 2201

Decision 2201

The case to be forwarded for the approval in ACM.

Item 2202: Bachelor of Computer Engineering Revised Roadmap in accordance with PEC OBE Undergraduate Engineering Curriculum 2020

Sponsor: HOD (CE) BUIC & BUKC Referral Authority: DBOS CE BUIC & BUKC

Summary of the Case

- PEC has sent letter reference number "PEC/CPD/OBE-Curri/2020" dated 20th October, 2020 for implementation of OBE Undergraduate Engineering Curriculum for Computer Engineering program w.e.f Fall-2020 after due consent of HEC.
- Dean – ES asked CE departments at BSEAS-BUKC and BSEAS-BUIC to review and present revised roadmaps.
- CE BUIC and BUKC reviewed the revised roadmap and presented their recommendations, which were deliberated in 22nd meeting of FBoS-ES in detail.

Discussion

The sponsor presented and reiterated the agenda point, after detailed discussion and deliberation the house suggested few changes which were incorporated. The Revised Roadmap of BCE is attached at Appendage 2202

Decision 2202

The case to be forwarded for the approval in ACM.

Item 2203: Bachelor of Software Engineering Revised Roadmap in accordance with PEC OBE Undergraduate Engineering Curriculum 2020

Sponsor: HoD (SE) BUIC & BUKC Referral Authority: DBOS SE BUIC & BUKC

Summary of the Case

- PEC has sent letter reference number "PEC/CPD/OBE-Curri/2020" dated 20th October, 2020 for implementation of OBE Undergraduate Engineering Curriculum for Software Engineering program w.e.f Fall-2020 after due consent of HEC.
- Dean – ES asked SE departments at BSEAS-BUKC and BSEAS-BUIC to review and present revised roadmaps.
- SE BUIC and BUKC reviewed the revised roadmap and presented their recommendations, which were deliberated in 22nd meeting of FBoS-ES in detail.

Discussion:

The sponsor presented and reiterated the agenda point, after detailed discussion and deliberation the house suggested few changes which were incorporated. The Revised Roadmap of BCE is attached at appendage 2203.

Decision 2203:

The case to be forwarded for the approval in ACM.

Item 2204: Launch of BS-Artificial Intelligence (AI) program

Sponsor: HOD (CS) BUIC & BUKC | Referral Authority: DBOS CS BUIC & BUKC

Summary of the Case

1. With reference to Letter number BU-HO/DES/2020/L/002, Dean Engineering Science, Dr. Atif Raza Jafri, asked to carry out the feasibility study to launch the BS AI program on the directions of Honorable Rector BU at BUIC, BUKC and BULC.
2. Committees were constituted at respective campuses to work on the curriculum design and infrastructure requirements for BS AI program.
3. Keeping in view the infrastructure limitations, BULC cannot launch BS-AI w.e.f Spring 2021.
4. HOD CS BUIC and HOD CS BUKC presented the working of their respective committees.
5. Proposals were thoroughly deliberated in house and joint feasibility has been finalized

Discussion

The sponsor iterated and presented the agenda item, which was deliberated by the house in detail. Based on the feasibility study attached at appendage 2204, following is recommended for approval:

1. Proposed roadmap.
2. Equipment, HR and Infrastructure requirement.
3. To proceed with NCEAC for zero visit.
4. Launch of BS-AI w.e.f Spring-2021 subject to NCEAC approval.

Decision 2204

The case to be forwarded for the approval in ACM.

Item 2205: Update of Pre-Requisite Courses for Elective Courses in BS (CS) and BS(IT) Programs

Sponsor: HOD CS BUIC | Referral Authority: DBOS CS BUIC

Summary of the Case

- The pre-requisites of some courses in the BS(CS) and BS(IT) programs roadmaps have discrepancies in the following categories:
  I. Some courses that are pre-requisites of other courses are offered in 6th semester or later, e.g., Artificial Intelligence is a prerequisite of several elective courses. Some of the elective courses for which Artificial Intelligence is a prerequisite course are not related.
  II. Some pre-requisite courses have a course code that does not match any existing course title in the roadmap.
  III. Some elective courses have prerequisites from core courses which are irrelevant.

- The BS CS and BS IT programs roadmaps were reviewed and the courses with pre-requisite discrepancies were examined one-by-one and appropriate prerequisites were recommended in line with the HEC/NCEAC curriculum.

Discussion

The sponsor presented the agenda point which was deliberated in detail by the house. The house also suggested few changes which are incorporated. The updated pre-requisite courses for BS CS and BS IT programs are attached at appendage 2205.

Decision 2005

The case to be forwarded for the approval in ACM.

Item 2206: Addition of Maritime Course in IDEE Elective List

Sponsor: HOD(EE) BUKC Referral Authority: DBOS EE BUKC

Summary of the Case

- Maritime education aim is to provide a wide range of talent in the Ship building industry, fisheries, shipbuilding machinery, engineering shipbuilding, port, crew training and a wide range of maritime services such as finance maritime, maritime security and delivery services.
- To enhance Maritime education in Pakistan, Bahria University has recently introduced BS program in Maritime Business and management to open doors for new entrants and maritime professionals. The business of shipping is therefore pivotal to the world economy and spans a number of disciplines including commerce, economics, law, logistics and management etc.
- Introducing a course of related to maritime industry in BEE curriculum will offer the diversity to the student to apply themselves in different area of maritime field.
- Maritime course can be added in the BEE curriculum as an IDEE elective.

Discussion

HoD EE BUKC presented the agenda point which was deliberated in detail by the house. The course outline of subject Maritime Technologies is attached at appendage 2206.

Decision 2206

The case to be forwarded for the approval in ACM.

Item 2207: Alignment of Department Vision and Mission with BU Revised Vision and Mission

Sponsor: HOD (CS) BUIC Referral Authority: DBOS CS BUIC

Summary of the Case

1. Bahria University Vision and Mission was recently revised and approved from BoG in July 2020. Each department is directed to ensure the alignment of its vision and mission with the revised BU Vision and Mission through respective DBoS and FBoS. In reference to letter no. BU-HO/DQA/2020/L/008, the CS Department's Vision and Mission statements is revised accordingly.**Discussion**

HOD CS BUIC presented the agenda item while rest of the house suggested few changes which were later incorporated by the sponsor. The chair suggested all other departments to discuss realignment of their respective department vision and mission with the revised BU Vision and Mission in DBoS.

Decision 2207

The mapping of departmental vision and mission are approved and attached at appendage 2207 .

Item 2208: Addition of Electives in BS (IT) roadmap

Sponsor: HOD (CS) BUKC Referral Authority: DBOS CS BUKC

Summary of the Case

1. There are many courses in different previous roadmaps of BS (IT) which were core courses, however, could not even included in elective list of most recent roadmap approved in 31st ACM. These courses are required to be added as an electives so that new students can also opt them. Similarly, if there are few students who have these course as a core course, they can also able to take it as core course. The details of the courses are as follows:

- SEN-310 Web Engineering, SEL-310 Web Engineering Lab and SEN-322 Advanced Web Engineering, SEL-322 Advanced Web Engineering Lab courses were core courses in the approved roadmap 23rd ACM.
- SEN-493 Multimedia Systems, SEL-493 Multimedia Systems Lab, CSC-328 System Integration and Architecture, CSC-458 Management Information System, ITC-316 Internet Architecture and Protocols and CSC-318 Object Oriented Analysis and design courses were core courses in the approved roadmap 32nd ACM.

Discussion

HoD CS BUKC presented the agenda point which was deliberated in detail by the house. The chair added that students can still opt those courses in new roadmap as well. The house agreed with the chair.

Decision 2208

Point dropped.

Item 2209: Modification in FYP, Thesis and Internship Result Submission

Sponsor: HOD (CS) BUKC | Referral Authority: DBOS CS BUKC

Summary of the Case

1. As per the newly system of FYP, Thesis and Internship Result submission, the system puts the coordinator in too much hassle as the coordinator has to individually search for each student's record and then fill details of each individual's FYP, Thesis and/or Internship which is finally submitted to HoD. The HoD again has to search every individual with enrollment and has to submit result of each student separately.

Discussion

The sponsor presented and iterated the case. After detailed discussion and arguments, the house suggested raising the agenda point with DIT on file.

Decision 2209

Case to be processed on file after discussion with DIT.

Item 2210: Proposed Reduction in Eligibility Criteria for BS-Environmental Science from 50% to 45% at E&ES-BUKC

Sponsor: HOD (E&ES) BUKC | Referral Authority: DBOS E&ES BUKC

Summary of the Case

BUKC Admissions advertisement for Spring 2021 semester has to be sent soon for newspaper print / social media and for online website display. While presenting & getting approval for upcoming newly-launched BS-Geosciences program with 45% eligibility criteria at 35th ACM, the low-intake program, i.e., BS-Environmental Sciences at BUKC, was also deliberated for bringing the eligibility criteria for Spring intake at-par in terms of Eligibility of applicants (FSc./A levels/DAE at 45%) for enhancing low in-take programs in Applied sciences at BUKC. The other program in Maritime Science Dept. also accept 45% Intermediate/DAE. Subsequently, it was advised by Honorable Rector at ACM that BUKC can follow the procedure either through Campus Administration or through FBoS. Since this is first F-BoS being convened since last 35th ACM, the agenda item is placed before august house to consider Southern Pakistan's lack of interest in applied sciences by reducing eligibility criteria of BS-Environmental Sciences (from existing 50% to 45%) for Spring 2021 onward at E&ES, BU KARACHI CAMPUS ONLY . It will not only bring eligibility criteria for both undergraduate programs, i.e., BS-Geoscience & BS-Environmental Sciences, in consonance but will also enable more applicants to seek admissions in forth-coming semester, where many candidates holding FSC b/w 45% 50% were recommended to other low eligibility criteria in Fall 2020 semester. The same eligibility criteria reduction was approved by BUHO previously vide reference 'A' for BS-Geophysics in 2017 & later continued in 2018.

Discussion

The sponsor presented and iterated the case. After detailed discussion and arguments, the house suggested raising the agenda point on file.

Decision 2210

Case to be processed on file.

Item 2211: Access to Student Internship Record in CMS

Sponsor: HOD (EE) BUIC | Referral Authority: DBOS EE BUIC

Summary of the Case

- In CMS, access may be given to the Career Service Coordinator (CSC) to enter the record of the whole batch of the students. Currently, CSC has to enter records by entering enrollment numbers only.
- CSC may be given access to search the record of the student by name
- Also, the search option in CMS with respect to the company's name may be available to facilitate the department in tracking the progress with respect to MOUs signed with companies.

Discussion
The sponsor presented and iterated the case. After detailed discussion and arguments, the house suggested raising the agenda point with DIT on file.
Decision 2211
Case to be processed on file after discussion with DIT.

Item 2212: Addition of Lab Component in HCI and Numerical Analysis

Sponsor: HOD (SE) BUKC Referral Authority: DBOS SE BUKC

Summary of the Case
As per the revised BSE curriculum and roadmap, it is recommended that the courses Human Computer Interaction" (HCI) and "Numerical Analysis" should have lab components. Therefore, we discussed this point in our 10th DBoS and it was agreed to work on adding lab components to HCI while adding a lab component to Numerical Analysis would be discussed at FBoS level.
Discussion
The sponsor presented and iterated the case. After detailed discussion and arguments, the house suggested that new roadmap of software engineering already includes lab component of Numerical Analysis. The house agreed that there is no need of lab component for HCI.
Decision 2211
Point dropped.

Closing of the Meeting

There being no further points, the Chair brought the meeting to close, thanking the participants for their wholehearted participation in both sessions.

Prof. Dr Atif Raza Jafri
Dean (ES), Head FBoS
November, 2020

Distribution:

	Rector, Pro-Rector, Registrar
BUHQ:	DAA
BUIC:	DG BUIC, DIC HOD(EES), HOD(EE), HOD(CS), HOD(SE), HOD(CE)
BUKC:	DG BUKC, DKC HOD(EES), HOD(EE), HOD(CS), HOD(SE), HOD(CE)
BULC:	DLC, HOD(CS)

Appendages:

Appendage 2201

Bachelor Programs of Earth & Environmental Sciences Department

Curriculum
2021

Departments of Earth & Environmental Sciences
BAHRIA UNIVERSITY

Roadmap of BS Geology

General Education Courses

Total Courses = 13
Total Credit Hours = 39
To be offered in first two years

HEC Policy 2020	Category along with HEC Policy Reference	Domains of Knowledge	Number of courses as per HEC policy	Existing Roadmap	BUIC New Roadmap
General Education	Breadth (Para 6.1)	Arts and Humanities	2 courses of 3 CH each	NIL	**Two of the Following** 1. Urban and Town Planning (3 CH) 2. Museology (3 CH) 3. Physical Education (3 CH) 4. Introduction to Film Making and Analysis (3 CH) 5. Photography (3 CH)
		Natural Sciences	2 courses of 3 CH each	1. Chemistry (3 CH) 2. Physics (3 CH)	
		Social Sciences	2 courses of 3 CH each	**One of the Following** 1. Introduction to International Relations (3 CH) 2. Introduction to Media Studies (3 CH) 3. Introduction to Anthropology (3 CH) 4. Introduction to Sociology (3 CH)	**Two of the Following** 1. Introduction to International Relations (3 CH) 2. Introduction to Media Studies (3 CH) 3. Introduction to Anthropology (3 CH) 4. Introduction to Sociology (3 CH) 5. Introduction to Psychology (3 CH)
	Foundation Skills (Para 6.2)	Expository Writing	3 courses of 3 CH each	1. English-I (3 CH) 2. English-II (3 CH) 3. Oral Communication (3 CH)	1. English-I (3 CH) 2. English-II (3 CH) 3. Oral Communication (3 CH)
		Quantitative Reasoning	2 courses of 3 CH each	1. Introduction to Computers (3 CH) 2. Statistics (3 CH)	1. Introduction to Computers and programming (3 CH) 2. Statistics (3 CH)
	Civilization Knowledge (Para 6.3)	Islamic Studies	1 course of 3 CH each	Islamic Studies (2 CH)	Islamic Studies (3 CH) Increase of 1 CH
		Pakistan Studies	1 course of 3 CH each	Pakistan Studies (2 CH)	Pakistan Studies (3 CH) Increase of 1 CH

Disciplinary Courses

Total Credit Hours = 98

Major and Minors cannot be offered at this stage

Practical Learning Requirement

- Internship (9-week duration)
    - Currently internship is not part of any program under E&ES department. In order to include this element there is need to collaborate with employer as per HEC policy. FBoS recommended to explore enterprises those can offer internships through Directorate of student affairs in consultation with E&ES department.

As per HEC policy, Practical Learning Lab (PLL) should be included in each UG Program. FoES recommended to modify ILP program in this regard while taking inputs from all other faculties and administration.

Bachelor of Science (BS) Geology
Roadmap Amendments

Description	HEC Proposed	Existing	Revised
Total number of credit hours	130-140	135	137

Semester - 1

Course code	Course Title	Credit Hours	Amendments
PAK 101	Pakistan Studies	2	**3 credit hours**
ISL 101	Islamic Studies	2	**3 credit hours**
ENG 103	English I	3	
MAT 105*	Mathematics	0	
CSC 105	Introduction to Computers	3	Modification of Course Title and Contents.
PHY 101	Physics	3	
GEO 105	Physical & General Geology	3	
	Total Credit Hours	**16**	**18**

*Academic credit of this course is zero but its contact hours, teaching material and tuition fee are equal to a 3 credit hours course.

Semester – 3

Course code	Course Title	Credit Hours	Amendments
ENG 232	Oral Communication	3	
MAT 205	Statistics	3	
GEO 205	Structure Geology	3	
CSC 205	**Programming Fundamentals**	**3**	**Course removed**
GEO 210	Mineralogy & Crystallography	3	
Two of the Following Social Sciences Courses			
HSS 111	Introduction to International Relations	3	**List of Social sciences courses are added**
HSS 115	Introduction to Media Studies	3	
HSS 201	Introduction to Anthropology	3	
HSS 202	Introduction to Sociology	3	
HSS 107	Introduction to Psychology	3	
	Total Credit Hours	**18**	**18**

Note: Students will be offered two of the Social Sciences Courses.

Semester – 4

Course code	Course Title	Credit Hours	Amendments
GEO 215	Sedimentology	3	
GEO 220	Optical Mineralogy	3	
GEO 225	Geochemistry	3	
GEO 230	Geotectonics	3	
MAT 210	**Advance Mathematics**	**3**	**Course removed**
Two of the Following Arts and Humanities Courses			
ARH 210	Urban and Town Planning	3	**List of Arts and Humanities Courses are added**
ARH 211	Museology	3	
ARH 212	Physical Education	3	
MTB 411	Introduction to Film Making and Analysis	3	
MED 111	Photography	3	
	Total Credit Hours	**15**	**18**

Note: Students will be offered two of the Arts and Humanities Courses.

Semester – 5

Course code	Course Title	Credit Hours	Amendments
GEO 326	**Computing with Matlab**	**3**	**Shifted to 7th Semester**
GEO 325	Stratigraphy of Pakistan	3	
GEO 315	Igneous & Metamorphic Petrology	3	
GEO 320	Marine Geology	3	
GEO 305	Environmental Geology	3	
GEO 310	Paleontology	3	
	Total Credit Hours	**18**	**15**

Semester – 7

Course code	Course Title	Credit Hours	Amendments
GEO 410	Engineering Geology	3	
GEO 415	Economic Geology	3	
GEO 425	Research Methodology	2	
GEO 420	Hydrogeology	3	
GEO 405	**Petroleum Engineering**	**3**	**Course removed**
GEO 326	**Computing with Matlab**	**3**	**Shifted from 5th semester**
	Total Credit Hours	**14**	**14**

Semester - 8

Course code	Course Title	Credit Hours	Amendments
GEO 445	Seismic Stratigraphy	3	
GEO 430	Geochemical Exploration Technique	3	
GEO 435	GIS & Remote Sensing	3	
GEO 440	Thesis	6	
GEO 465	Comprehensive Viva Voce	0	**Removed**
	Total Credit Hours	**15**	

Bachelor of Science (BS) Geology
New Roadmap

Semester - 1

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
PAK 101	Pakistan Studies	3+0	3	0
ISL 101	Islamic Studies	3+0	3	0
ENG 103	English I	3+0	3	0
MAT 105*	Mathematics	0+0	3	0
CSC 106	Introduction to Computers and Programming	2+1	2	2
PHY 101	Physics	2+1	2	2
GEO 105	Physical & General Geology	2+1	2	2
	Total Credit Hours	**18**		

*Academic credit of this course is zero but its contact hours, teaching material and tuition fee are equal to a 3 credit hours course.

Semester - 2

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
CHM 105	Chemistry	2+1	2	2
ENG 104	English –II Prerequisite: ENG 103 - English I	3+0	3	0
MAT 115	Calculus & Analytical Geometry	3+0	3	0
GEO 110	Fundamental of Geography & Geomorphology	3+0	3	0
GEO 115	Introduction to Geophysics Prerequisite: PHY 101 - Physics	3+0	3	0
GEO 120	Field Geology Prerequisite: GEO 105 - Physical & General Geology	3+0	3	0
	Total Credit Hours	**18**		

Semester – 3

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
ENG 232	Oral Communication Prerequisite: ENG 104 - English II	3+0	3	0
MAT 205	Statistics	3+0	3	0
GEO 205	Structure Geology Prerequisite: GEO 105 - Physical & General Geology	3+0	3	0
GEO 210	Mineralogy & Crystallography Prerequisite: GEO 105 - Physical & General Geology	2+1	2	2
Two of the Following Social Sciences Courses				
HSS 111	Introduction to International Relations	3+0	3	0
HSS 115	Introduction to Media Studies	3+0	3	0
HSS 201	Introduction to Anthropology	3+0	3	0
HSS 202	Introduction to Sociology	3+0	3	0
HSS 107	Introduction to Psychology	3+0	3	0
	Total Credit Hours	**18**		

Note: Students will be offered two of the Social Sciences Courses.

Semester – 4

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 215	Sedimentology Prerequisite: GEO 105 - Physical & General Geology	3+0	3	0
GEO 220	Optical Mineralogy Prerequisite: GEO 210 - Mineralogy & Crystallography	2+1	2	2
GEO 225	Geochemistry Prerequisite: CHM 105 - Chemistry	3+0	3	0
GEO 230	Geotectonics Prerequisite: GEO 205 - Structure Geology	3+0	3	0
Two of the Following Arts and Humanities Courses				
ARH 210	Urban and Town Planning	3+0	3	0
ARH 211	Museology	3+0	3	0
ARH 212	Physical Education	3+0	3	0
MTB 411	Introduction to Film Making and Analysis	3+0	3	0
MED 111	Photography	3+0	3	0
	Total Credit Hours	**18**		

Note: Students will be offered two of the Arts and Humanities Courses.

Field Work I

Course code	Course Title	Credit Hours
GEO 235	Geology Field Work & Report-I	3

Semester - 5

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 325	Stratigraphy of Pakistan Prerequisite: GEO 215 - Sedimentology	3+0	3	0
GEO 315	Igneous & Metamorphic Petrology Prerequisite: GEO 210 - Mineralogy & Crystallography	2+1	2	2
GEO 320	Marine Geology Prerequisite: GEO 215 - Sedimentology	3+0	3	0
GEO 305	Environmental Geology	3+0	3	0
GEO 310	Paleontology	2+1	2	2
	Total Credit Hours	**15**		

Semester - 6

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 340	Wireline logging	3+0	3	0
GEO 350	Geology of Pakistan Prerequisite: GEO 230 - Geotectonics	3+0	3	0
GEO 330	Micropaleontology & Biostratigraphy Prerequisite: GEO 310 - Paleontology	2+1	2	2
GEO 345	Petroleum Geology Prerequisite: GEO 325 - Stratigraphy of Pakistan	3+0	3	0

GEO 335	Earthquake Seismology	3+0	3	0
	Total Credit Hours	**15**		

Field Work II

Course code	Course Title	Credit Hours
GEO 355	Geology Field Work & Report-II	3

Semester - 7

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 410	Engineering Geology	2+1	2	2
GEO 415	Economic Geology Prerequisite: GEO 315 - Igneous & Metamorphic Petrology	2+1	2	2
GEO 425	Research Methodology	2+0	2	0
GEO 420	Hydrogeology	3+0	3	0
GEO 326	Computing with Matlab	2+1	2	2
	Total Credit Hours	**14**		

Semester - 8

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 445	Seismic Stratigraphy	3+0	3	0
GEO 430	Geochemical Exploration Techniques	3+0	3	0
GEO 435	GIS & Remote Sensing	2+1	2	2
GEO 440	Thesis	6+0		
	Total Credit Hours	**15**		

Course Outlines of new courses added under the category of Arts and Humanities group

ARH 210 Urban and Town Planning (3CH)

New Course Added

Introduction to Urban and Town Planning, Justification and Aims of Planning, Planning Principles and Elements of Planning, Scope, nature and purpose of Physical Planning, Types of Plans and Planning, Characteristics of Planned and Unplanned Human Settlements, Overview of Old and New Towns Designed in the Developed and Developing Countries, Introduction to Planning System in Pakistan, Historical and Modern Cities of Pakistan.

ARH 211 Museology (3CH)

New Course Added

Introduction of Museology, Museum and Its Function, Collection, recording, preservation, exhibition and education, Different types of museums, History of Museology in Pakistan Problems and prospects of museums in Pakistan, Museum Administration, Museum Security, Record keeping, Care and Storage of Museum Objects, Museum Architecture, Museum Exhibition.

ARH 212 Physical Education (3CH)

New Course Added

Introduction and background of Physical Education, Scope of Physical Education, Aims and objectives of Physical Education, philosophy and Physical Education, Relationship of Physical Education with Naturalism, Idealism, Realism, Physical Education as an academic discipline, Physical Education and Islam, Physical Education as a profession, Biological interpretation of Physical Education, Psychological interpretation of Physical Education, Sociological interpretation of Physical Education, Physical Education and Recreation.

MTB 411 Introduction to Film Making and Analysis (3CH)

Course added from BS (TV BROADCASTING) program

Students will be introduced to basic film vocabulary such as montage, mise-en-scene, narrative, cinematography, sound, editing, etc and explore film within a cultural context specifically in relationship to other media (the novel, theatre, and the visual arts). The course will also enable students to study the aesthetic eye: basic theory regarding the camera's role in shaping the viewer's perception. The course will also examine narration and sequence (storyboard) and analyze the purposes and functions of film: (its aesthetic, socio-political, spiritual, economic, expressive aspects).

MED 111 Photography (3CH)

Course added from BS (Media Studies) program

An introductory course in the study of photography with emphasis on the digital single lens reflex (D-SLR) camera. Exposure, metering, focus, depth of field, lenses, basic lighting, design elements and composition are explored. Basic principles of digital photographic capture are discussed. Students are responsible for providing a digital single lens reflex (D-SLR) camera.

Modification in course code, title and outline of Introduction to Computers.

CSC 106 Introduction to Computers and Programming (3 CH)

History of Computer development; application of Computers; Classification and types of computers; Basic block diagram of computer; Hardware (input, output, memory, CPU and software (system software & Application software); social impact of computer age; Computer in education and Scientific research; Introduction to, and history of Internet; Internet service providers and connections; the World Wide Web. Introduction to MicroSoft (word, Excel, Powerpoint); Structure of C; Input and output function of C++; Variable and Operators; Decision and Loops.

Roadmap of BS Geophysics

General Education Courses

Total Courses = 13
Total Credit Hours = 39
To be offered in first two years

HEC Policy 2020	Category along with HEC Policy Reference	Domains of Knowledge	Number of courses as per HEC policy	Existing Roadmap	BUIC New Roadmap
General Education	Breadth (Para 6.1)	Arts and Humanities	2 courses of 3 CH each	NIL	**Two of the Following** 1. Urban and Town Planning (3 CH) 2. Museology (3 CH) 3. Physical Education (3 CH) 4. Introduction to Film Making and Analysis (3 CH) 5. Photography (3 CH)
		Natural Sciences	2 courses of 3 CH each	1. Chemistry (3 CH) 2. Physics (3 CH)	1. Chemistry (3 CH) 2. Physics (3 CH)
		Social Sciences	2 courses of 3 CH each	**One of the Following** 1. Introduction to International Relations (3 CH) 2. Introduction to Media Studies (3 CH) 3. Introduction to Anthropology (3 CH) 4. Introduction to Sociology (3 CH)	**Two of the Following** 1. Introduction to International Relations (3 CH) 2. Introduction to Media Studies (3 CH) 3. Introduction to Anthropology (3 CH) 4. Introduction to Sociology (3 CH) 5. Introduction to Psychology (3 CH)
	Foundation Skills (Para 6.2)	Expository Writing	3 courses of 3 CH each	1. English-I (3 CH) 2. English-II (3 CH) 3. Oral Communication (3 CH)	1. English-I (3 CH) 2. English-II (3 CH) 3. Oral Communication (3 CH)
		Quantitative Reasoning	2 courses of 3 CH each	1. Introduction to Computers (3 CH) 2. Statistics (3 CH)	1. Introduction to Computers and Programming (3 CH) 2. Statistics (3 CH)
	Civilization Knowledge (Para 6.3)	Islamic Studies	1 course of 3 CH each	Islamic Studies (2 CH)	Islamic Studies (3 CH) Increase of 1 CH
		Pakistan Studies	1 course of 3 CH each	Pakistan Studies (2 CH)	Pakistan Studies (3 CH) Increase of 1 CH

Disciplinary Courses

Total Credit Hours = 98

Major and Minors cannot be offered at this stage

Practical Learning Requirement

- Internship (9-week duration)
    - Currently internship is not part of any program under E&ES department. In order to include this element there is need to collaborate with employer as per HEC policy. FBoS recommended to explore enterprises those can offer internships through Directorate of student affairs in consultation with E&ES department.

As per HEC policy, Practical Learning Lab (PLL) should be included in each UG Program. FoES recommended to modify ILP program in this regard while taking inputs from all other faculties and administration.

Bachelor of Science (BS) Geophysics
Roadmap Amendments

Description	HEC Proposed	Existing	Revised
Total number of credit hours	130-140	135	137

Semester - 1

Course code	Course Title	Credit Hours	Amendments
PAK 101	Pakistan Studies	2	**3 credit hours**
ISL 101	Islamic Studies	2	**3 credit hours**
ENG 103	English I	3	
MAT 105*	Mathematics	0	
CSC 105	Introduction to Computers	3	**Modification of Course Title and Contents.**
PHY 101	Physics	3	
GEO 105	Physical & General Geology	3	
	Total Credit Hours	**16**	**18**

*Academic credit of this course is zero but its contact hours, teaching material and tuition fee are equal to a 3 credit hours course.

Semester – 3

Course code	Course Title	Credit Hours	Amendments
ENG 232	Oral Communication	3	
MAT 205	Statistics	3	
GEO 205	Structure Geology	3	
CSC 205	**Programming Fundamentals**	**3**	**Course removed**
GEO 210	Mineralogy & Crystallography	3	
Two of the Following Social Sciences Courses			
HSS 111	Introduction to International Relations	3	**List of Social sciences courses are added**
HSS 115	Introduction to Media Studies	3	
HSS 201	Introduction to Anthropology	3	
HSS 202	Introduction to Sociology	3	
HSS 107	Introduction to Psychology	3	
	Total Credit Hours	**18**	**18**

Note: Students will be offered two of the Social Sciences Courses.

Semester – 4

Course code	Course Title	Credit Hours	Amendments
GEO 215	Sedimentology	3	
GEO 240	Gravity & Magnetic Exploration Techniques	3	
GEO 365	Electrical & Radioactive Techniques	3	
GEO 230	Geotectonics	3	
MAT 210	**Advance Mathematics**	**3**	**Course removed**
Two of the Following Arts and Humanities Courses			
ARH 210	Urban and Town Planning	3	**List of Arts and Humanities Courses are added**
ARH 211	Museology	3	
ARH 212	Physical Education	3	
MTB 411	Introduction to Film Making and Analysis	3	
MED 111	Photography	3	
	Total Credit Hours	**15**	**18**

Note: Students will be offered two of the Arts and Humanities Courses.

Semester - 5

Course code	Course Title	Credit Hours	Amendments
GEO 326	**Computing with Matlab**	**3**	**Shifted to 7th Semester**
GEO 325	Stratigraphy of Pakistan	3	
GEO 315	Igneous & Metamorphic Petrology	3	
GEO 320	Marine Geology	3	
GEO 305	Environmental Geology	3	
GEO 370	Geomagnetism & Paleomagnetism	3	
	Total Credit Hours	**18**	**15**

Semester - 7

Course code	Course Title	Credit Hours	Amendments
GEO 470	Seismic Data Processing	3	
GEO 415	Economic Geology	3	
GEO 425	Research Methodology	2	
GEO 420	Hydrogeology	3	
GEO 405	**Petroleum Engineering**	**3**	**Course removed**
GEO 326	**Computing with Matlab**	**3**	**Shifted from 5th semester**
	Total Credit Hours	**14**	

Semester - 8

Course code	Course Title	Credit Hours	Amendments
GEO 445	Seismic Stratigraphy	3	
GEO 475	Seismic Data Interpretation	3	
GEO 435	GIS & Remote Sensing	3	
GEO 460	Thesis	6	
GEO 465	Comprehensive Viva Voce	0	**Course removed**
	Total Credit Hours	**15**	

Bachelor of Science (BS) Geophysics
New Roadmap

Semester – 1

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
PAK 101	Pakistan Studies	3+0	3	0
ISL 101	Islamic Studies	3+0	3	0
ENG 103	English I	3+0	3	0
MAT 105*	Mathematics	0+0	3	0
CSC 106	Introduction to Computers and Programming.	2+1	2	2
PHY 101	Physics	2+1	2	2
GEO 105	Physical & General Geology	2+1	2	2
	Total Credit Hours	**18**		

*Academic credit of this course is zero but its contact hours, teaching material and tuition fee are equal to a 3 credit hours course.

Semester - 2

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
CHM 105	Chemistry	2+1	2	2
ENG 104	English –II Prerequisite: ENG 103 - English I	3+0	3	0
MAT 115	Calculus & Analytical Geometry	3+0	3	0
GEO 110	Fundamental of Geography & Geomorphology	3+0	3	0
GEO 115	Introduction to Geophysics Prerequisite: PHY 101 - Physics	3+0	3	0
GEO 120	Field Geology Prerequisite: GEO 105 - Physical & General Geology	3+0	3	0
	Total Credit Hours	**18**		

Semester – 3

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
ENG 232	Oral Communication Prerequisite: ENG 104 - English II	3+0	3	0
MAT 205	Statistics	3+0	3	0
GEO 205	Structure Geology Prerequisite: GEO 105 - Physical & General Geology	3+0	3	0
GEO 210	Mineralogy & Crystallography Prerequisite: GEO 105 - Physical & General Geology	2+1	2	2
Two of the Following Social Sciences Courses				
HSS 111	Introduction to International Relations	3+0	3	0
HSS 115	Introduction to Media Studies	3+0	3	0
HSS 201	Introduction to Anthropology	3+0	3	0

HSS 202	Introduction to Sociology	3+0	3	0
HSS 107	Introduction to Psychology	3+0	3	0
	Total Credit Hours	**18**		

Note: Students will be offered two of the Social Sciences Courses.

Semester – 4

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 215	Sedimentology Prerequisite: GEO 105 - Physical & General Geology	3+0	3	0
GEO 240	Gravity & Magnetic Exploration Techniques Prerequisite: GEO 115 - Introduction to Geophysics	3+0	3	0
GEO 365	Electrical & Radioactive Techniques Prerequisite: GEO 115 - Introduction to Geophysics	3+0	3	0
GEO 230	Geotectonics Prerequisite: GEO 205 - Structure Geology	3+0	3	0
Two of the Following Arts and Humanities Courses				
ARH 210	Urban and Town Planning	3+0	3	0
ARH 211	Museology	3+0	3	0
ARH 212	Physical Education	3+0	3	0
MTB 411	Introduction to Film Making and Analysis	3+0	3	0
MED 111	Photography	3+0	3	0
	Total Credit Hours	**18**		

Note: Students will be offered two of the Arts and Humanities Courses.

Field Work I

Course code	Course Title	Credit Hours
GEO 250	Geology and Geophysical Field Work and Report-I	3

Semester – 5

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 325	Stratigraphy of Pakistan Prerequisite: GEO 215 - Sedimentology	3+0	3	0
GEO 315	Igneous & Metamorphic Petrology Prerequisite: GEO 210 - Mineralogy & Crystallography	2+1	2	2
GEO 320	Marine Geology Prerequisite: GEO 215 - Sedimentology	3+0	3	0
GEO 305	Environmental Geology	3+0	3	0
GEO 370	Geomagnetism & Paleomagnetism Prerequisite: GEO 115 - Introduction to Geophysics	3+0	3	0
	Total Credit Hours	**15**		

Semester - 6

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 340	Wireline logging	3+0	3	0
GEO 350	Geology of Pakistan	3+0	3	0

	Prerequisite: GEO 230 - Geotectonics			
GEO 367	Seismic Data Acquisition & Planning Prerequisite: GEO 115 - Introduction to Geophysics	3+0	3	0
GEO 345	Petroleum Geology Prerequisite: GEO 325 - Stratigraphy of Pakistan	3+0	3	0
GEO 335	Earthquake Seismology	3+0	3	0
	Total Credit Hours	**15**		

Field Work II

Course code	Course Title	Credit Hours
GEO 375	Geology and Geophysical Field Work and Report-II	3

Semester – 7

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 470	Seismic Data Processing Prerequisite: GEO 367 - Seismic Data Acquisition & Planning	3+0	3	0
GEO 415	Economic Geology Prerequisite: GEO 315 - Igneous & Metamorphic Petrology	2+1	2	2
GEO 425	Research Methodology	2+0	2	0
GEO 420	Hydrogeology	3+0	3	0
GEO 326	Computing with Matlab	2+1	2	2
	Total Credit Hours	**14**		

Semester – 8

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 445	Seismic Stratigraphy	3+0	3	0
GEO 475	Seismic Data Interpretation Prerequisite: GEO 470 - Seismic Data Processing	3+0	3	0
GEO 435	GIS & Remote Sensing	2+1	2	2
GEO 440	Thesis	6+0		
	Total Credit Hours	**15**		

Roadmap of BS Environmental Sciences

HEC Policy 2020	Category along with HEC Policy Reference	Domains of Knowledge	Number of courses	Existing Roadmap	BUIC New Roadmap
General Education	Breadth (Para 6.1)	Arts and Humanities	2 courses of 3 CH each	NIL	**Two of the Following** 1. Urban and Town Planning (3 CH) 2. Museology (3 CH) 3. Physical Education (3 CH) 4. Introduction to Film Making and Analysis (3 CH) 5. Photography (3 CH)
		Natural Sciences	2 courses of 3 CH each	1. Chemistry (3 CH) 2. Physics (3 CH)	1. Chemistry (3 CH) 2. Physics (3 CH)
		Social Sciences	2 courses of 3 CH each	**3rd Semester** **One of the Following** 1. Introduction to International Relations (3 CH) 2. Introduction to Media Studies (3 CH) **4th Semester** 1. Introduction to Psychology (3 CH)	**Two of the Following** 1. Introduction to International Relations (3 CH) 2. Introduction to Media Studies (3 CH) 3. Introduction to Anthropology (3 CH) 4. Introduction to Sociology (3 CH) 5. Introduction to Psychology (3 CH)
	Foundation Skills (Para 6.2)	Expository Writing	3 courses of 3 CH each	1. English-I (3 CH) 2. English-II (3 CH) 3. Oral Communication (3 CH)	1. English-I (3 CH) 2. English-II (3 CH) 3. Oral Communication (3 CH)
		Quantitative Reasoning	2 courses of 3 CH each	1. Introduction to Computers (3 CH) 2. Statistics (3 CH)	1. Introduction to Computers (3 CH) 2. Statistics (3 CH)
	Civilization Knowledge (Para 6.3)	Islamic Studies	1 course of 3 CH each	Islamic Studies (2 CH)	Islamic Studies (3 CH) Increase of 1 CH
		Pakistan Studies	1 course of 3 CH each	Pakistan Studies (2 CH)	Pakistan Studies (3 CH) Increase of 1 CH

Disciplinary Courses

Total Credit Hours = 95

Major and Minors cannot be offered at this stage

Practical Learning Requirement

- Internship (9-week duration)
    - Currently internship is not part of any program under E&ES department. In order to include this element there is need to collaborate with employer as per HEC policy. FBoS recommended to explore enterprises those can offer internships through Directorate of student affairs in consultation with E&ES department.

As per HEC policy, Practical Learning Lab (PLL) should be included in each UG Program. FoES recommended to modify ILP program in this regard while taking inputs from all other faculties and administration.

Bachelor of Science (BS) Environmental Sciences
Roadmap Amendments

Description	HEC Proposed	Existing	Revised
Total number of credit hours	124-136	135	134

Semester – 1

Course code	Course Title	Credit Hours	Amendments
PAK 101	Pakistan Studies	2	**3 credit hours**
ISL 101	Islamic Studies	2	**3 credit hours**
ENG 103	English I	3	
CSC 105	Introduction to Computers	3	
PHY 101	Physics	3	
GEO 105	**Physical & General Geology**	**3**	**Course removed**
ENV 105	**Introduction to Environmental Sciences**	**3**	**Shifted from 2nd semester**
MAT 105* OR BIO 105*	Fundamentals of Biology	0	
	Fundamentals of Mathematics	0	
	Total Credit Hours	**16**	**18**

*Academic credit of this course is zero but its contact hours, teaching material and tuition fee are equal to a 3 credit hours course.

Semester - 2

Course code	Course Title	Credit Hours	Amendments
CHM 105	Chemistry	3	
ENG 104	English –II	3	
MAT 115	Calculus & Analytical Geometry	3	
GEO 110	Fundamental of Geography & Geomorphology	3	
ENV 105	**Introduction to Environmental Sciences**	**3**	**Shifted to 1st semester**
ENV 236	**Introduction to Climate Change**	**3**	**Shifted from 4th semester**
ENV 110	Environmental Biology	3	
	Total Credit Hours	**18**	**18**

Semester – 3

Course code	Course Title	Credit Hours	Amendments
ENG 232	Oral Communication	3	
MAT 205	Statistics	3	
ENV 210	Environmental Chemistry	3	
ENV 205	**Fundamentals of Ecology**	**3**	**Course removed**
ENV 230	Environmental Issues	3	**Course removed**
Two of the Following Social Sciences Courses			
HSS 111	Introduction to International Relations	3	**List of Social sciences courses are added**
HSS 115	Introduction to Media Studies	3	
HSS 201	Introduction to Anthropology	3	
HSS 202	Introduction to Sociology	3	
HSS 107	Introduction to Psychology	3	
	Total Credit Hours	**18**	**15**

Note: Students will be offered two of the Social Sciences Courses.

Semester – 4

Course code	Course Title	Credit Hours	Amendments
ENV 215	Social Theory of Environment	3	
ENV 220	Environmental Microbiology	3	
ENV 225	Applied Ecology	3	
ENV 236	**Introduction to Climate Change**	**3**	**Shifted to 2nd semester**
ENV 245	Introduction to Oceanography	3	
HSS 107	**Introduction to Psychology**	**3**	**Shifted to third semester in list of Social Sciences Courses**
Two of the Following Arts and Humanities Courses			
ARH 210	Urban and Town Planning	3	**List of Arts and Humanities Courses are added**
ARH 211	Museology	3	
ARH 212	Physical Education	3	
MTB 411	Introduction to Film Making and Analysis	3	
MED 111	Photography	3	
	Total Credit Hours	**18**	**18**

Semester - 8

Course code	Course Title	Credit Hours	Amendments
ENV 350	Remote Sensing and GIS for Environment	3	
ENV 440	Energy and Environment	3	
ENV 430	Environmental Policies & Laws	3	
GEO 435	Thesis	6	
GEO 445	Comprehensive Viva Voce	0	**Removed**
	Total Credit Hours	**15**	

Bachelor of Science (BS) Environmental Sciences
New Roadmap

Semester – 1

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
PAK 101	Pakistan Studies	3+0	3	0
ISL 101	Islamic Studies	3+0	3	0
ENG 103	English I	3+0	3	0
CSC 105	Introduction to Computers	2+1	2	2
PHY 101	Physics	2+1	2	2
ENV 105	Introduction to Environmental Sciences	3+0	3	0
MAT 105* OR BIO 105*	Fundamentals of Biology	0+0	3	0
	Fundamentals of Mathematics	0+0	3	0
	Total Credit Hours	**18**		

*Academic credit of this course is zero but its contact hours, teaching material and tuition fee are equal to a 3 credit hours course.

Semester – 2

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
CHM 105	Chemistry	2+1	2	2
ENG 104	English –II Prerequisite: ENG 103 - English I	3+0	3	0
MAT 115	Calculus & Analytical Geometry	3+0	3	0
GEO 110	Fundamental of Geography & Geomorphology	3+0	3	0
ENV 236	Introduction to Climate Change Prerequisite: ENV 105 - Introduction to Environmental Sciences	3+0	3	0
ENV 110	Environmental Biology	3+0	3	0
	Total Credit Hours	**18**		

Semester – 3

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
ENG 232	Oral Communication Prerequisite: ENG 104 - English II	3+0	3	0
MAT 205	Statistics	3+0	3	0
ENV 210	Environmental Chemistry Prerequisite: CHM 105 Chemistry	2+1	2	2
Two of the Following Social Sciences Courses				
HSS 111	Introduction to International Relations	3+0	3	0
HSS 115	Introduction to Media Studies	3+0	3	0
HSS 201	Introduction to Anthropology	3+0	3	0
HSS 202	Introduction to Sociology	3+0	3	0
HSS 107	Introduction to Psychology	3+0	3	0
	Total Credit Hours	**15**		

Note: Students will be offered two of the Social Sciences Courses.

Semester – 4

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
ENV 215	Social Theory of Environment Prerequisite: ENV 105 - Introduction to Environmental Sciences	3+0	3	0
ENV 220	Environmental Microbiology Prerequisite: ENV 110 Environmental Biology	3+0	3	0
ENV 225	Applied Ecology	3+0	3	0
ENV 245	Introduction to Oceanography	3+0	3	0
Two of the Following Arts and Humanities Courses				
ARH 210	Urban and Town Planning	3+0	3	0
ARH 211	Museology	3+0	3	0
ARH 212	Physical Education	3+0	3	0
MTB 411	Introduction to Film Making and Analysis	3+0	3	0
MED 111	Photography	3+0	3	0
	Total Credit Hours	**18**		

Note: Students will be offered two of the Arts and Humanities Courses.

Field Work

Course code	Course Title	Credit Hours
ENV 240	Environmental Sciences Field Work and Report	3

Semester – 5

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
ENV 305	Environmental Monitoring	3+0	3	0
ENV 310	Environmental Toxicology Prerequisite: ENV 105 - Introduction to Environmental Sciences	3+0	3	0
ENV 315	Environmental Management System	3+0	3	0
ENV 320	Environmental Biotechnology Prerequisite: ENV 110 Environmental Biology	3+0	3	0
ENV 335	Analytical Techniques in Environmental Sciences	3+0	3	0
GEO 305	Environmental Geology	3+0	3	0
	Total Credit Hours	**18**		

Semester – 6

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
ENV 425	Occupational Health & Safety	3+0	3	0
ENV 340	Solid Waste Management	3+0	3	0
ENV 325	Environmental Engineering	3+0	3	0
ENV 345	Environmental Hazard & Management	3+0	3	0
ENV 330	Environmental & Natural Resource Economics	3+0	3	0
	Total Credit Hours	**15**		

Semester – 7

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
ENV 405	Pollution Control Technology	3+0	3	0
ENV 415	Natural Resource Management Prerequisite: ENV 105 - Introduction to Environmental Sciences	3+0	3	0
ENV 420	Research Methods in Environmental Sciences	2+0	2	0
GEO 420	Hydrogeology	3+0	3	0
ENV 410	Environmental Impact Assessment	3+0	3	0
	Total Credit Hours	**14**		

Semester – 8

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
ENV 350	Remote Sensing and GIS for Environment	2+1	2	2
ENV 440	Energy and Environment	3+0	3	0
ENV 430	Environmental Policies & Laws	3+0	3	0
GEO 435	Thesis	6+0		
	Total Credit Hours	**15**		

Roadmap of BS Geosciences (New Program @ BUKC)

General Education Courses

Total Courses = 13
Total Credit Hours = 39
To be offered in first two years

HEC Policy 2020	Category along with HEC Policy Reference	Domains of Knowledge	Number of courses as per HEC policy	Existing Roadmap	BUIC New Roadmap
General Education	Breadth (Para 6.1)	Arts and Humanities	2 courses of 3 CH each	NIL	**Two of the Following** 6. Language & Literature 7. Urban and Town Planning (3 CH) 8. Museology (3 CH) 9. Physical Education (3 CH) 10. Introduction to Film Making and Analysis (3 CH) 11. Photography (3 CH)
		Natural Sciences	2 courses of 3 CH each	3. Chemistry (3 CH) 4. Physics (3 CH)	
		Social Sciences	2 courses of 3 CH each	**One of the Following** 5. Introduction to International Relations (3 CH) 6. Introduction to Media Studies (3 CH) 7. Introduction to Anthropology (3 CH) 8. Introduction to Sociology (3 CH) 9. Introduction to Psychology (3 CH)	**Two of the Following** 6. Introduction to International Relations (3 CH) 7. Introduction to Media Studies (3 CH) 8. Introduction to Anthropology (3 CH) 9. Introduction to Sociology (3 CH) 10. Introduction to Psychology (3 CH)
	Foundation Skills (Para 6.2)	Expository Writing	3 courses of 3 CH each	4. English-I (3 CH) 5. English-II (3 CH) 6. Oral Communication (3 CH)	4. English-I (3 CH) 5. English-II (3 CH) 6. Oral Communication (3 CH)
		Quantitative Reasoning	2 courses of 3 CH each	3. MAT 115 – Calculus & Anal. Geometry (3 CH) 4. Statistics (3 CH)	5. MAT 115 – Calculus & Anal. Geometry (3 CH) 2. Statistics (3 CH)

	Civilization Knowledge (Para 6.3)	Islamic Studies	1 course of 3 CH each	Islamic Studies (2 CH)	Islamic Studies (3 CH) Increase of 1 CH
		Pakistan Studies	1 course of 3 CH each	Pakistan Studies (2 CH)	Pakistan Studies (3 CH) Increase of 1 CH

Disciplinary Courses

Total Credit Hours = 98

Major and Minors cannot be offered at this stage

Practical Learning Requirement

- Internship (9-week duration)
    - Currently internship is not part of any program under E&ES department. In order to include this element there is need to collaborate with employer as per HEC policy. FBoS recommended to explore enterprises those can offer internships through Directorate of student affairs in consultation with E&ES department.

As per HEC policy, Practical Learning Lab (PLL) should be included in each UG Program. FoES recommended to modify ILP program in this regard while taking inputs from all other faculties and administration.

REVISED ROAD MAP OF BS - GEOSCIENCES PROGRAM

YEAR-1

Semester I

Course code	Course Title	Credit Hrs	Contact Hrs	Remarks
PAK-101	Pakistan studies	3	3+0	+1 Cr. Hr
ISL-101	Islamic Studies	3	3+0	+1 Cr. Hr
ENG-103	English I	3	3+0	
GEO-101	Introduction to Geosciences	3	2+2	
MAT-105	Mathematics (for pre-med.)	0	3+0	
CSC-105	Introduction to Computers	3	2+2	
PHY-101	Physics	3	2+2	
	Total	**18**	**21**	**+2 Hours**

Semester II

Course code	Course Title	Credit Hrs.	Contact Hrs	Remarks
ENG-104	English II	3	3+0	
	Any one of following ***Arts & Humanities – I*** *Urban & Town Planning* *Museology (Museum Sci.)* *Language & Literature* *Photography* *Film/Film Production*	3	3+0	Added
GEO- 115	Introduction To Geophysics	3	2+2	
GEO- 120	Field Geology	3	2+2	Merged with Field Report-I
MAT-115	Calculus & Analytical Geometry	3	3+0	
CHM-105	Chemistry	3	2+2	
	Total	**18**	**21**	

YEAR-2

Semester III

Course code	Course Title	Credit Hrs.	Cont. Hrs	Remarks
ENG- 232	Oral Communication	3	3+0	No Change
GEO- 205	Structural Geology	3	2+2	
GEO- 210	Mineralogy & Crystallography	3	2+2	
CSC- 205	Programming Fundamentals	3	2+2	
ENV- 245	Introduction to Oceanography	3	3+0	
HSS-107 HSS-111 HSS- 115 HSS-201 HSS-202	**One of The Following:** Intro. Psychology Introduction to IR Intro. Media Studies Intro. Anthropology Intro. Sociology	3	3+0	
	Total	**18**	**21**	

Semester IV

Course code	Course Title	Credit Hrs.	Contact Hrs	Remarks
GEO-215	Sedimentology	3	2+2	
MAT-205	Statistics	3	2+2	
GEO-225	Geochemistry	3	2+2	
GEO-230	Geo-tectonics	3	2+2	
HSS-107 HSS-111 HSS- 115 HSS-201 HSS-202	**One of The Following:** Intro. Psychology Introduction to IR Intro. Media Studies Intro. Anthropology Intro. Sociology	3	3+0	
	Any one of following (A&H group) ***Arts & Humanities – II*** *Urban & Town Planning* *Museology (Museum Sci.)* *Language & Literature* *Photography* *Film/Film Production*	3	3+0	Added
	Total	**18**	**22**	

YEAR-3

Semester V

Course code	Course Title	Credit Hrs.	Contact Hrs.	Remarks
GEO-305	Environmental Geology	3	2+2	
GEO-302	Geophysical Exploration Methods	3	2+2	
GEO-315	Igneous & Metamorphic Petrology	3	2+2	
GEO-352	Geology & Stratigraphy of Pakistan	3	3+0	**Content Merged of GEO-325, New Course Code given**
GEO-435	GIS & Remote Sensing	3	2+2	
	Total	**15**	**19**	

Field Work - I

GEO-280	Geosciences Field Work and Report-I	2	0+2	Placed & registered along Semester-V

Semester VI

Course code	Course Title	Credit Hrs.	Contact hours	Remarks
GEO-320	Marine Geology	3	2+2	
GEO-335	Earthquake Seismology	3	2+2	

GEO-410	Engineering Geology	3	2+2	
GEO-345	Petroleum Geology	3	3+0	
GEO-425	Research Methodology	2	2+0	
	Total	**14**	**17**	

Field Work - II

GEO-380	Geosciences Field Work and Report II	2	0+2	Placed & registered along Semester-VI

YEAR-4 (Specialization Year)* +

Semester VII

Course code	Course Title	Credit Hrs.	Contact Hrs.	Remarks
GEO- XX	Specialize Course - I	3	2+2	
GEO- XX	Specialize Course - II	3	2+2	
GEO- XX	Specialize Course - III	3	2+2	
GEO- XX	Specialize Course - IV	3	2+2	
GEO- XX	Specialize Course - V	3	2+2	
	Total	**15**	**20**	

Semester VIII

Course code	Course Title	Credit Hrs.	Contact Hrs	Remarks
GEO- XXX	Specialize Course - VI	3	2+2	
GEO- XXX	Specialize Course - VII	3	2+2	
ENV- 425	Occupational Health & Safety	3	3+0	
GEO- 490	Thesis	6	0+6	
	Total	**15**	**17**	
	Grand Total	**135**	**(162)**	

***** All Courses in the Specialization will be offered during Year-IV (semester VII-VIII) and will be of 400s Level

+ The courses under Specialization mentioned as GEO XXX (above) will be picked up from listed courses given below, accordingly.

SPECIALIZATION COURSES

The following 3-Specializations will be offered to students at registration for Semester-VII, to choose from. The list of courses for each specialization is listed below:

- Marine Geology

- Marine Geophysics
- GIS & Remote Sensing

Specialization& List of Courses

Specialization Courses	Marine Geology	Marine Geophysics	GIS & RS
I	**GEO 461 - Coastal Geology & Geomorphology**	**GEO 461 - Coastal Geology & Geomorphology**	GEO 481- GIS Database Management
II	GEO 462 - Physical Oceanography & Surveying	GEO 450 - Seismic Exploration Techniques (Addition of New Course)	GEO 482 - Satellite Image Processing
III	**GEO 463 - Ocean Crust Sedimentation**	**GEO 463 - Ocean Crust Sedimentation**	GEO 483 - GIS Data Analysis
IV	**GEO 445- Seismic Stratigraphy**	**GEO 445 - Seismic Stratigraphy**	GEO 484 - Cartography & Mapping
V	GEO 415 - Economic Geology	GEO 441 – Applied Borehole Geophysics	GEO 485 - GIS Surveying & GPS Tech.
VI	**GEO 420 - Hydrogeology**	**GEO 420 - Hydrogeology**	GEO 486 - Mapping of Natural Resources
VII	**GEO 444 - Applied GIS & RS Techniques**		

D. Arts & Humanities COURSES (2 Courses to be selected) (6 Credit Hrs.)

The following courses have been suggested to be incorporated as per HEC requirement under Art & Humanities Cluster. The A&H Courses are same as proposed by other programs, i.e., BS-Geology; Geophysics & Environmental Sciences.

A&H XXX – BASIC CHINESE (LANGUAGE & LITERATURE) (3CH)

Objectives & Learning Outcomes: The learning framework for the Foreign Language and Literature provide typical themes, grammar and vocabulary fields of the respective language. The course is to prepare students to communicate effectively in the given language.

Course Contents:

Intro to phonetics system; Greetings in normal and polite ways; Introduce self, introduce others. Talking about oneself; Likes & dislikes; Taking a taxi, Asking about directions; Expressing time, days and counting numbers from 0-100; Shopping, asking about prices, sizes and colours; Buying tickets for travel; Talking about jobs, company and business etiquette; Asking for help; Word order in sentence; Cultural content; Explore cultural differences with greetings, phonetics, and feelings; Learn how to ask for and give names, greet people, say goodbye, Understand cultural perspectives on family celebrations.

A&H XXX – FILM & FILM PRODUCTION (3 CH)

Objectives & Learning Outcomes: This course can be delivered from three perspectives: historical, literary, and contemporary production practices. Through lectures, readings, and discussion, students will study film and theatre as important art forms and understand their relevance to their own life as well as to other art forms. The goal of this course is to introduce each student to the basic fundamentals of motion picture cinematography, to include both technical knowledge and artistic application. The course will also enable students to study the aesthetic eye: basic theory regarding the camera's role in shaping the viewer's perception. The course will also examine narration and sequence (storyboard) and analyze the purposes and functions of film: (its aesthetic, socio-political, spiritual, economic, expressive aspects).

Course Contents:

Fundamentals of Film: Definition, Scope and Importance Genres of Films, Brief History of World Cinema History of Cinema in Pakistan Camera operation, composition and framing, lens choice, camera movement, setting proper exposure, lighting, collaboration, blocking, continuity and all aspects of visual. Role of the cinematographer, Screen clips & short film, Composition & Framing

Camera operating, Static camera, Panning/Tilting, Lighting for emotional impact, Lighting example clips, Lighting terminology & concepts, Media literacy; Basic film vocabulary such as montage, mise-en-scene, narrative, cinematography, sound, editing, etc and explore film within a cultural context specifically in relationship to other media (the novel, theatre, and the visual arts).

A&H XXX - PHOTOGRAPHY (3 CH)

Objectives & Learning Outcomes: This course focuses on the development of conceptual and technical know-how by introducing students to a broad spectrum of topics in photography and its applications. Specific attention will also be given to teach the historical, critical and analytical skills necessary for the development of a photographer. The students will come to know about different genres of photography.

Course Contents:

Pinholes to Pixels-Historical Perspective, Photography Genres: Abstract Photography; Candid Photography; Conceptual Photography; Documentary Photography; Fashion Photography; Lifestyle Photography; Time-lapse Photography; Narrative photography; Snapshot Photography. Application of Photography. Ethics.

A&H XXX - Museology (3CH)

Course Contents:

Introduction of Museology, Museum and Its Function, Collection, recording, preservation, exhibition and education, Different types of museums, History of Museology in Pakistan Problems and prospects of museums in Pakistan, Museum Administration, Museum Security, Record keeping, Care and Storage of Museum Objects, Museum Architecture, Museum Exhibition.

A&H XXX URBAN & TOWN PLANNING (3CH)

Course Contents:

Concepts in the field of urban and regional planning and current urban planning and policy issues and debates. Topics include: forces that have historically guided and are currently guiding urbanization; land use change phenomenon, growth management, transportation and traffic congestion, economic development, housing and community development, environmental planning; legal, environmental, governmental contexts; Urban Planning and politics: Major debates and issues in urban policy and politics nationally and regionally. Urban trends pre- & post 20th century; Urban Design; Urban renewal and community development; Transportation planning; Economic development planning; Growth management and sustainable development; Planning for metropolitan regions; Environmental and energy planning.

Required Textbooks & References:

1. Contemporary Urban Planning. 8th edition. By John M. Levy, Upper Saddle River, NJ: Prentice Hall, Inc. 2009. ISBN-13: 978-0-13-602545-0.

A&H XXX - Film Making (3CH)

Course Contents

2.
3. **MED 111 Photography (3CH)**
4. **Course added from BS (Media Studies) program**
5. An introductory course in the study of photography with emphasis on the digital single lens reflex (D-SLR) camera. Exposure, metering, focus, depth of field, lenses, basic lighting, design elements and composition are explored. Basic principles of digital photographic capture are discussed. Students are responsible for providing a digital single lens reflex (D-SLR) camera.

Bachelors of Computer Engineering

Curriculum
2020

Departments of Computer Engineering

BAHRIA UNIVERSITY

Scheme of Studies

Duration	4 years
Number of Semesters	8
Number of weeks per semester	18 (16 for teaching and 2 for exams)
Total number of credit hours	136
Number of credit hours per semester	15-18
Non-Engineering Courses	16 Courses, 41 Cr Hrs, 30.1 % of total
Engineering Courses	27 Courses, 95 Cr Hrs, 69.9 % of total

Courses of Non-Engineering Domain

Knowledge Profile (WK-1 to WK-8)	Knowledge Area	Sub Area	Course Title	Theory	Lab	Total	Total Courses	Total Credits	%age Area	% Overall
				Credit Hours						
Non-Engineering Domain										
WK-7	Humanities	English	Functional English	3	0	3	3	7	17.1	5.1471
			Communication Skills	2	0	2				
			Technical Writing	2	0	2				
		Culture	Islamic Studies	2	0	2	2	4	9.76	2.9412
			Pakistan Studies	2	0	2				
		Social Sciences	Social Science Elective-I (Professional Ethics/ Sociology for Engineers)	2	0	2	2	4	9.76	2.9412
			Social Science Elective-II (Engg. Economics)	2	0	2				
	Management Sciences	Professional Practice	Management Science Elective – I (Entrepreneurship)	2	0	2	2	5	12.2	3.6765
			Management Science Elective - II (Engg. Management/ Project Management)	3	0	3				
WK-2	Natural Sciences	Math	Applied Calculus & Analytic Geometry	3	0	3	7	21	51.2	15.441
WK-1			Differential Equations	3	0	3				
			Complex Variables & Transforms	3	0	3				
			Linear Algebra	2	0	2				
			Probability & Statistics	3	0	3				
			Numerical Analysis	2	1	3				
		Physics	Applied Physics	3	1	4				
Total (Non-Engineering Domain)				**39**	**2**	**41**	16	41	100%	30.14%

Courses of Engineering Domain

Knowledge Profile (WK-1 to WK-8)	Knowledge Area	Sub Area	Course Title	Theory	Lab	Total	Total Courses	Total Credits	%age Area	% Overall
				Credit Hours						
Engineering Domain										
WK-2/ WK-4/ WK-5/ WK-6	Computer and Information Science	ICT/AI/ Data Science/ Cyber Security	Computing Fundamentals	2	1	3	3	10	10.5	7.3529
			Computer Programming	3	1	4				
			Discrete Structures	3	0	3				
WK-3/ WK-2	Engineering Foundation	--	Workshop Practices	0	1	1	8	29	30.5	21.324
			Digital Logic Design	3	1	4				
			Circuit Analysis	3	1	4				
			Electronic Devices & Circuits	3	1	4				
			Object Oriented Programming	3	1	4				
			Data Structures & Algorithms	3	1	4				
			Signals & Systems	3	1	4				
			Computer Organization & Architecture	3	1	4				
WK-4/ WK-1/ WK-2	Major Based Core (Breadth Courses)	--	Data Communication & Networking	3	1	4	7	27	28.4	19.853
			Microprocessors & Interfacing	3	1	4				
			Operating Systems	3	1	4				
			Data Base Management Systems	3	1	4				
			Software Engineering	3	0	3				
			Digital Signal Processing	3	1	4				
			Digital System Design	3	1	4				
WK-5/ WK-6	Major Based Core (Depth courses)	--	Cloud and Distributed Computing	3	1	4	4	16	16.8	11.765
			Comp. Engg. Depth Elect.-I	3	1	4				
			Comp. Engg. Depth Elect.-II	3	1	4				
			Comp. Engg. Depth Elect.-III	3	1	4				
WK-3/ WK-4/ WK-2/ WK-1	Multi-Disciplinary Engineering Courses	--	MDE Elective -1	3/2	0/1	3	3	7	7.37	5.1471
			MDE Elective – 2	3/2	0/1	3				
			Occupational Health and Safety (Mandatory)	1	0	1				
WK-6/ WK-7/ WK-8	Final Year Design Project (FYDP)/ Capstone	Industrial/ Innovative/ Creative Project	Project-1	0	3	3	2	6	6.32	4.4118
			Project-2	0	3	3				
WK-6/ WK-7	Industrial Training (Summer)	At least 6 -8 weeks internship (summer)		0	0	0	0	0	0	0
WK-2/ WK-4/ WK-5/ WK-6/ WK-7/ WK-8	**Innovative & Critical Thinking (under relevant courses)** - Complex Problem Solving - Complex Engineering Activities - Semester Project - Case Studies - Open Ended Labs - Problem Based Learning (PBL)									
Total (Engineering Domain)				**69 (67)**	**26(28)**	**95**	27	95	100%	69.90%

Semester Wise Course Offering

Semester 1						
S. No.	**Pre-Req**	**Course Code**	**Course Title**	**Theory**	**Lab**	**Total**
1	None	GSC 110	Applied Calculus & Analytical Geometry	3	0	3
2	None	ISL 101 /HSS 116	Islamic Studies / Ethics	2	0	2
3	None	CSC 110	Computing Fundamentals	2	1	3
4	None	GSC 113	Applied Physics	3	1	4
5	None	ENG 105	Functional English	3	0	3
6	None	EEL 112	Workshop Practices	0	1	1
			Total:	**13**	**3**	**16**

Semester 2						
S. No.	**Pre-Req**	**Course Code**	**Course Title**	**Theory**	**Lab**	**Total**
1	None	GSC 120	Linear Algebra	2	0	2
2	GSC 113	CEN 121	Circuit Analysis	3	1	4
3	None	CSC 113	Computer Programming	3	1	4
4	None	PAK 103	Pakistan Studies and Global Perspective	2	0	2
5	None	ENV 101	Occupational Health & Safety	1	0	1
6	None	CEN 120	Digital Logic Design	3	1	4
			Total:	**14**	**3**	**17**

Semester 3						
S. No.	**Pre-Req**	**Course Code**	**Course Title**	**Theory**	**Lab**	**Total**
1	None	CSC 115	Discrete structures	3	0	3
2	GSC 113	EEN 224	Electronic Devices & Circuits	3	1	4
3	CSC 113	CSC 210	Object Oriented Programming	3	1	4
4	None	HSS 118	Communication Skills	2	0	2
5	GSC 110	GSC 220	Complex Variables & Transforms	3	0	3
6			Social Science Elective-I	2	0	2
			Total:	**16**	**2**	**18**

Semester 4						
S. No.	**Pre-Req**	**Course Code**	**Course Title**	**Theory**	**Lab**	**Total**
1	GSC 110	GSC 210	Differential Equations	3	0	3
2	CSC 210	CSC 221	Data Structures & Algorithms	3	1	4
3	None	EEN 313	Signals & Systems	3	1	4

4	CEN 120	CEN 221	Computer Architecture & Organization	3	1	4
5			MS-Elective – I	3	0	3
			Total:	**15**	**3**	**18**

Semester 5						
S. No.	**Pre-Req**	**Course Code**	**Course Title**	**Theory**	**Lab**	**Total**
1	CEN 221	CSC 320	Operating Systems	3	1	4
2	ENG 105	HSS 321	Technical Writing	2	0	2
3	CEN 221	CEN 321	Microprocessors & Interfacing	3	1	4
4	EEN 313	EEN 325	Digital Signal Processing	3	1	4
5	None	CEN 223	Computer Communication & Networks	3	1	4
			Total:	**14**	**4**	**18**

Semester 6						
S. No.	**Pre-Req**	**Course Code**	**Course Title**	**Theory**	**Lab**	**Total**
1			CEDE-I	3	1	4
2	CSC 210	CSC 220	Database Management Systems	3	1	4
3	CSC 221	SEN 220	Software Engineering	3	0	3
4	None	GSC 122	Probability & Statistics	3	0	**3**
5			CEDE-II	3	1	4
			Total:	**15**	**3**	**18**

Semester 7						
S. No.	**Pre-Req**	**Course Code**	**Course Title**	**Theory**	**Lab**	**Total**
1	CEN 221	CEN 442	Digital System Design	3	1	4
2	None	HSS 423	Entrepreneurship	2	0	2
3			CEDE-III	3	1	4
4		ESC 498	Project-I	0	3	3
5	GSC 120	GSC 321	Numerical Analysis	2	1	2
			Total:	**10**	**6**	**16**

Semester 8						
S. No.	**Pre-Req**	**Course Code**	**Course Title**	**Theory**	**Lab**	**Total**
1		ESC 499	Project-II	0	3	3
2			CEDE-IV	3	1	4
3			MDEE-I	3	0	3

4			MDEE-II	3	0	3
5			Social Science Elective-II	2	0	2
			Total:	**11**	**4**	**15**

Total Credit Hours: 136

Multi-Disciplinary Engineering Electives (MDEE) (6 Credit Hours)						
S. No.	**Pre-Req**	**Course Code**	**Course Title**	**Theory**	**Lab**	**Total**
1	None	SEN 320	Human Computer Interaction	3	0	3
2	None	CEN 429	Introduction to Block Chain Technologies	3	0	3
3	None	CSC 449	Neural Networks & Fuzzy Logic	3	0	3
4	EEN 313	CEN 458	Robotics	2	1	3
5	None	CSC 341	Mobile Application Development	2	1	3
6	None	CEN 426	Introduction to Virtual Reality	3	0	3
7	None	SEN 420	Software Quality Assurance	3	0	3
8	EEN 224	CEN 457	VLSI Design	2	1	3
9	None	CSC 457	Data Mining & Warehousing	2	1	3
10	None	GEO 437	GIS & Remote Sensing	3	0	3
11	None	GEO 436	Health Safety & Environment	3	0	3
12	None	CEN 427	Biomedical Engineering	3	0	3
13	None	SEN 449	Business Process Automation	3	0	3
14	None	EEN 467	Control Engineering	3	0	3

Computer Engineering Depth Electives (CEDE) (16 Credit Hours)						
S. No.	**Pre-Req**	**Course Code**	**Course Title**	**Theory**	**Lab**	**Total**
1	CSC 320	CEN 411	Cloud & Distributed Computing	3	1	4
2	CEN 321	CEN 449	Internet of Things	3	1	4
3	CEN 321	CEN 440	Embedded System Design	3	1	4
4	EEN 313	CEN 409	Artificial Intelligence & Machine Learning	3	1	4
5	CSC 320	CEN 444	Digital Image processing	3	1	4
6	CSC 113	CEN 408	System & Network Security	3	1	4
7	CSC 320	CEN 454	System Programming	3	1	4
8	CSC 320	CEN 407	High Performance Computing	3	1	4
10	CSC 221	CEN 326	Algorithm Design and Analysis	3	1	4
11	EEN 325	CEN 425	Hardware Design for DSP & ML	3	1	4

Management Science Electives (MSE - I) (2 Credit Hours) *						
S. No.	**Pre-Req**	**Course Code**	**Course Title**	**Theory**	**Lab**	**Total**
1	None	EMG 222	Principles of Management	2	0	2
2	None	HSS 423	Entrepreneurship	2	0	2

Management Science Electives (MSE - II) (3 Credit Hours) *						
S. No.	**Pre-Req**	**Course Code**	**Course Title**	**Theory**	**Lab**	**Total**
1	None	EMG 201	Engineering Project Management	3	0	3
2	None	MGT 423	Engineering Management	3	0	3
3	None	MTM 101	Introduction to Maritime Industry	3	0	3

*** MSEE – Total 5 hours**

Social Science Electives (SSE) (4 Credit Hours)						
S. No.	**Pre-Req**	**Course Code**	**Course Title**	**Theory**	**Lab**	**Total**
1	None	HSS 412	Engineering Economics	2	0	2
2	None	HSS 413	Sociology for Engineers	2	0	2
3	None	HSS 424	Engineering Ethics	2	0	2
4	None	HSS 541	Organizational Behavior	2	0	2

Comparison of the Course Titles adopted for BCE Curriculum at Bahria University Vs The Course Titles Suggested by PEC

S.No.	Course Titles adopted for BCE Curriculum at BU	Course Titles Suggested by PEC
1	Applied Calculus & Analytical Geometry	Calculus and Analytical Geometry
2	Islamic Studies / Ethics	Islamic Studies and Ethics
3	Computing Fundamentals	Information and Communication Technologies (ICT)
4	Applied Physics	Applied Physics
5	Functional English	Functional English
6	Workshop Practices	Engg. Workshop
7	Occupational Health & Safety	Occupational Health and Safety
8	Linear Algebra	Linear Algebra
9	Circuit Analysis	Circuit Analysis
10	Computer Programming	Computer Programming
11	Communication Skills	Communication Skills
12	Electronic Devices & Circuits	Electronic Devices and Circuits
13	Pakistan Studies and Global Perspective	Pakistan Studies and Global Perspective
14	Digital Logic Design	Digital Logic Design
15	Technical Writing	Technical Writing
16	Object Oriented Programming	Object Oriented Programming
17	Discrete Structures	Discrete Structures
18	Complex Variables & Transforms	Complex Variables and Transforms
19	Differential Equations	Differential Equations
20	Data Structures & Algorithms	Data Structures and Algorithms
21	Signals & Systems	Signals & Systems
22	Computer Architecture & Organization	Computer Architecture and Organization
23	Digital Signal Processing	Digital Signal Processing
24	Microprocessors & Interfacing	Microprocessors and Interfacing
25	Computer Communication & Networks	Computer Communication and Networks
26	Operating Systems	Operating Systems
27	Engineering Economics	Engineering Economics
28	Database Management Systems	Database Management System
29	Software Engineering	Software Engg.
30	Probability & Statistics	Probability and Statistics
31	Entrepreneurship	Entrepreneurship
32	Digital System Design	Digital System Design
33	Cloud & Distributed Computing	Cloud and Distributed Computing
34	Numerical Analysis	Numerical Analysis
35	Project - I	Senior Design Project -1
36	Project - II	Senior Design Project-2

S.No.	Course Titles adopted for BCE Curriculum at BU	Course Titles Suggested by PEC
34	Human Computer Interaction	Human Computer Interaction (UI/UX)
35	Introduction to Block Chain Technologies	Block Chain Technologies and Applications
36	Neural Networks & Fuzzy Logic	Neural Networks and Fuzzy Logic
37	Robotics	Robotics and Automation
38	Mobile Application Development	Mobile Application/Game Development
39	Introduction to Virtual Reality	Virtual Reality
40	Software Quality Assurance	Software Quality Assurance
41	VLSI Design	VLSI System Design
42	Data Mining & Warehousing	Data Warehousing and Big Data
43	GIS and Remote Sensing	GIS and Remote Sensing
44	Health Safety & Environment	Health, Safety and Environment (HSE)
45	Biomedical Engineering	Biomedical Engg
46	Business Process Automation	Business Process Re-engineering
47	Cloud & Distributed Computing	Cloud and Distributed Computing
48	Internet of Things	Internet of Things
49	Embedded System Design	Embedded System Design
50	Artificial Intelligence & Machine Learning	Artificial intelligence and Machine Learning
51	Digital Image Processing	Image Processing and Analysis
52	System & Network Security	System and Network Security
53	System Programming	Systems Programming
54	High Performance Computing	High Performance Computing
55	Control Engineering	Control Engineering
56	Algorithm Design & Analysis	Algorithm Design and Analysis
57	Hardware Design for DSP & ML	Hardware Design for DSP and ML
58	Engineering Ethics	Professional Ethics

List of Courses which need New Unified Course Codes and Proposed Course Codes

S. No.	Proposed Course Code	Course Title	Theory	Lab	Total
1	GSC 120	Linear Algebra	2	0	2
2	ENV 101	Occupational Health & Safety	1	0	1
3	EMG 201	Engineering Project Management	3	0	3
4	HSS 321	Technical Writing	2	0	2
5	HSS 412	Engineering Economics	2	0	2
6	CEN 411	Cloud & Distributed Computing	3	1	4
7	GSC 321	Numerical Analysis	2	1	2
8	CEN 429	Introduction to Block Chain Technologies	3	0	3
9	CEN 426	Introduction to Virtual Reality	3	0	3
10	CEN 427	Biomedical Engineering	3	0	3
11	CEN 449	Internet of Things	3	1	4
12	CEN 409	Artificial Intelligence & Machine Learning	3	1	4
13	CEN 408	System & Network Security	3	1	4
14	CEN 407	High Performance Computing	3	1	4
15	CEN 326	Algorithm Design & Analysis	3	1	4
16	CEN 425	Hardware Design for DSP & ML	3	1	4
17	EMG 201	Engineering Project Management	3	0	3
18	EMG 222	Principles of Management	2	0	2
19	HSS 412	Engineering Economics	2	0	2
20	HSS 413	Sociology for Engineers	2	0	2
21	HSS 541	Organizational Behavior	2	0	2
22	PAK 103	Pakistan Studies & Global Perspective	2	0	2

Course Contents of New Courses Introduced in Proposed Curriculum

Pakistan Studies and Global Perspective

Area Scope:

The knowledge units in this area collectively encompass the following:

- Have a better understanding of the rationale for the creation of Pakistan.
- Enable students to contribute in social, political and economic growth of Pakistan.
- Become a part of strong nation with a sense of ownership and responsibility towards Pakistan
- Play an active role toward sustainable development of Pakistan in global perspective.

Course Outline:

Historical and Ideological Perspective

a. Pakistan Movement
- Aligarh Movement
- Two Nations Theory

b. Founders of Pakistan
- Allama Muhammad Iqbal
- Quaid-e-Azam Muhammad Ali Jinnah
- Other Leaders (Women and other Pakistan Movement Leaders)

c. Quaid's Vision for Pakistan
d. Kashmir – An unfinished Agenda of Partition

Constitution of Pakistan

a. An overview of constitutional development in Pakistan
b. Salient features of the Constitution of 1973
c. Constitutional Amendments
d. Fundamental Rights and Responsibilities of Citizens

Contemporary Pakistan

a. Pakistan's society, culture and demography – celebrating diversity
b. Current Challenges: social, economic, environmental, political and external
c. Nation's resilience in War on Terror

Economy of Pakistan

a. An overview of Economy
b. Services, Manufacturing and Agricultural Profile of Pakistan
c. Regional Economic Cooperation
d. One Belt One Road (OBOR) – CPEC

Land of Opportunities

a. Physical features: diversity and beauty
b. Natural resources - mineral, water, energy, agriculture & livestock, and marine resources
c. Tourism and Culture

Pakistan's Foreign Policy

a. Foreign Policy – Principles and Objectives
b. Relations with Neighbors
c. Major Economies
d. Muslim World
e. Geo-political and strategic significance of Pakistan in Regional and Global Politics

Pakistan in pursuit of Global Agenda

a. SDGs-2030 - Pakistan Goals
b. Commitments on Climate Change
c. Peace and Security

Suggested Books:

- Khalid B. Sayeed, Pakistan: The Formative Phase 1857 – 1948, Pakistan Publishing House, 1960
- Gulam Allana, Quaid-e-Azam: the story of Pakistan, Ferozsons, 1967.
- Shahid M. Amin, Pakistan's Foreign Policy: A Reappraisal, Oxford University Press, 2010.
- S. Akbar Zaidi, Issues in Pakistan's economy, Oxford University Press, 2003.
- Hamid Khan, Constitutional & political history of Pakistan, Oxford University Press, 2003
- Rafi Raza, Pakistan in Perspective 1947-1997, Oxford University Press, 2003
- Sharif-ul-Mujahid, The Ideology of Pakistan, Progressive Publishers, 1974.
- Ziring Lawrence, Pakistan in the Twentieth Century, Oxford University Press, 1997 -
- Burke S. M. & Ziring Lawrence, Pakistan's Foreign Policy, Oxford University Press, 1973. Mohammad Qadeer , Pakistan
- Climate Change Policies-Ministry of Climate Change, Islamabadhttp://mocc.gov.pk/
- Sustainable Development Goals (SDGs)- www.pc.gov.web/sdg/sdgpak
- Economic Survey of Pakistan- http://finance.gov.pk/survey_1617.html
- Foreign Policies- Ministry of Foreign Affairs, Pakistan http://mofa.gov.pk/
- Population Census of Pakistan- Economic Survey of Pakistan http://finance.gov.pk/survey_1617.html
- Issues in Pakistan's Economy by S. Akbar Zaidi, ISBN: 0195790529.
- Pakistan's Foreign Policy: A Reappraisal by Shahid M. Amin. ISBN: 0195798015
- Newspapers editorial and selected journalistic writings on current affairs.
- Pakistan (Lands, Peoples, & Cultures) by Carolyn Black, Bobbie Kalman. ISBN: 0778797147

Discrete Structures Course Outline

- Logic: propositional logic, logical equivalence, predicates & quantifiers, and logical reasoning.
- Sets: basics, set operations
- Functions: one-to-one, onto, inverse, composition, graphs
- Integers: greatest common divisor, Euclidean algorithm.
- Sequences and Summations

Mathematical reasoning: Proof strategies, Mathematical Induction, Recursive definitions, Structural Induction

- Counting: basic rules, Pigeon hall principle, Permutations and combinations, Binomial coefficients and Pascal triangle.
- Probability: Discrete probability. Expected values and variance.
- Relations: properties, Combining relations, Closures, Equivalence, partial ordering
- Graphs: directed, undirected graphs.
- Trees, O-Notation and the Efficiency of Algorithms

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment: Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Discrete Mathematics and Its Applications by Kenneth Rosen. Latest Edition, McGraw Hill Publishing Co. • Discrete Mathematics by Richard Johnson baugh latest edition, Prentice Hall Publishers.

Computer Communication and Networks Course Outline

- Introduction to Computer Networks
- OSI reference model, the TCP/IP reference model
- Packet switching and architectures
- Circuit switching and architectures
- Data link layer and issues
- Error correction and congestion control in networks
- Network layer and issues (Protocols and Services)
- IPv4 and IPv6, IP addressing and subnetting
- Network Routing
- Introduction to Multi-Protocol Label Switching (MPLS)
- Wireless networks
- Transport Layer and Issues (TCP and UDP)
- Software defined Networking (SDN)/ Virtual network functions (VNF)
- Multimedia networking and streaming services
- Introduction to multi- Protocol label switching Teaching Methodology (Proposed as applicable): Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing.

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

Computer Networking A Top Down Approach latest Edition by Jim Kurose and Keith Ross, Pearson publishers.

Cloud & Distributed Computing

Course Outline:

- Introduction to Cloud Computing
- Adopting the Cloud
- Exploiting Software as a Service (SaaS)
- Exploring the technical foundation for PaaS
- Building services with solution stacks
- Managing cloud storage
- Employing support services
- Deploying Infrastructure as a Service (IaaS)
- Building a Business Case
- Migrating to the Cloud

Suggested Books:

- Cloud Computing: AUTHOR: Sandeep Bhowmik, Hooghly Engineering and Technology College, Hooghly, April 2017
- Distributed and Cloud Computing: From Parallel Processing to the Internet of Things 1st Edition by Kai Hwang, Jack Dongarra Geoffrey C. Fox
- Cloud Computing Theory and Practice by Dan C. Marinesco. MK Publishers 2017.

Internet of Things

Course Outline:

- What is the IoT and why is it important
- Introduction to the Elements of an IoT ecosystem.
- Understanding of Technology and business drivers.
- Description of IoT applications, trends and implications.
- Analysis of Sensing components and devices, Sensor modules, nodes and systems.
- Wireless technologies for the IoT as well as Edge connectivity and protocols.
- Introduction to the Wireless sensor networks (WSNs) and Internet connectivity and MGC architecture, CortexM and BLE.
- Analysis of Typical costs and computing an energy budget, Energy management and sleep states.
- Introduction to the Microcontrollers: Peripherals, buses and DMA
- Brief explanation of Operating systems and introduction to the concepts of multiprogramming.
- Overview of IoT and Big Data overlap – stream processing and Data Aggregation.
- Network as a distributed query processor?
- Concepts of Time Synchronization, Localization, IoT Security
- Energizing IoT devices: battery/harvesting/wirelessly

- Discussion about Future Research and Development Opportunities, Analytics and applications.
- Basic understanding of Signal processing, real-time and local analytics, Databases, cloud analytics and applications.

Suggested Books:

- Greengard, Samuel. "The internet of things". MIT press, latest edition.
- Schwab, Klaus, and Nicholas Davis. "Shaping the future of the fourth industrial revolution". Currency, latest edition.
- Pfister, Cuno. "Getting started with the Internet of Things: connecting sensors and microcontrollers to the cloud", O'Reilly Media, Inc., latest edition.
- Waher, Peter, "Learning internet of things", Packt Publishing Ltd, latest edition.

Hardware Design for DSP & ML

Course Outline:

- Introduction to Embedded System Design with Hybrid Processors, Fixedpoint & Floating-point Arithmetic and Processors.
- Analysis of Architecture for DSPs, FPGAs and GPP.
- Introduction to ZYNQ SOC for H/W, SW Co-Design, ZYNQ design Flow and peripheral interfacing, AXI interfacing and Custom IP Creation.
- Understanding of Memory Hierarchy, DMA Controller and AXI interfacing with Custom Logic, Partial Dynamic Reconfiguration for Practical Applications.
- Analysis of MPSoC Design and Conversion of DSP/ML Algorithms with Case Studies.
- Folding/Unfolding of Algorithms for Hardware Mapping, Application Specific Processor Design with Case Studies.
- Implementing the Case Studies pertaining to CNN, Clustering, Adaptive Filtering and Big Data Analysis Algorithms.

Suggested Books:

- Louise H. Crockett, Ross A. Elliot, Martin A., "The Zynq Book Tutorials for Zybo and ZedBoard", Strathclyde Academic Media, latest edition.
- Shoab A. Khan, "Digital Design of Signal Processing Systems", John Wiley & Sons, latest edition.

High Performance Computing

Course Outline:

- Introduction to modern processors
- Optimization techniques for serial core
- Vector Processors – Vector and Matrix Algorithms
- Vector Processor Analysis
- Design and development of parallel algorithms
- Processor resource utilization
- Architectures: N-wide superscalar architectures
- Multi-core Architecture.
- Multi-threaded Architecture.
- Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation etc.) GPGPUs Framework like CUDA and OpenCL.
- Thread Organization

- Fundamental Design Issues in Parallel Computing
- Parallel Programming – Shared Memory and Message Passing Programming
- The Message Passing Interface (MPI). Characterization of Distributed Systems
- Inter-process Communication
- Locality optimization on HPC architectures
- Topology and affinity in multi-core environment.

Suggested Books:

- High Performance Computing: Modern Systems and Practices, by Thomas Sterling, Matthew Anderson, latest edition.
- Introduction to High Performance Computing for Scientist and Engineers, by Georg Hager and Gerhard Wellein, latest edition.

Artificial Intelligence & Machine Learning

Course Outline:

Introduction to AI Systems

Solving problems and AI Application

- Solving problems by searching
- Converting the problem statement into actions transitions and goal statements.

Informed search methods

- BFS, DFS , Uniform cost Search, Iterative deepening

Uninformed Search

- Heuristics and greedy search A*.

Local Search

- Hill climbing , Simulated Annealing , GA

Game Playing

- Adversarial Search and Games
- Min Max Algorithm

Neural Networks

- Introduction to Machine learning, Perceptron, NN

Utility Based Agents

- Constraint Satisfaction Problems
- CSP Backtracking
- Reinforcement Learning,
- Markov Decision Processes

Knowledge Based Agents

- Inference in Predicate and FOL
- Building a Knowledge base

Forward and backward chaining

Suggested Books:

- S. Russell and P. Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall, latest edition
- R. Brachman, H. Levesque. Knowledge Representation and Reasoning, Morgan Kaufmann, latest edition.
- G. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving.
- Addison Wesley; latest edition, E. Alpaydin. Introduction to Machine

Introduction to Blockchain Technologies

Course Outline:

- Introduction to Blockchain technology.
- Blockchain data structure.
- Public Key Infrastructure and blockchains.
- Distributed Ledgers.
- Consensus Mechanism
- Transactions and transactions life cycle
- Sending, Receiving and checking transactions
- Blockchain types (public, private, semiprivate and propriety)
- Methods of decentralization
- Hyper ledgers
- Blockchain as a service
- Scalability in Blockchain
- Privacy in Blockchain
- Cryptoassests (cryptocurrencies) management and mining methods.

Suggested Books:

- Blockchain Science: Distributed Ledger Technology by Roger Wattenhofer, Publisher: Independently published latest edition.
- Distributed Ledger Technology: The Science of the Blockchain latest Edition by Roger Wattenhofer. Publisher: CreateSpace Independent Publishing Platform; latest edition.
- Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained, 2nd edition– March 30, 2018 by Imran Bashir.

Mobile Application Development

Course Outline:

- Introduction to Mobile Computing
- Mobiles Application Development Platform
- Development Environment, Factors in Developing Mobile Applications
- HTML5 for Mobiles
- Android OS: Architecture
- Framework and Application Development; iOS: Architecture Framework
- User-interface, Text-to-Speech Techniques, Intents and Services
- Storing and Retrieving Data, Communications Via Network and the Web
- Telephony, Notifications and Alarms, Graphics, Multimedia, Location, Hardware Sensors, Developers and App store license agreements, Security and Hacking, Platforms Issues. Challenges with Mobility and Wireless Communication; Location-aware Applications
- Performance/Power Trade-offs; Mobile Platform Constraints; Emerging Technologies
- Game Development: Introduction to Game Development,
- Introduction to Gaming Market and Revenue,
- Introduction to Game Development Life Cycle, Unity3D as Best tool for Game Development
- Introduction to 3D Graphics and 2D Graphics, C# Basics
- Introduction Game Programming (Scripting)
- Introduction to 3D and 2D animations
- Introduction to Game Cinematics

- Introduction to Augmented Reality (AR) and Virtual Reality (VR)
- Making Product ready for Release (alpha and beta testing)
- Post Processing and Marketing of the Final Product

Suggested Books:

- IOS Programming: The Big Nerd Ranch Guide, latest Edition, Joe Conway, Aaron Hillegass and Christian Keur, Big Nerd Ranch Guides.
- Android Programming: The Big Nerd Ranch Guides, latest Edition, Bill Phillips and Brian Hardy, Big Nerd Ranch Guides.
- Professional Android 4 Application Development, latest Edition, Reto Meier, Wrox professional press.
- Introduction to Game Design, Prototyping, and Development, by Jeremy Gibson
- Unity Scripting reference, https://docs.unity3d.com/ScriptRefe

Occupational Health & Safety

Course Description:

This course introduces the student to the study of workplace occupational health and safety. The student will learn safe work practices in offices, industry and construction as well as how to identify and prevent or correct problems associated with occupational safety and health in these locations as well as in the home.

Learning Outcomes:

Upon successful completion of this course, the student will be able to:

- Identify hazards in the home, laboratory and workplace that pose a danger or threat to their safety or health, or that of others.
- Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.
- Present a coherent analysis of a potential safety or health hazard both verbally and in writing, citing the Ontario Occupational Health and Safety Regulations as well as supported legislation.
- Demonstrate a comprehension of the changes created by WHMIS and OSHA legislation in everyday life.

Course Outline:

Health and Safety Foundations

- Nature and scope of health and safety
- Reasons/benefits and barriers for good practices of health and safety
- Legal frame work and OHS Management System

Fostering a Safety Culture

- Four principles of safety- RAMP (Recognize, Assess, Minimize, Prepare)
- Re-thinking safety-learning from incidents
- Safety ethics and rules
- Roles and responsibilities towards safety
- Building positive attitude towards safety
- Safety cultures in academic institutions

Recognizing and Communicating Hazards

- Hazards and Risk
- Types of hazards: Physical (mechanical and non-mechanical), Chemical (Toxic and biological agents), electrical, fire, construction, heat and temperature, noise and vibration, falling and lifting etc.

- Learning the language of safety: Signs, symbols and labels

Finding Hazard Information
- Material safety data sheets
- Safety data sheets and the GHS (Globally Harmonized Systems)

Accidents & Their Effect on Industry
- Costs of accidents
- Time lost
- Work injuries, parts of the body injured on the job
- Chemical burn injuries
- Construction injuries
- Fire injuries

Assessing and Minimizing the Risks from Hazards
- Risk Concept and Terminology
- Risk assessment procedure
- Risk Metric's
- Risk Estimation and Acceptability Criteria
- Principles of risk prevention
- Selection and implementation of appropriate Risk controls
- Hierarchy of controls

Preparing for Emergency Response Procedures
- Fire
- Chemical Spill
- First Aid
- Safety Drills / Trainings:

♣ Firefighting
♣ Evacuation in case of emergency

Stress and Safety at Work Environment
- Workplace stress and sources
- Human reaction to workplace stress
- Measurement of workplace stress
- Shift work, stress and safety
- Improving safety by reducing stress
- Stress in safety managers
- Stress and workers compensation

Incident Investigation
- Importance of investigation
- Recording and reporting
- Techniques of investigation
- Monitoring
- Review
- Auditing Health and Safety

Suggested Books:
- The A-Z of health and safety by Jeremy Stranks, 2006.
- The Manager's Guide to Health & Safety at Work by Jeremy Stranks, 8th edition, 2006.

• Occupational safety and health law handbook by Ogletree, Deakins, Nash, Smoak and Stewarts, second edition, 2008.

Technical Writing

Area Scope:

The knowledge units in this area collectively encompass the following:

• The students will be able to write technically correct statements, assignments, final year project report, project proposal, short report and research paper

• The students would be able to their write CV, cover letter and business/professional Correspondence meeting all criteria

• The students would be able to present their work/ research at a technical forum.

Course Outlines:

• Introduction to Technical writing

• Proposal write-up and improvement strategies Introduction to research and research types choosing research problems and research advisors How to carry out research

• Formulation – Problem statement, Literature

• Review

• Design – Methodology

• Analysis - Data analysis and interpretation Good writing style techniques

• Uses of correct words

• Presenting and publishing research

• Write business/professional correspondence, cover letter and CV

• Writing meeting minutes

Suggested Books:

• Writing for Computer science by Justin Zobel Research Methodologies – A step by step guide for beginners, Ranjit Kumar.

Numerical Analysis

Area Scope:

The knowledge units in this area collectively encompass the following:

• To comprehend different numerical techniques such as: error propagation, interpolation, differentiation, integration, eigenvalues and solution of algebraic and differential equations

• To apply the numerical techniques to different linear and nonlinear engineering problems

Course Outline

Error Analysis and Interpolation

• Error analysis, Types of error, Sources of error, Norms of vectors and matrices, Computer arithmetic, Condition number of a matrix, Significant digits and loss of significant digits, Floating point arithmetic, Binary and decimal representation, Single and double precision

• Interpolation: Newton forward and backward difference formula for interpolation, Central difference interpolation formulae, Lagrange's interpolation, Error in interpolation, Linear least square approximation, Interpolation versus least square approximation, Relevant engineering case studies

Numerical Differentiation and Integration

• Derivation of numerical differentiation of first order and second order derivatives using two points, three points, and five points formulas along with its application in engineering, Relevant case studies

• Numerical integration: Trapezoidal rule, Simpson's rules, Composite Trapezoidal Simpson Rules and Romberg integration, Applications of numerical in engineering, Relevant case studies

Methods of Solution a System of Linear Equations

• Solution of system of linear algebraic equations, Gauss elimination method
• LU factorization, Tridiagonal solver
• Applications of these methods in engineering disciplines, Relevant case studies

Iterative Methods for Linear and Nonlinear Equations

• Numerical Solution of nonlinear equations: Bisection method, Newton's method, Secant method, Convergence analysis of these methods
• Newton's method for system of nonlinear equations
• Solution of system of linear equations by Jacobi, Gauss Seidel and SOR methods, Applications of these methods in engineering disciplines, Relevant case studies

Numerical Methods for IVPs and BVPs

• Euler's method and its variations, Taylor's higher order methods, Error analysis, Consistency, stability and convergence
• Runge-Kutta methods of order 2, 3, and 4, Stiff ODEs, Consistency, stability and convergence
• Linear multistep methods, Numerical solution of system of ODEs
• Numerical solution of BVPs by Finite Difference Method
• Applications in engineering: Some relevant case studies

Numerical Methods for Computing Eigenvalues

• Eigenvalues and Eigenvectors of matrix: power method,
• Inverse power method, Shifted inverse power method.
• Applications of eigenvalues in engineering disciplines.

Numerical Optimization

• Unconstrained Optimization,
• Golden search ratio, Lagrange Multipliers,
• Method of steepest descent
• Applications of optimization in engineering disciplines

Suggested Books:

• Numerical Analysis: By Richard L. Burden, J. Douglas Faires, Latest Edition
• Numerical methods for scientist and engineers by R.W. Hamming (Latest Edition)
• Numerical methods for Engineers by Steven C. Chapra and R. P. Canale (Latest Edition)

Complex Variables & Transforms

Area Scope:

The knowledge units in this area collectively encompass the following:

• Explain the concept of complex number system, complex function, limit, continuity, differentiability and integral of complex valued functions
• Utilize the theory of complex integration and power series (Taylor series. Laurent series) to solve problems from the area of residue calculus
• Apply various transforms to solve complex integration.

Course Outline

Introduction

- Review of complex numbers, Complex valued functions, Elementary functions (exponential and logarithmic functions, Trigonometric and hyperbolic functions and theirs inverses),
- Limits and continuity,
- Applications in Engineering

Complex Differentiation and Integration

- Derivatives of complex valued functions, Differentiability,
- Analyticity, Cauchy Riemann Equations, Harmonic Functions,
- Complex integrals, Cauchy-Goursat Theorem, Independence of Path,

Cauchy's Integral Formulas and Their Consequences, Applications

Power Series

- Taylor Series, Laurent Series, Singularities, Zeros and poles, Residue integration method, Residue theorem,
- Conformal mapping

Laplace Transformation

- Linearity, Scaling, First shifting theorem, Heaviside's Shifting theorem,
- Inverse Laplace transformation, Properties of inverse Laplace,
- Convolution theorem, Applications in relevant engineering discipline

Special functions and Fourier Transforms

- (Gamma, Beta functions, Periodic functions, Error function),
- Fourier Series, Fourier Sine and Cosine series,
- Fourier transform, Fourier cosine and sine transform, properties.
- Applications in relevant engineering discipline

Z-Transformation

- Z-transform, Properties of Z-transform, linearity and scaling, Standard Ztransform, Inverse Z-transform,
- Inverse Z- transform by using residue, convolution theorem of Z-transform,
- Formation of difference equation and its solution using Z-transform.

Suggested Books:

- Advanced Engineering Mathematics, by Erwin Kreyszing, Latest Edition
- Complex Variables and Applications by Churchill, Latest Edition
- R. J. Beerends, Fourier and Laplace Transform, Cambridge University Press, Latest Edition.
- Jeffry A, Advanced Engineering

Sociology for Engineers

Area Scope:

This course is meant to provide engineering students, with an opportunity to view the discipline of sociology from the engineering perspective and will highlight its application to engineering profession. This will also enable the engineers to fit their technical ideas into a socially acceptable product /project in a more successful manner. The knowledge units in this area collectively encompass the following:

- To introduce to the methods and philosophy of the social science to help their understanding of the socio-cultural dimension of human existence as a fundamental reality in engineering projects etc.

- To provide opportunity for students to begin the process of considering social problems/ issues while designing engineering products.
- To allow engineers to play a pro-active role in critical discussions of social issues specifically.
- To demonstrate comprehension of roles and functions of various social institutions, state organizations, Professional bodies and relationships for analyzing their social impact Assessment.

Course Outline:

Fundamental Concepts and Importance of Sociology for Engineers

What is sociology? Nature, Scope, and Importance of Sociology, Sociological Perspectives and Theories, Social Interactions, Social Groups/ Social Institutions & heir interface with Engineering Project/services, Sociology & Impact of Technology & Engineering Products/Projects on Society. **Cultural Impacts of Engineering Projects on Society**

Definition of Culture, Types of Culture & Elements of Culture, Culture & Power, Authority, Dominance Socialization and Personality, Role of Engineering Projects on Culture, social norms and values of Society, Cultural Infusion of Engineers in Society

Theoretical Perspective of Sociology: Diffusion and Innovation; Adoption and Adaptation; Social development; Community Development

Community Development & Social consequences of Industrialization, Development Processes of Societal Development, Cooperation and Conflict in Community Development in Engineering Context.

Understanding of Societal & Ethical Norms and Values for Engineers

Engineering Ethics, Engineering product/services for less privileged, Role of Engg & Technology in addressing Social inequality, Core Social Values/Norms affecting Engg Performance

Organizational Social Responsibility (OSR) of Engineers

- Extenttowhichdevelopmentintendstosensitizesocietalandunder-privileged needs
- Gender inclusiveness and balance
- Special and Disadvantaged Community of the Area
- Planning for community inclusiveness
- Societal Obligation of Engineers

Engineers, Society and Sustainability

Social System and Concept of Sustainable Development Technology and Development, Population Dynamics in Pakistan, Causes and Consequences of Unplanned Urbanization, Community Development, Programs in Pakistan, Community Organization & Engineering Projects, Population, Technological & Industrial expansion and Development with focus on social/human/ethical dimensions.

Industrial & Organizational Psychology Interpersonal Relations

Interpersonal Behavior, Formation of Personal Attitudes, Language and Communication, Motivations and Emotions, Impact of Technology on human feelings and level of Sensitivity

Climate Change and Ecological Friendliness from Engineering Perspective

Ecological Processes, Ecosystem and Energy, Impact of Engineering Projects on Eco System & Human Ecology, Industrial & Environmental impact on Population & General Masses, Technological Intervention, Ecosystem and Physical Environment, Social Impact of Technology & Engineering Products & Services (Solid Waste Disposal, Pollution control etc.).

Social Approaches and Methodologies for Development Administration & Stakeholders Analysis:

All Phases of the Project (pre, post and execution) Structured, Focused Group, Stakeholder Consultative Dialogues etc. Dynamics of Social Change, Sociology of Change and Industrial Development, Social Change due to Technology Driven Economic Growth.

SIA (Social Impact Assessment):

Base line and need-assessment, evaluation and impact assessment surveys of the development projects. Role of Engg & Technology for Creating Social Cohesiveness & Societal Integration. Technology Based change in Collective Behavior, Social Audit of Engineering Projects.

Engineering Intervention for Social Stratification:

Factors of Social Stratification, Engineering Interventions for addressing Social Stratification, Social Mobilization through Technological Innovation.

Case Studies of Different Development Projects in Social Context

Suggested Books:

- Godhade, J. B., and S.T. Hunderkari. 2018. Social Responsibility of Engineers. International Journal of Academic Research and Development. Vol. 03; Special Issue. March, 2018.
- Nichols, S.P. and Weldon, W.F. 2017. Professional Responsibility: The Role of Engineering in Society Center for Electro-mechanics, The University of Texas at Austin, USA.
- Aslaksen, E.W. 2016. The Relationship between Engineers and Society: is it currently fulfilling its potential? Journal and Proceedings of the Royal Society of New SouthWales, Vol.148. Nos.455-456. Gumbooya Pty Lte, Allambie Heights, Australia.
- Bell, S. Engineers, Society and Sustainability. Synthesis Lectures on Engineers, Technology, and Society. Edited by Caroline Baillie, University of Western Australia. Morgan and Claypool Publishers
- Jamison, A., Christensen, S.H., and Lars, B. 2011. A Hybrid Imagination: Science and Technology in Cultural Perspective.
- Vermaas, P., Kroes, P., Poet, l., and Houkes, W. 2011. A Philosophy of Technology: From Technical Artefacts to Socio technical systems.
- Mitcham, C., and Munoz, D. 2010. Humanitarian Engineering. Morganand Claypool Publishers. Riley, D. 2008. Engineering and Social Justice. Morgan and Claypool Publishers.
- Bugliarello, G. 1991. The Social Functions of Engineering: A Current Assessment, A Chapter in “Engineering as A Social Enterprise”.

Organizational Behavior

Course Outline:

Introduction to Organizational Behavior

- Organizational Disciplines and topics
- Psychological Perspective
- Social-Psychological Perspectives

Structure and Control in Organization

- Introduction of Bureaucracy
- Managerial Work
- Contingency theory
- Organizational Design

Individual and Work Learning

- Learning Theories
- Learning and Work

Stress

- Types of Stress and Work
- Occupational Stress Management

Individual Differences

- Personality and its factors
- Personality dimensions and social learning Intelligence

Motivation and Job Satisfaction

- Needs at Work
- Theories of Motivation and job satisfaction
- Correlates of Job satisfaction

Group and Work

- Social Interaction
- Dramaturgy and impression Management
- Social Skill

Group and Inter Group Behavior

- Group Structure & Norms
- Group Processes
- How throne Studies

Leadership

- Leadership as an attribute
- Leadership Style

Patterns of Work

- Work-the classical approach
- Marx, Weber, & The critique of labor
- Foucault & Disciplinary Power
- Conflict and Consent in Work
- The labor Process debate
- Work place control and resistance
- Industrial conflict and industrial relations

Organizational Culture

- Organizational culture and strategic management
- Exploring organizational culture
- Evaluating concept of culture

Suggested Books:

- Finchan, R., & Rhodes, P. (2003), Principles of Organizational Behaviour, 3rd Oxford.
- Noe, R., Hollenbeck, J. Gerhart, B., & Wright, P. (2006), Human Resource Management, 5th ed., McGraw Hill.
- Newstrom John W. (2007), Organizational Behaviour, (12th Ed), McGraw Hill.
- Luthan Fred, (2005), Organizational Behaviour, McGraw Hill Inc.
- Robins, Stephen, (2005), Organizational Behaviour, McGraw Hill Inc.

Engineering Economics

Area Scope:

- Apply the appropriate engineering economics analysis method(s) for problem solving i.e. present worth, annual cost, rate of return, payback, break-even, benefit-cost ratio
- Evaluate the cost effectiveness of individual projects using the methods learnt, draw inferences for investment decisions, and compare the life cycle cost of multiple projects.
- Compute the depreciation of an asset using standard depreciation techniques to assess its impact on present or future value

Course outline

Engineering Economics

- Role of engineers in business
- Economic decisions v/s design decisions
- Large scale engineering projects and types of strategic economic decisions
- Fundamental principles of engineering economics

Interest Rate and Economic Equivalence

- Interest: The Cost of Money
- Economic Equivalence
- Development of Formulas for Equivalence Calculation
- Unconventional Equivalence Calculations

Understanding Money and Its Management

- Nominal and Effective Interest Rates
- Equivalence Calculations with Effective Interest Rates and with Continuous Payments
- Changing Interest Rates
- Debt Management
- Investing in Financial Assets

Present-Worth Analysis

- Project Cash Flows
- Initial Project Screening Methods: payback Screening and Discounted Cash Flow Analysis
- Variations of Present-Worth Analysis
- Comparing Mutually Exclusive Alternatives

Annual Equivalent-Worth Analysis

- Annual Equivalent Worth Criterion
- Capital Costs versus Operating Costs
- Applying Annual-Worth Analysis
- Life-Cycle Cost Analysis
- Design Economics

Rate-of-Return Analysis

- Rate of Return and Methods of Finding
- Internal Rate-of-Return Criterion
- Mutually Exclusive Alternatives

Cost Concepts Relevant to Decision Making

- General Cost Terms; Classifying Costs for Financial Statements
- Cost Classifications for Predicting Cost Behavior
- Future Costs for Business Decisions
- Estimating Profit from Production

Depreciation and Corporate Taxes

- Asset Depreciation: Economic versus Accounting
- Book and Tax Depreciation Methods (MACRS)
- Depletion
- Income Tax Rate to be used in Economic Analysis
- The Need for cash Flow in Engineering Economic Analysis

Developing Project Cash Flows

- Cost-Benefit Estimation for Engineering Projects
- Developing Cash Flow Statements

Project Risk and Uncertainty

- Origins of Project Risk
- Methods of Describing Project Risk: Sensitivity, Break-Even and Scenario Analysis

Special Topics in Engineering Economics

- Replacement Decisions
- Capital Budgeting Decisions
- Economic Analysis in the Service Sector

Suggested Books:

- Contemporary Engineering Economics by Chan S. Park, 6th edition, Pearson 2015, ISBN: 9780134105598
- Engineering Economic Analysis by Donal G. Newnan, Jerome P. Lavelle, Ted G. Eschenbach, 12th edition, Oxford University Press, ISBN: 978-0199339273
- Engineering Economy by Leland T. Blank and Anthony Tarquin.

Engineering Project Management

Area Scope:

The primary objective of this course is to get the fair understanding of core issues pertaining to Engineering Project Management. This course is aimed at providing both basic and some advanced exposure to emerging trends in the field of Project Management, so as to enable the engineering professionals of tomorrow to successfully complete sophisticated projects within the constraints of capital, time, and other resources with due regards to stakeholders set of expectations. Engineering students will learn key Project Management skills and strategies and will be able to face emerging challenges.

Core Objectives of this course are:

- To develop competencies in project costing, budgeting, and financial appraisal;
- To gain exposure to project Planning Control and Management, using standard tools and schedule variance analysis;
- To appreciate the elements of risk and quality in hi-tech projects;
- To learn Project Management by “practice”, through the medium of “End of Semester Group Project”; and
- To appreciate and understand the use of computers in Project Management, especially a tool like MS Project & Primavera etc.

Course Outline:

Project Management Concepts

History of Project Management, Introduction to Project Management, Project, Program & Portfolio Management, Project characteristics, Objectives& Requirements, Project Phases/Stages, Project Life Cycle, Project Environment, Project Scope & Project Charter, Project Manager, Project Stakeholder Analysis.

Project Proposal Development

Project Proposal, Characteristics of good proposal, Types of Proposals, Request for Proposal, Request for Quotation etc.). Proposal Templates etc.

Project Feasibility

Brief review of various aspects of Project Feasibility like Technical, Social, Managerial, Economic, Financial & Marketing, Administrative etc.

Project Selection Criteria (Economic Analysis of Engineering Projects)

Using Break Even Analysis, Cost Benefit Ratio, Internal Rate of Return, Net Present Value etc.

Project Contract & Procurement Management

Engineering contracts, Type of contracts, understanding of procurement Process & Cycle, PPRA Rules

Project Planning and Scheduling

Project Planning (Resource & HR Planning), Work Breakdown Structure, Project Network & Scheduling, Manning Schedule and Activity Charts, Critical Path Method (CPM)/Project Evaluation & Review Techniques

Project Costing & Estimation

Cost Estimation in Projects, Cost components in projects and methods for cost estimation in projects, Cost Control in Projects, Estimation of Outstanding Work, Earned Value Management, Schedule & cost variance analysis

Project HRM & Communication Management

Effective organization and communication for Successful Projects, Project Organizational Structures (Project matrix and project based organizations), Project HR Plan preparation, HR Need Assessment and HR Matrix, Building and Managing effective project team, Selection & control mechanism of HRM in Projects, Effective Communication Plan.

Project Risk Management

Definitions Project Risk, Project Risk Management Tools, Types of Project Risk, Project Risk Assessment, Risk Identification and Mitigation, Monitoring & Controlling Risk, Generic Risk Management Strategies & Technique.

Computer Application in Project Management

Basic/Elementary Introduction and hands on basic exposure of use of MS Project & Primavera P6 Software in Project Management

Project Quality Management

Defining Quality, Quality Assurance, Quality Management, 7 Quality Improvement Tools as applied to Project Management, Project Quality Management Plan, Quality Management Processes and Strategies

Project Closure & Termination

Project Evaluation, defining project success, Project Completion Criteria, Project Audit, Project Termination &When to close a project, the termination process, Project Close Up & lesson learnt, & Project Archive

Suggested Books:

- Project Management: A system Approach to Planning, Scheduling and Controlling latest Edition, Harold Kerzner
- Bennett, F. Lawrence. Latest edition. *The management of engineering*. New York: Wiley.
- Cleland, David. Latest edition *Field guide to project management.* New York: Wiley.
- Eisner, H. *Essentials of project management and systems engineering management*. New York: Wiley, latest edition.
- Frame, J. D. *Managing projects in organizations*. San Francisco: JosseyBass

• Goldratt, Eliyahu. Latest edition Critical chain. North River Press.
• Haynes, M.E. *Project management: From idea to implementation*. Los Altos, CA: Crisp Publications latest edition.
• Lewis, James, *Project planning, scheduling & control*. New York: McGrawHill, latest edition.
• Lewis, James, P. Latest edition. *Mastering project management*. New York: McGraw-Hill
• Lientz, Bennet & Rea, Kathryn. Latest edition. *Project management for the 21st century*. San Diego: Academic Press.
• Miller, Roger & Lessard, Donald. Latest edition. *The strategic management of large engineering projects.* Cambridge, MA: MIT Press.
• Nicholas, J.M. *Managing business & engineering projects*. Englewood Cliffs, NJ: Prentice Hall, latest edition
• Shtub, Avraham, Bard, Jonathan, & Globerson, Shlomo. 1994. *Project management: Engineering, technology, and implementation.* Englewood Cliffs, Prentice-Hall latest edition.
• Project Management by Adrienne Watt, latest edition.
• J.R. Meredith and S.J. Mantel. Project Management: A Managerial Approach. John Wiley and Sons. New York. Latest edition.

Entrepreneurship

Area Scope:

• Develop a business plan with an appropriate business model
• Demonstrate the ability to provide a self-analysis in the context of an entrepreneurial career
• Demonstrate the ability to find an attractive market that can be reached economically

Course Outlines

• Basic Concept-Entrepreneurship
• Innovation and Entrepreneurship
• Basic Plan Development Cycle
• Intellectual Rights
• Financial and Legal Modalities
• Marketing
• Industrial Competiveness
• Gap Analysis, Critical Thinking and Idea Generation
• Business Plan Development
• Successful Case Studies (local)

Suggested Books:

• Michael J Etzel, Bruce J Walker, William J Stanton, Marketing, McGrawHill, latest edition.
• William D. Bygrave and Andrew Zacharak, Entrepreneurship 2nd Edition, Wiley, latest edition.
• Entrepreneurship by Hisrich, McGraw- Hill, latest edition.
• Principles of Marketing, Cotrell McGraw- Hill, latest edition.
• Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship, latest edition.
• P.N. Singh: Entrepreneurship for Economic Growth, latest edition.
• Peter F. Drucker: Innovation and Entrepreneurship Peter F. Drucker, latest edition.
• John B. Miner: Entrepreneurial Success, latest edition.

- "Marketing that Works: How Entrepreneurial Marketing Can Add Sustainable Value to Any Sized Company", by Leonard Lodish, Howard Morgan, Shellye Archambeau and Jeffrey Babin, Pearson FT Press, latest edition.
- "Entrepreneurial Marketing," Lessons from Wharton's Pioneering MBA Course, Morgan, H. L., A. Kallianpur, and L. M. Lodish, John Wiley & Sons, latest edition.

Principles of Management

Area Scope

- The focus will be on the learning fundamental principles of management and of managing people and organization.
- Develop analytical and conceptual framework of how people are managed in small, medium and large public and private national and international organizations.

Course Contents:

- Introduction, overview and scope of discipline
- The evolution and emergence of management thought
- Management functions
- Planning concepts, objectives, strategies and policies
- Decision making
- Organizing; departmentalization, line/staff authority, commitments and group decision making
- Staffing: principles of selection, performance, career planning
- Leading: Motivation, leadership, communication
- Controlling: the system, process and techniques of controlling
- Management and Society: future perspective

Suggested Books:

- Stephen P. Robins, Mary Coulter: Management, latest edition.
- H. Koontz Odonnel and H. Weihrich: Management, latest edition.
- Mc Farland: Management: Foundation and Practice, latest edition.
- Robert M. Fulmer: The New Management, latest edition.

Bachelors of Software Engineering

Curriculum
2020

Applicable from Fall 2020 intake

Department of Software Engineering

BAHRIA UNIVERSITY

Scheme of Studies

Duration	4 years
Number of Semesters	8
Number of weeks per semester	18 (16 for teaching and 2 for exams)
Total number of credit hours	134
Number of credit hours per semester	15-18
Non-Engineering Courses	14 Courses, 36 Cr Hrs, 26.87 % of total
Engineering Courses	31 Courses, 98 Cr Hrs, 73.13 % of total

Courses of Non-Engineering Domain

Knowledge Area	Sub Area	Name of Course	Lec. Cr. Hrs	Lab Cr. Hrs	Total Cr. Hrs.	Total Cou-rses	Total Cre-dits	% Area	% Overall
Humanities and Social Sciences	English	Functional English	3	0	3	3	7	22.22%	5.97%
		Communicatio n Skills	2	0	2				
		Technical Writing & Presentatio n Skills	3	0	3				
	Culture	Islamic Studies/Ethics	2	0	2	2	4	11.11%	2.99%
		Pakistan Studies and Global Perspective	2	0	2				
	Social Sciences	Social Sciences Elective 1	2	0	2	2	4	11.11%	2.99%
		Social Sciences Elective 2	2	0	2				
Management Sciences		Management Sciences Elective 1	3	0	3	2	5	13.89%	3.73%
		Management Sciences Elective 2	2	0	2				
Natural Sciences	Math	Applied Calculus & Analytical Geometry	3	0	3	4	12	33.33%	8.96%
		Linear Algebra	3	0	3				
		Probability & Statistics	3	0	3				
		Numerical Analysis	2	1	3				
	Physics	Applied Physics	2	1	3	1	3	8.33%	2.24%
Total			34	2	36	14	36	100%	26.87%

Humanities and Social Sciences Electives: (With no Pre-req)

HSS 217	Introduction to Sociology
HSS 119	Introduction to International Relations
HSS 121	Introduction to Media Studies
HSS 218	Introduction to Anthropology
HSS 457	Organizational Behavior
PSY 102	Introduction to Psychology
HSS 219	Sociology for Engineers
SEN 442	Software Engineering Economics
ENG 123	English Literature
HSS 462	Foreign Language
HSS 463	Accounting & Finance

Management Science Electives (With no Pre-req)

2 Credit Hour Courses

HSS 423	Entrepreneurship

3 Credit Hour Courses

MGT 111	Principles of Management
HSS 453	Human Resource Management
MGT 423	Engineering Management
MTM 101	Introduction to Maritime Industry

Courses of Engineering Domain

Knowledge Area	Course Title	Lec	Lab	Total	Total Courses	Total Cr. Hrs.	% Area	% Overall
Computing and Information Sciences	Computing Fundamentals	2	1	3	2	7	7.14%	5.22%
	Computer Programming	3	1	4				
Core Breadth of Engineering discipline	Introduction to Software Engineering	3	0	3	10	30	30.61%	22.39%
	Software Requirement Engineering	3	0	3				
	Design and Analysis of Algorithms	3	0	3				
	Software Design & Architecture	2	1	3				
	Software Construction	2	1	3				
	Software Quality Engineering	3	0	3				
	Human Computer Interaction	3	0	3				
	Cloud Computing	2	1	3				
	Software Project Management	3	0	3				
	Information Security	3	0	3				
Core Depth of Engineering discipline	Engineering Elective-I*	-	-	3	6	18	18.37%	13.43%
	Engineering Elective-II*	-	-	3				
	Engineering Elective-III*	-	-	3				
	Engineering Elective-IV*	-	-	3				
	Engineering Elective-V*	-	-	3				
	Engineering Elective-VI*	-	-	3				
Engineering Foundation	Discrete Structures	3	0	3	8	30	30.61%	22.39%
	Object Oriented Programming	3	1	4				
	Computer Architecture and Logic Design	3	1	4				
	Operating Systems	3	1	4				
	Database Management System	3	1	4				
	Computer Communication & Networks	3	1	4				
	Formal Methods in Software Engineering	3	0	3				

	Data Structures & Algorithms	3	1	4				
Multi-Disciplinary Engineering Courses	Occupational Health and Safety	1	0	1	3	7	7.14%	5.22%
	MDEE-I*	-	-	3				
	MDEE-II*	-	-	3				
Senior Design Project	Project I	0	3	3	2	6	6.12%	4.48%
	Project II	0	3	3				
Internship (Summer)		0	0	0	0	0	0	0
Total					31	98	100%	73.13%

**Course is either 2-1-3 or 3-0-3 depending on the offered elective course.*

Multi-Disciplinary Engineering Elective (MDEE) Courses

1. (With no Pre-req)

Course Code	Course Title Total	Credit Hours	Theory	Lab
CEN 122	Digital Design	3	2	1
CSC 448	Introduction to Bio-Informatics	3	3	0
CEN 463	Robotics	3	2	1
CSC 315	Theory of Automata	3	3	0
CEN 439	Embedded System Design	3	2	1
SEN 429	Fault Tolerant Systems	3	3	0
SEN 449	Business Process Automation	3	3	0

2. (With Pre-req)

Pre-Req	Course Code	Course Title Total	Credit Hours	Theory	Lab
GSC 110	GSC 210	Differential Equations	3	3	0
GSC 110	GSC 220	Complex Variables and Transforms	3	3	0
GSC 122	GSC 445	Operations Research	3	3	0
GSC 122	CEN 450	Simulation and Modeling	3	2	1
GSC 114	GSC 446	Physics-II (Mechanics)	3	3	0
GSC 122	GSC 440	Stochastic Processes	3	3	0
CSC 320	CEN 449	System Programming	3	2	1
CSC 320	CEN 453	Real Time Systems	3	3	0
CSC 315	CSC 323	Compiler Construction	3	2	1
GSC 110	CSC 453	Information Theory	3	3	0
CSC 113	SEN 460	IoT Application Development	3	2	1

Engineering Electives

**At least 2 courses with lab components will be offered*

1. (With no Pre-req)

Course Code	Course Title Total	Credit Hours	Theory	Lab
SEN 448	Software Applications For Mobile Devices	3	2	1
SEN 324	Software Metrics & Estimation	3	3	0
SEN 450	Design Pattern	3	3	0
SEN 452	Agile Development	3	3	0
CSC 411	Artificial Intelligence	3	2	1
SEN 443	Introduction to Soft Computing	3	2	1
SEN 331	Scientific Computing	3	3	0
SEN 330	Agent Based Computing	3	3	0
SEN 459	Mobile and Pervasive Computing	3	3	0
CEN 451	Data Encryption & Security	3	3	0
CSC 495	Introduction to Data Science	3	2	1
SEN 332	Big Data Analytics	3	3	0
SEN 455	Knowledge Based Management Systems	3	3	0
SEN 453	Information System Audit	3	3	0
CSC 444	Computer Graphics	3	2	1
SEN 329	Digital Animation	3	3	0
SEN 493	Multimedia Systems	3	3	0
SEN 424	Semantic Web	3	2	1
SEN 456	Usability Engineering	3	3	0

2. (With Pre-req)

Pre-Req	Course Code	Course Title Total	Credit Hours	Theory	Lab
CSC 113	CSC 313	Visual Programming	3	2	1
CSC 113	CSC 445	Principles of Programming Languages	3	3	0
CSC 210	SEN 328	Game Application Development	3	2	1
CSC-113	SEN 441	Mathematical Tools For Software Engineering	3	3	0
GSC 122	CSC 441	Natural Language Processing	3	3	0
CSC 210	CSC 456	Distributed Computing	3	2	1
CSC 220	CSC 460	Data Mining	3	2	1
CSC 220	CSC 454	Data Warehousing	3	3	0
SEN 120	CSC 458	Management Information Systems	3	3	0
CSC 220	SEN 326	Advanced Database Management Systems	3	2	1

CSC 220	SEN 327	Distributed Database Systems	3	3	0
GSC 121	CEN 445	Digital Image Processing	3	2	1
CEN 445	CSC 464	Computer Vision	3	3	0
SEN 210	SEN 335	Object Oriented Software Engineering	3	2	1
SEN 311	SEN 411	Software Re-Engineering	3	3	0
CSC 113	SEN 310	Web Engineering	3	2	1
CSC 113	SEN 461	Secure Programming	3	2	1

Roadmap of BSE with Pre-requisites

Semester 1

Pre-requisite Courses	Course Code	Course Title	Lec	Lab	Total
None	CSC 110	Computing Fundamentals	2	1	3
None	CSC 113	Computer Programming	3	1	4
None	ENG 105	Functional English	3	0	3
None	GSC 110	Applied Calculus & Analytical Geometry	3	0	3
None	GSC 114	Applied Physics	2	1	3
				Total =	16

Semester 2

Pre-requisite Courses	Course Code	Course Title	Lec	Lab	Total
None	CSC 115	Discrete Structures	3	0	3
Computer Programming (CSC 113)	CSC 210	Object Oriented Programming	3	1	4
None	SEN 120	Introduction to Software Engineering	3	0	3
Functional English (ENG 105)	HSS 118	Communication Skills	2	0	2
None	ISL 101	Islamic Studies/Ethics	2	0	2
None	GSC 121	Linear Algebra	3	0	3
None	ENV 101	Occupational Health and Safety	1	0	1
				Total =	18

Semester 3

Pre-requisite Courses	Course Code	Course Title	Lec	Lab	Total
Object Oriented Programming (CSC 210)	CSC 221	Data Structures & Algorithms	3	1	4
Introduction to Software Engineering (SEN 120)	SEN 211	Software Requirement Engineering	3	0	3
None	GSC 122	Probability & Statistics	3	0	3
-	-	Social Science Elective-I	2	0	2
None	CEN 220	Computer Architecture and Logic Design	3	1	4
None	PAK 103	Pakistan Studies and Global Perspective	2	0	2
				Total =	18

Semester 4

Pre-requisite Courses	Course Code	Course Title	Lec	Lab	Total
Computer Architecture and Logic Design (CEN 220)	CSC 320	Operating Systems	3	1	4
Computer Programming (CSC 113)	CSC 220	Database Management System	3	1	4
Data Structures & Algorithms (CSC 221)	CSC 321	Design and Analysis of Algorithms	3	0	3
Software Requirement Engineering (SEN 211)	SEN 221	Software Design & Architecture	2	1	3
-	-	Management Science Elective-I	3	0	3
				Total =	17

Semester 5

Pre-requisite Courses	Course Code	Course Title	Lec	Lab	Total
None	CEN 223	Computer Communication & Networks	3	1	4
Applied Calculus & Analytical Geometry (GSC 110)	SEN 323	Formal Methods in Software Engineering	3	0	3
Software Design & Architecture (SEN 221)	SEN 311	Software Construction	2	1	3
-	-	Engineering Elective-I*	-	-	3
-	-	MDEE-I*	-	-	3
-	-	Social Science-II	2	0	2
				Total =	18

Semester 6

Pre-requisite Courses	Course Code	Course Title	Lec	Lab	Total
Introduction to Software Engineering (SEN 120)	SEN 321	Software Quality Engineering	3	0	3
None	SEN 212	Human Computer Interaction	3	0	3
None	HSS 320	Technical Writing & Presentation Skills	3	0	3
-	-	Engineering Elective-II*	-	-	3
-	-	Engineering Elective-III*	-	-	3
None	SEN 401	Cloud Computing	2	1	3
				Total =	18

Semester 7

Pre-requisite Courses	Course Code	Course Title	Lec	Lab	Total
-	ESC 498	Project I	0	3	3
Introduction to Software Engineering (SEN 120)	SEN 410	Software Project Management	3	0	3
None	CSC 407	Information Security	3	0	3
Applied Calculus & Analytical Geometry (GSC 110)	GSC 321	Numerical Analysis	2	1	3
-	-	Engineering Elective-IV*	-	-	3
-	-	Management Science Elective-II	2	0	2
				Total =	17

Semester 8

Pre-requisite Courses	Course Code	Course Title	Lec	Lab	Total
-	ESC 499	Project II	0	3	3
-	-	Engineering Elective-V*	-	-	3
-	-	Engineering Elective-VI*	-	-	3
-	-	MDEE-II*	-	-	3
				Total =	12

**Course is either 2-1-3 or 3-0-3 depending on the offered elective course.*

Total Credit Hours= 134 Credit Hours

Course Title: Occupational Health and Safety
Course Code: ENV 101
Credit Hours: 1 + 0
Prerequisite: None

Course Description:
This course introduces the student to the study of workplace occupational health and safety. The student will learn safe work practices in offices, industry and construction as well as how to identify and prevent or correct problems associated with occupational safety and health in these locations as well as in the home. The course will cover contents related to:

- Health and Safety Foundations
- Fostering a Safety Culture
- Recognizing and Communicating Hazards
- Finding Hazard Information
- Accidents & Their Effect on Industry
- Assessing and Minimizing the Risks from Hazards
- Preparing for Emergency Response Procedures
- Stress and Safety at Work environment
- Importance of investigation

Textbook:
1. S. Z. Mansdorf, "Handbook of Occupational Safety and Health", John Wiley & Sons, Third Edition, 2019.
2. David Allan Galloway, "Safety WALK Safety TALK: How small changes in what you THINK, SAY, and DO shape your safety culture", CreateSpace Independent Publishing Platform, 2019.
3. Occupational safety and health law handbook by Ogletree, Deakins, Nash, Smoak and Stewarts, second edition, 2008.
4. The Manager's Guide to Health & Safety at Work by Jeremy Stranks, 8th edition, 2006.
5. The A-Z of health and safety by Jeremy Stranks, 2006.

Course Title: Discrete Structures
Course Code: CSC 115
Credit Hours: 3 + 0
Prerequisite: None

Course Description:
The course would cover introduction to Discrete Structures, Propositional Calculus, Bi-conditionals, Equivalence, Applications to Natural Language and System Specification, Predicates and Quantifiers, Algorithms: Searching, Linear and Binary Search, Sorting: Bubble Sort, Insertion Sort, Algorithmic Efficiency: Big O Notation; Theorems and Examples, Big O for Combinations of Functions, Complexity of Algorithms: Linear and, Binary Search, Miscellaneous Asymptotic Analysis Topics, Counting: Product and Sum Rules, Pigeonhole Principle: Generalized Pigeonhole Principle. Permutations and Combinations: Binomial Theorem and Identities, Pascal's Identity, Pascal's Triangle, Number Theory: Divisibility, Division Algorithm, Modular Arithmetic, Modular Arithmetic and Congruence, Prime Numbers, Fundamental Theorem of Arithmetic, GCD, LCM. Review of Number Theory, Algorithm for div and mod (Quotient and Remainder), Euclid's Algorithm for GCD, Review of Asymptotic Analysis, Integer representations, Computing representations, Integer addition algorithm, Integer multiplication algorithm, Exponentiation, Exponentiation Algorithms, Graph Theory Introduction, Types of Graphs. Paths and Circuits: Euler Circuits and Paths, Graph Isomorphism. Planar Graphs, K3, 3, Euler's Formula. Shortest Path Problems and Dijkstra's Algorithm, Complexity, Hamiltonian Circuits, Traveling Salesman Problem. Trees: Definitions and basic properties, Applications of Trees: Searching, Binary Search Trees, Tree Traversal: Inorder, Preorder, Postorder, Applications to file systems, expressions. Spanning Trees: Construction of spanning trees, Breadth First Search, Depth First Search, Minimum Spanning Trees.

Textbook:
1. K. Rosen, “Discrete Mathematics and Its Applications”, latest Edition.
2. S. Epp, “Discrete Mathematics with Applications”, latest edition.

Course Title: Computer Architecture and Logic Design
Course Code: CEN 220
Credit Hours: 3 + 1
Prerequisite: None

Course Description:
Computer Architecture and Logic Design are core concepts in computing and engineering programs, which aim to cultivate students' abilities towards the basic understanding of logic circuits, and the architecture of uniprocessor in terms of system performance. The course would cover the following topics:

- Logic Gates. Expression of Digital Function in Boolean Algebra. Canonical Forms; Standard Forms: SOP, POS.
- Gate Level Minimization. K-map 2, 3, 4 variables maps.
- Full Adder and Half Adder Circuits. 4-bit Binary Adder.
- Combinational Circuits, Decoder, Encoder, Multiplexer
- Sequential Circuits. Latches: SR, D Latch. D Flip-flop JK Flip Flop, T Flip Flop: Characteristic Table, characteristic equations.
- Design Process of Synchronous Sequential Circuits. Design with D Flip Flops.
- Design Process of Synchronous Sequential Circuits. Design with JK and T Flip Flops. Design of a synchronous Counter
- Registers: Shift Register, Counters, Ripple and Synchronous Counters.
- Instruction, Instruction Cycle. Addressing Modes.
- CPU: Registers, Addressing Modes, Instruction Cycle
- Memory Organization
- Input Output Organization.
- Assembly Language

Textbook:
1. Digital Logic & Computer Design by M. Morris Mano. ISBN 978-81-7758-409-7, latest edition.
2. William Stallings, Computer Organization and Architecture Designing for performance, 10th Edition, Prentice Hall Inc. 2016.

Course Title: Pakistan Studies and Global Perspective
Course Code: PAK 103
Credit Hours: 2 + 0
Prerequisite: None

Course Description:
The knowledge units in this area collectively encompass the following: Have a better understanding of the rationale for the creation of Pakistan, enable students to contribute in social, political and economic growth of Pakistan, become a part of strong nation with a sense of ownership and responsibility towards Pakistan, and play an active role toward sustainable development of Pakistan in global perspective. The course would cover the following topics:

- Historical and Ideological Perspective
- Constitution of Pakistan
- Contemporary Pakistan
- Economy of Pakistan
- Land of Opportunities
- Pakistan's Foreign Policy
- Pakistan in pursuit of Global Agenda

Textbooks:

1. Khalid B. Sayeed, Pakistan: The Formative Phase 1857 – 1948, Pakistan, Publishing House, 1960.
2. Gulam Allana, Quaid-e-Azam: the story of Pakistan, Ferozsons, 1967.
3. Shahid M. Amin, Pakistan's Foreign Policy: A Reappraisal, Oxford University Press, 2010.
4. S. Akbar Zaidi, Issues in Pakistan's economy, Oxford University Press, 2003.
5. Hamid Khan, Constitutional & political history of Pakistan, Oxford University Press, 2003.

Course Title: Sociology for Engineers
Course Code: HSS 219
Credit Hours: 2 + 0
Prerequisite: None
Course Description:
This course is meant to provide engineering students, with an opportunity to view the discipline of sociology from the engineering perspective and will highlight its application to engineering profession. This will also enable the engineers to fit their technical ideas into a socially acceptable product /project in a more successful manner. The knowledge units in this area collectively encompass the following:

- To introduce to the methods and philosophy of the social science to help their understanding of the socio-cultural dimension of human existence as a fundamental reality in engineering projects.
- To provide opportunity for students to begin the process of considering social problems/ issues while designing engineering products.
- To allow engineers to play a pro-active role in critical discussions of social issues specifically.
- To demonstrate comprehension of roles and functions of various social institutions, state organizations, Professional bodies and relationships for analyzing their social impact Assessment.

Textbook:

1. Godhade, J. B., and S.T. Hunderkari. 2018. Social Responsibility of Engineers. International Journal of Academic Research and Development. Vol. 03; Special Issue. March, 2018.
2. Nichols, S.P. and Weldon, W.F. 2017. Professional Responsibility: The Role of Engineering in Society Center for Electro-mechanics, The University of Texas at Austin, USA.
3. Aslaksen, E.W. 2016. The Relationship between Engineers and Society: is it currently fulfilling its potential? Journal and Proceedings of the Royal Society of New SouthWales, Vol.148. Nos.455-456. Gumboil Pty Lte, Allambie Heights, Australia.

Course Title: Secure Programming
Course Code: SEN 461
Credit Hours: 2 + 1
Prerequisite: Computer Programming (CSC 113)

Course Description:
This course teaches the principles and practices for managing, auditing and writing secure software, including software for performing information management, networking and communications. The course addresses secure software practices and the ways of writing codes in a software so that it is protected from all kinds of accidental vulnerabilities, cyber-attacks or any event can cause harm to the software or the system using it. Software developers should be familiar with and understand the basic principles and practices for computing securely and writing secure software including: secure software design, authentication, authorization, access control, prevention of buffer-overflow attacks, security in layered networking architectures, firewalls, intrusion-detection systems, security in *(web applications, databases and information management systems)*, SQL injection attacks and defenses, applied cryptography, password management, anti-tampering and client-side security.

Textbook:
1. Michael Howard, David LeBlanc, John Viega, "24 Deadly Sins of Software Security: Programming Flaws and How to Fix Them", McGraw-Hill Education, 1st Ed, 2009.
2. Jason Grembi, "Secure Software Development: A Security Programmer's Guide", Cengage Learning, 1st Ed, 2008.
3. Software Security: Building Security In, by Gary McGraw, 2006.
4. Foundations of Security. Neil Daswani, Christoph Kern, and Anita Kesavan. Apress, 1st edition, 2007.
5. J. Viega, M. Messier. Secure Programming Cookbook, O'Reilly, 2003.
6. M. Howard, D. LeBlanc. Writing Secure Code, Microsoft, second edition, 2002.
7. J. Viega, G. McGraw. Building Secure Software, Addison Wesley, 2002.

COURSE TITLE: SECURE PROGRAMMING
COURSE CODE: SEL-461

SN	EXPERIMENT TITLES
1	Guiding principles to secure software development
2	Managing software security risk
3	Selecting software development technologies (open and closed source)
4	Software auditing
5	Race conditions
6	Integer-/Buffer-overflow prevention
7	Format-string attack prevention
8	Web application security
9	Input validation
10	Authentication and password management
11	Session Management
12	Database security and Data Protection
13	Applied cryptography
14	Protecting against denial of service attack

NEW PROGRAMME PROPOSAL

BACHELOR OF SCIENCE IN ARTIFICIAL INTELLIGENCE – BS AI

A. ACADEMIC DETAILS	
1	**Faculty/Department:** Faculty of Engineering and Sciences, Bahria University Islamabad, Computer Science Department
2	**Name of the Programme:** Bachelor of Science in Artificial Intelligence – BS AI
3	**Mission of the Programme:** To prepare graduates who can analyze, design and develop effective AI solutions.
4	**Objectives of the Programme:** • To provide an understanding of the fundamental concepts of Artificial Intelligence. • To enrich the students with modern tools and technologies with respect to an ever changing business and technological environment. • To provide mathematical and logical skills critical for solving AI problems. • To develop skills in order to collaborate effectively through written and oral communication • To develop effective team working/leading skills
5	**Outcomes of the Programme:** Graduates capable of fulfilling developmental and research needs in the domain of AI.
6	**Rationale for the Programme:** The BS AI program gives the students an in-depth knowledge they need to transform large and complex scenarios into actionable decisions. The program and its curriculum focuses on how complex inputs — such as knowledge, vision, language and huge databases — can be used to make decisions to enhance human capabilities.
7	**Brief Description of the Programme:** The curriculum of the BS AI program includes coursework in computing, mathematics, automated reasoning, statistics, computational modelling, introduction to classical artificial intelligence languages and case studies, knowledge representation and reasoning, artificial neural networks, machine learning, natural language processing, vision and symbolic computation. The program also encourages students to take courses in ethics and social responsibility, with the opportunity to participate in long term projects in which artificial intelligence can be applied to solve problems that can change the world for the better — in areas like agriculture, defense, healthcare, governance, transportation, e-commerce, finance and education
8	**Duration:** 4 years
9	**Venue(s):** ✔ **On Site/Off Site/Both On & Off Site** *(Tick one; if Off Site, give details)* IQBAL Block, Bahria University, Shangrilla Road, Sector E-8, Islamabad
10	**Programme Scheduling Format:** Morning (Bi-Semester)
11	**Proposed Date of Commencement:** Spring 2021

12	**Mode of Study/Examination:** Mode of study for BS Artificial Intelligence is based on classroom teaching. Assignments, quizzes, mid-term, and final term exams will be used to evaluate the students in each semester. Students will be required to undertake 6 credit hours of Final Year Project.
13	**Additional Faculty Member(s) Required:** For intake of two batches per annum (90 students) 14 faculty members (3 PhD and 11 MS) are required for the BS AI program. Following faculty members are already available, whereas, rest of the HR will be inducted as per schedule mentioned in section 7. • Dr. Samabia Tehseen, Ph.D. Research Interests: Artificial Intelligence, Machine Learning • Ms. Momina Moetesum, Ph.D. (In Progress) Specialization: Deep Learning, Pattern Recognition • Ms. Faima Abbasi, MS Specialization: Data Science, Artificial Intelligence Note: Detailed CVs of above-mentioned faculty members are attached for reference. Total 14 FMs (3 PhD and 11 MS) are required after program maturity and will be inducted as per following plan.
14	**Additional Skilled-Worker(s) Required:** *(Indicate if there is a requirement for additional Skilled Staff, fulltime/part-time, along with their qualifications/skill sets.)*
15	**Additional Classroom(s) required:** Total six class rooms will be required, with the following breakdown. First Year: 2 Classrooms

Year	No. of FMs	PhD	MS
First Year	4	1	3
Second Year	3	1	2
Third Year	4	-	4
Fourth Year	3	1	2

<table>
<tr><td></td><td>Second Year: 3 Classrooms

Third Year: 5 Classrooms

Fourth Year: 6 Classrooms

Class rooms will be available in the morning after shifting of Engineering programs to H-11 Campus.</td></tr>
<tr><td>16</td><td>Additional Requirement for Laboratories: 7 Labs – 2 Computing, 1 Digital Logic, 1 Systems Lab, 1
<table>
<tr><th>LAB</th><th>Year 1</th><th>Year 2</th><th>Year 3</th><th>Year 4</th><th>Total</th></tr>
<tr><td>Computing/AI

Lab</td><td>1 Lab (50 PC)</td><td>1 AI Lab (40 HPC Machines)</td><td>1 Lab (50 PC)</td><td>-</td><td>3</td></tr>
<tr><td>Digital Logic Lab</td><td>1 Lab (25 stations)</td><td>-</td><td>-</td><td>-</td><td>1</td></tr>
<tr><td>Systems Lab</td><td>-</td><td>1 Lab (50 PC)</td><td>-</td><td>-</td><td>1</td></tr>
<tr><td>General Purpose Lab</td><td>-</td><td>1 Lab (50 PC)</td><td>-</td><td>-</td><td>1</td></tr>
<tr><td>Final Year Project Lab</td><td>-</td><td>-</td><td>-</td><td>1 Lab (40 PC)</td><td>1</td></tr>
<tr><td colspan="5">Total</td><td>7 Labs</td></tr>
</table>
General Purpose Lab, and 1 Final Year Project.</td></tr>
<tr><td>17</td><td>Additional Requirement for Books, Subscriptions, Memberships to Online Research Sites/ Repositories: 100 Book Titles.</td></tr>
<tr><td>18</td><td>Minimum Entry Level: Minimum 50% marks in Intermediate (HSSC) Examination (Pre-Medical/Pre-Engg.) or equivalent qualification with Mathematics certified by IBCC.

Deficiency:

For Pre-Medical students, the following two deficiency courses of mathematics will be taught during the first year.

• Fundamentals of Mathematics I GSC 103 (3 Credit Hours)
• Fundamentals of Mathematics II GSC 104 (3 Credit Hours)</td></tr>
<tr><td>19</td><td>Admission Criteria:

Matric/O-level : 10%

Intermediate/A-level: 40%

Entry Test Score: 50%</td></tr>
<tr><td>20</td><td>Additional/Different Examination Requirement

(Indicate if there will be any examination requirement, additional to or different from the BU Academic Rules or Examination Policy in vogue).</td></tr>
<tr><td>21</td><td>Number of Admissions Expected for First Intake: 45 admissions for first intake.</td></tr>
<tr><td>22</td><td>Number of Admissions Planned/Expected for Subsequent Intakes: 45 admissions per intake.</td></tr>
</table>

23	**Referred by:** *(delete which is inapplicable)*
24	**Complete Plan of Studies, inclusive of complete Roadmap:** Complete plan for BS Artificial Intelligence Program is attached with this document for reference (Annex – A).
25	**Course Outlines, Descriptions, Pre-Requisites & Readings (Compulsory & Recommended)** Course outlines for BS Artificial Intelligence Program are attached with this document for reference (Annex – B).

B. FINANCIAL DETAILS

1 **Source of Funding: BU: Fully**

2 **Degree Duration:** 4 years **Annual or Semester System:**

Semester

3 **Expected fee to be charged based on Cost & Benefits Analysis:**

	Students			Fee per student		Total Fee		
Semester	**Fresh**	**Existing**	**Total**	**Fresh**	**Existing**	**Fresh**	**Existing**	**Total**
Spring 2021	45	0	45	116,000	0	5,220,000	0	**5,220,000**
Fall 2021	45	45	90	116,000	80,000	5,220,000	3,600,000	**8,820,000**
Spring 2022	45	90	135	116,000	80,000	5,220,000	7,200,000	**12,420,000**
Fall 2022	45	135	180	116,000	80,000	5,220,000	10,800,000	**16,020,000**
Spring 2023	45	180	225	116,000	80,000	5,220,000	14,400,000	**19,620,000**
Fall 2023	45	225	270	116,000	80,000	5,220,000	18,000,000	**23,220,000**
Spring 2024	45	270	315	116,000	80,000	5,220,000	21,600,000	**26,820,000**
Fall 2024	45	315	360	116,000	80,000	5,220,000	25,200,000	**30,420,000**

*4900 Rs per credit hour and 16.25 credit hours per semester (Total 130 credit hours)

* For first semester: 21K admission fee, 5000 Misc. expenditures, and 10K refundable security fee shall be applicable

4 **Expected Number of students for 1st & 2nd Intakes:** 90 students

5 **Expected Earning from first two Intakes (B5):** Rs. 14,040,000

	Students			Fee per student		Total Fee		
Semester	**Fresh**	**Existing**	**Total**	**Fresh**	**Existing**	**Fresh**	**Existing**	**Total**
Spring 2021	45	0	45	116,000	0	5,220,000	0	**5,220,000**
Fall 2021	45	45	90	116,000	80,000	5,220,000	3,600,000	**8,820,000**

6 **Expected Earnings for the Next Five Years (B6):**

	Students			Fee per student		Total Fee		
Semester	**Fresh**	**Existing**	**Total**	**Fresh**	**Existing**	**Fresh**	**Existing**	**Total**

Spring 2022	45	90	135	116,000	80,000	5,220,000	7,200,000	**12,420,000**
Fall 2022	45	135	180	116,000	80,000	5,220,000	10,800,000	**16,020,000**
Spring 2023	45	180	225	116,000	80,000	5,220,000	14,400,000	**19,620,000**
Fall 2023	45	225	270	116,000	80,000	5,220,000	18,000,000	**23,220,000**
Spring 2024	45	270	315	116,000	80,000	5,220,000	21,600,000	**26,820,000**
Fall 2024	45	315	360	116,000	80,000	5,220,000	25,200,000	**30,420,000**
Spring 2025	45	315	360	116,000	80,000	5,220,000	25,200,000	**30,420,000**
Fall 2025	45	315	360	116,000	80,000	5,220,000	25,200,000	**30,420,000**

Year 1: Rs. 14,040,000

Year 2: Rs. 28,440,000

Year 3: Rs. 42,840,000

Year 4: Rs. 57,240,000

Year 5: Rs. 60,840,000

Total 5 years earnings: Rs. 203,400,000

7 **Total Estimated Salaries of all Additional Human Resources per annum (B7):**

	Posts	**Qualification**		**Per Semester Salary (6 months)**
Semester	**Regular FM**	**PhD**	**MS**	
Spring 2021	4	1	3	2,250,000
Fall 2021	4	1	3	2,250,000
Spring 2022	7	2	5	4,110,000
Fall 2022	7	2	5	4,110,000
Spring 2023	11	2	9	5,670,000
Fall 2023	11	2	9	5,670,000
Spring 2024	14	3	11	7,530,000
Fall 2024	14	3	11	7,530,000

* PhD 180K per month; MS 65K per month

* 40 courses per degree program: 5 courses per semester and 3 per last year

	Year 1: Rs. 4,500,000 **Year 2: Rs. 8,220,000** **Year 3: Rs. 11,340,000** **Year 4: Rs. 15,060,000** **Year 5: Rs. 15,060,000** **Total estimated salaries per annum of HR:** Rs. 15,060,000 (per annum)
8	**Cost of <u>Additional</u> Laboratory Equipment/Tools (B8):** Estimated financial cost is as below: 2 Computing Labs with 50 PCs each: 0.15 Million × 100 = 15 Million PKR 1 System Lab with 50 PCs: 0.20 Million × 50 = 10 Million PKR 1 FYP Lab with 40 PCs: 0.20 Million × 40 = 8 Million PKR 1 GP Lab with 50 PCs: 0.20 Million × 50 = 10 Million PKR 1 AI Lab with 40 HPC Machines: 0.75 Million × 40 = 30 Million PKR 1 DLD Lab: will be shared BS CS program DLD Lab. **Total Estimated Labs Cost in 4 Years: 73 Million** **Year 1: Rs. 7,500,000** **Year 2: Rs. 50,000,000** **Year 3: Rs. 7,500,000** **Year 4: Rs. 8,000,000**
9	**Cost of Additional Classrooms (B9):** N/A
10	**Cost of Additional Books, Subscription & Memberships to on-line Sites/Repositories (B10):** Year 1: Rs. 100,000.00 Year 2: Rs. 100,000.00
11	**Off-Site rental Expenses and Cost of other Fixtures (B11):** N/A
12	**Miscellaneous Expenses required for Starting the Program (B12):** - Advertisement: Rs. 300,000. - Printing & Stationery: Rs. 50,000. - Admin Cost: Nil - Zero visit: Rs. 75,000. Total: Rs. 425,000.

13	**Annual Recurring Expenditures in Subsequent Years (B13):** - Salaries: Rs. 15,060,000 (per annum) - Rentals: Nil - Subscriptions/Memberships: Nil - Advertisements: Rs. 200,000. - Printing & Stationery: Rs. 100,000. - Admin Cost - Accreditation Fee: Rs. 200,000. - Total: Rs. 15,560,000.
14	**Total Cost of the Programme (B14):** [Add B(7) to B(12)] Rs. 12,525,000
15	**Net Cost of the Programme (B15):** [Subtract B(1) from B(14)] Rs. 12,525,000
16	**Net Earnings in First Year (B16:** [Subtract B(15) from B(5)] Rs. 1,515,000

BS Artificial Intelligence - Road Map

Semester 1:

Pre-requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
None	GSC 110	Applied Calculus and Analytical Geometry	3	0	3	16
None	CSC 114	Introduction to Information & Communication Technology	2	0	2	
None	CSL 114	Introduction to Information & Communication Technology Lab	0	1	1	
None	ENG 105	Functional English	3	0	3	
None	CSC 113	Computer Programming	3	0	3	
None	CSL 113	Computer Programming Lab	0	1	1	
None	GSC 221	Discrete Mathematics	3	0	3	

Semester 2:

Pre-requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
None	CEN 120	Digital Logic Design	3	0	3	
None	CEL 120	Digital Logic Design Lab	0	1	1	
CSC 113	CSC 210	Object Oriented Programming	3	0	3	
CSC 113	CSL 210	Object Oriented Programming Lab	0	1	1	
None	CSC 220	Database Management Systems	3	0	3	
None	CSL 220	Database Management Systems Lab	0	1	1	
None	GSC 121	Linear Algebra	3	0	3	
None	GSC 122	Probability and Statistics	3	0	3	

Semester 3:

Pre-requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
ENG 105	HSS 120	Communication Skills	3	0	3	18
GSC 110	GSC 210	Differential Equations	3	0	3	
None	CEN 222	Data Communication and Networking	3	0	3	
None	CEL 222	Data Communication and Networking Lab	0	1	1	
CSC 113	CSC 221	Data Structures and Algorithms	3	0	3	
CSC 113	CSL 221	Data Structures and Algorithms Lab	0	1	1	
CSC 210	AIC 201	Artificial Intelligence	3	0	3	
CSC 210	AIL 201	Artificial Intelligence Lab	0	1	1	

Semester 4:

Pre-requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
CSC 221	CSC 320	Operating Systems	3	0	3	
CSC 221	CSL 320	Operating Systems Lab	0	1	1	
CEN 120	CEN 324	Computer Organization& Assembly Language	3	0	3	
CEN 120	CEL 324	Computer Organization& Assembly Language Lab	0	1	1	
CSC 221	CSC 321	Design and Analysis of Algorithms	3	0	3	
AIC 201	AIC 202	Programming for Artificial Intelligence	2	0	2	17
AIL 202	AIL 202	Programming for Artificial Intelligence Lab	0	1	1	
		AI Elective 1	3	-	3	

Semester 5:

Pre-requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
CEN 222	CSC 407	Information Security	3	0	3	
AIC 202	AIC 203	Knowledge Representation & Reasoning	3	0	3	
AIC 202	AIC 301	Machine Learning	2	0	2	
AIL 202	AIL 301	Machine Learning Lab	0	1	1	
CSC 320	AIC 302	Parallel & Distributed Computing	2	0	2	18
CSL 320	AIL 302	Parallel & Distributed Computing Lab	0	1	1	
		AI Elective 2 (3+0 or 2+1)			3	
		University Elective – I	3	0	3	

Semester 6:

Pre-requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
AIC 202	AIC 303	Artificial Neural Networks	2	0	2	
AIL 202	AIL 303	Artificial Neural Networks Lab	0	1	1	
None	AIC 304	Computer Vision	2	0	2	17
None	AIL 304	Computer Vision Lab	0	1	1	
None	CSC 441	Natural Language Processing	3	0	3	

		AI Elective 3	3	0	3	
None	ISL 101	Islamic Studies/Ethics	2	0	2	
		University Elective – II	3	0	3	

Summer:

Pre-requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
		Internship				

Semester 7:

Pre-requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
NONE	ESC 498	Project – I	0	3	3	
None	SEN 220	Software Engineering	3	0	3	
HSS 120	HSS 320	Technical Writing & presentation skills	3	0	3	
		AI Elective 4 (3+0 or 2+1)	-	-	3	14
None	PAK 101	Pakistan Studies	2	0	2	

Semester 8:

Pre-requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
NONE	ESC 499	Project – II	0	3	3	
None	CSC 307	Professional Practices	3	0	3	
		University Elective – III	3	0	3	
		University Elective – IV	3	0	3	12
		Total Credit Hours				**130**

General Education Courses (19 credit hours)

Pre requisite	Course Code	Course Title	Lec	Lab	CR
None	ENG 105	Functional English	3	0	3
ENG 105	HSS 120	Communication Skills	3	0	3
HSS 120	HSS 320	Technical Writing & presentation skills	3	0	3
None	CSC 307	Professional Practices	3	0	3
None	CSC 114	Introduction to Information & Communication Technology	2	1	3
None	PAK 101	Pakistan Studies	2	0	2
None	ISL 101	Islamic Studies	2	0	2

Mathematics and Science Foundation Courses (12 credit hours)

Pre requisite	Course Code	Course Title	Lec	Lab	CR
None	GSC 110	Applied Calculus & Analytical Geometry	3	0	3
None	GSC 122	Probability & Statistics	3	0	3
None	GSC 121	Linear Algebra	3	0	3
GSC 110	GSC 210	Differential Equations	3	0	3

University Electives (12 credit hours)

Pre requisite	Course Code	Course Title	Lec	Lab	CR
Foreign Language Elective					
None	HSS 459	Foreign Language	3	0	3
Management Science Electives					
None	MGT 111	Principles of Management	3	0	3
None	MKT 110	Principles of Marketing	3	0	3
None	FIN 201	Fundamentals of Finance	3	0	3
None	MGT 242	Organizational Theory & Behaviour	3	0	3
Social Science Electives					
None	HSS 107	Introduction to Psychology	3	0	3
None	HSS 202	Introduction to Sociology	3	0	3
None	HSS 115	Introduction to Media Studies	3	0	3
None	BES 103	Critical Thinking	3	0	3
Economics Electives					
None	HSS 410	Entrepreneurship	3	0	3
None	HSS 411	Engineering economics and management	3	0	3
None	ESCO 520	Economics	3	0	3

Computing Core Courses (39 credit hours)

Pre requisite	Course Code	Course Title	Lec	Lab	CR
None	CSC 113	Computer Programming	3	1	4
CSC 113	CSC 210	Object Oriented Programming	3	1	4
CSC 113	CSC 221	Data Structure & Algorithms	3	1	4
None	GSC 221	Discrete Mathematics	3	0	3
CSC 221	CSC 320	Operating Systems	3	1	4
None	CSC 220	Database Management Systems	3	1	4
None	SEN –220	Software Engineering	3	0	3
None	CEN 222	Data Communication and Networking	3	1	4
CEN 222	CSC 407	Information Security	3	0	3
None	ESC 498	Final Year Project	0	6	6

Computer Science Core Courses (18 credit hours)

Pre requisite	Course Code	Course Title	Lec	Lab	CR
CEN 120	CEN 324	Computer Organization and Assembly Language	3	1	4
GSC 113	CEN 120	Digital Logic Design	3	1	4
CSC 221	CSC 321	Design and Analysis of Algorithms	3	0	3
CSC 320	AIC 302	Parallel & Distributed Computing	2	1	3
CSC 210	AIC 201	Artificial Intelligence	3	1	4

Artificial Intelligence Core Courses (18 credit hours)

Pre requisite	Course Code	Course Title	Lec	Lab	CR
AIC 201	AIC 202	Programming for Artificial Intelligence	2	1	3
AIC 202	AIC 301	Machine Learning	2	1	3
AIC 202	AIC 303	Artificial Neural Networks	2	1	3
AIC 202	AIC 203	Knowledge Representation & Reasoning	3	0	3
None	AIC 304	Computer Vision	2	1	3
None	CSC 441	Natural Language Processing	3	0	3

Artificial Intelligence Electives (12 Credit hours)

Pre-requisite	Course Code	Course Title	Lec	Lab	CR
GSC 122	AIC 305	Advance Statistics	3	0	0
None	CSC 315	Theory of Automata	3	0	0
	CSC 452	Data Mining	3	0	0
	AIC 401	Deep Learning	2	1	3
	AIC 306	Speech Processing	3	0	0
	AIC 402	Reinforcements Learning	3	0	0
	AIC 403	Fuzzy Systems	2	1	3
	AIC 307	Evolutionary Computing	3	0	0
	AIC 308	Agent-based Modelling	3	0	0
CSC 225	SEN 455	Knowledge Based Management System	3	0	0
None	CEN 458	Robotics	3	0	0
None	ITC 411	Cyber Security	3	0	0

Artificial Intelligence

Course Name: Artificial Intelligence

Credit Hours: 4 (3 Theory, 1 Lab)

Pre-requisites: Object Oriented Programming

Course Outline:

An Introduction to Artificial Intelligence and its applications towards Knowledge Based Systems; Introduction to Reasoning and Knowledge Representation, Problem Solving by Searching (Informed searching, Uninformed searching, Heuristics, Local searching, Minmax algorithm, Alpha beta pruning, Game-playing); Case Studies: General Problem Solver, Eliza, Student, Macsyma; Learning from examples; Natural Language Processing; Recent trends in AI and applications of AI algorithms. Lisp & Prolog programming languages will be used to explore and illustrate various issues and techniques in Artificial Intelligence.

Reference Materials:

1. Russell, S. and Norvig, P. “Artificial Intelligence. A Modern Approach”, 3rd ed, Prentice Hall, Inc., 2015.
2. Norvig, P., “Paradigms of Artificial Intelligence Programming: Case studies in Common Lisp”, Morgan Kaufman Publishers, Inc., 1992.
3. Luger, G.F. and Stubblefield, W.A., “AI algorithms, data structures, and idioms in Prolog, Lisp, and Java”, Pearson Addison-Wesley. 2009.

Programming for Artificial Intelligence

Course Name: Programming for Artificial Intelligence

Credit Hours: 3 (2 Theory, 1 Lab)

Pre-requisites: Artificial Intelligence

Course Introduction:

This course aims to introduce standard programming practices and to help develop programming skills necessary for designing and implementing Artificial Intelligence systems. The course introduces a modern state of the art programming language for Artificial Intelligence, and builds up the necessary programming background for the main courses like Knowledge Representation & Reasoning, Machine Learning, Artificial Neural Networks, and Natural Language Processing. This course will help the students of Artificial Intelligence develop the programming acumen and style. The ultimate aim of this course is to help students in using the programming language to solve problems of interest to them.

Reference Materials:

Text Book:

1. Severance, C.R., 2016. “Python for everybody: Exploring data using Python 3.” CreateSpace Independent Publ Platform.
2. Miller, B.N., Ranum, D.L. and Anderson, J., 2019. “Python programming in context.” Jones & Bartlett Pub.
3. McKinney, W., 2012. “Python for data analysis: Data wrangling with Pandas, NumPy, and IPython.” O'Reilly Media, Inc.

Reference Book:

1. Joshi, P., 2017. “Artificial intelligence with python.” Packt Publishing Ltd.
2. Janert, P.K., 2010. “Data analysis with open source tools: a hands-on guide for programmers and data scientists.” O'Reilly Media, Inc.

Machine Learning

Course Name: Machine Learning

Credit Hours: 3 (2 Theory, 1 Lab)

Pre-requisites: Programming for Artificial Intelligence

Course Outline:

Introduction to machine learning; concept learning: General-to-specific ordering of hypotheses, Version spaces Algorithm, Candidate elimination algorithm; Supervised Learning: decision trees, Naive Bayes, Artificial Neural Networks, Support Vector Machines, Overfitting, noisy data, and pruning, Measuring Classifier Accuracy; Linear and Logistic regression; Unsupervised Learning: Hierarchical Aglomerative Clustering. k-means partitional clustering; Self-Organizing Maps (SOM) k-Nearest-neighbor algorithm; Semi-supervised learning with EM using labeled and unlabled data; Reinforcement Learning: Hidden Markov models, Monte Carlo inference Exploration vs. Exploitation Trade-off, Markov Decision Processes; Ensemble Learning: Using committees of multiple hypotheses, bagging, boosting.

Reference Materials:

1. Machine Learning, Tom, M., McGraw Hill, 1997.
2. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, MIT Press, 2012

Artificial Neural Networks

Course Name: Artificial Neural Networks

Credit Hours: 3 (2 Theory, 1 Lab)

Pre-requisites: Programming for Artificial Intelligence

Course Outline:

Introduction and history of neural networks, Basic architecture of neural networks, Perceptron and Adaline (Minimum Error Learning) for classification, Gradient descent (Delta) rule, Hebbian, Neo-Hebbian and Differential Hebbian Learning, Drive Reinforcement Theory, Kohonen Self Organizing Maps, Associative memory, Bi-directional associative memory (BAM), Energy surfaces, The Boltzmann machines, Backpropagation Networks, Feedforward Networks; Introduction to Deep learning and its architecture.

Reference Materials:

1. Neural Network Design, 2nd Edition, Martin T. Hagan, Howard, B. Demuth, Mark Hudson Beale and Orlando De Jesus, Publisher: Martin Hagan; 2 edition (September 1, 2014), ISBN-10: 0971732116.
2. An Introduction to Neural Networks, James A Anderson, Publisher: A Bradford Book (March 16, 1995), ISBN-10: 0262011441
3. Fundamentals of Artificial Neural Networks, Mohammad Hassoun, Publisher: A Bradford Book (January 1, 2003), ISBN-10: 0262514672

Knowledge Representation and Reasoning

Course Name: Knowledge Representation and Reasoning

Credit Hours: 3 (3 Theory)

Pre-requisites: Artificial Intelligence

Course Outline:

Propositional Logic, First-order Logic, Horn Clauses, Description Logic, Reasoning using Description Logic, Forward and Backward Chaining in Inference Engines, Semantic Networks, Ontologies and Ontology Languages, Logical Agents, Planning, Rule-based Knowledge Representation, Reasoning Under Uncertainty, Bayesian Networks Representation, Inference in Bayesian Networks, Fuzzy Logic, Inferene using Fuzzy Rules, Markov Models, Commonsense Reasoning, Explainable AI.

Reference Materials:

1. Stuard Russell and Peter Norvig, Artificial Intelligence: A Modern Approach (3rd Ed.) (2015)
2. David Poole and Alan Mackworth, Artificial Intelligence: Foundations of Computational Agents, 2nd Ed, 2017
3. Ronald Brachman and Hector Levesque. Knowledge Representation and Reasoning, 2004

Computer Vision

Course Name: Computer Vision

Credit Hours: 3 (2 Theory, 1 Lab)

Pre-requisites: Artificial Neural Networks

Course Outline:

Introduction to Computer Vision (Problems faced, History and Modern Advancements). Image Processing, Image filtering, Image pyramids and Fourier transform, Hough transform. Camera models, Setting up a camera model from parameters, Camera looking at a plane, Relationship of plane and horizon line, Rotation about camera center. Concatenation, Decomposition and Estimation of transformation from point correspondences, Points and planes in 2D/3D, Transformations in 2D/3D, Rotations in 2D/3D. Edge detection, corner detection. Feature descriptors and matching (HoG features, SIFT, SURF). Applications of Computer Vision Traditional Methods: Image Stitching: Making a bigger picture from smaller picturesSingle View Geometry: Converting a single image into a 3D model. Applications of CV using Deep Learning: Image Detection (Localization, Historical Techniques, RCNN, FRCNN, YOLO, Retina), Image Segmentation (UNet, SegNet, MaskRCNN), Image Generation (GANN).

Reference Materials:

Text Book:

1. Computer Vision: Algorithms and Applications, by Richard Szeliski.

Reference Book:

2. Multiple View Geometry in Computer Vision, by Richard Hartley and Andrew Zisserman.
3. Computer Vision: A Modern Approach, by David Forsyth and Jean Ponce.
4. Digital Image Processing, by Rafael Gonzalez and Richard Woods.

Advance Statistics

Course Name: Advance Statistics

Credit Hours: 3 (3 Theory)

Pre-requisites: Probability and Statistics

Course Outline:

Introduction to Statistics, Use of Statistics in Data Science, Experimental Design, Statistical Techniques for Forecasting, Interpolation/ Extrapolation, Introduction to Probability, Conditional Probability, Prior and Posterior Probability, Random number generation (RNG), Techniques for RNG, Correlation analysis, Chi Square Dependency tests, Diversity Index, Data Distributions Multivariate Distributions, Error estimation, Confidence Intervals, Linear transformations, Gradient Descent and Coordinate Descent, Likelihood inference, Revision of

linear regression and likelihood inference, Fitting algorithms for nonlinear models and related diagnostics, Generalized linear model; exponential families; variance and link functions, Proportion and binary responses; logistic regression, Count data and Poisson responses; log-linear models, Overdispersion and quasi-likelihood; estimating functions, Mixed models, random effects, generalized additive models and penalized regression; Introduction to SPSS, Probability/ Correlation analysis/ Dependency tests/ Regression in SPSS.

Reference Materials:

1. Probability and Statistics for Computer Scientists, 2nd Edition, Michael Baron.
2. Probability for Computer Scientists, online Edition, David Forsyth
3. Discovering Statistics using SPSS for Windows, Andy Field

Data Mining

Course Name: Data Mining

Credit Hours: 3 (2 Theory, 1 Lab)

Pre-requisites: Probability and Statistics

Course Outline:

Introduction to data mining and basic concepts, Pre-Processing Techniques & Summary Statistics, Association Rule mining using Apriori Algorithm and Frequent Pattern Trees, Introduction to Classification Types, Supervised Classification (Decision trees, Naïve Bae Classification, K-Nearest Neighbors, Support Vector Machines etc.), Unsupervised Classification (K Means, K Median, Hieratical and Divisive Clustering, Kohonan Self Organizing maps), outlier & anomaly detection, Web and Social Network Mining, Data Mining Trends and Research Frontiers. Implementing concepts using Python

Reference Materials:

1. Jiawei Han & Micheline Kamber, Jian Pei (2011). Data Mining: Concepts and Techniques, 3rd Edition.
2. Pang-Ning Tan, Michael Steinbach, and Vipin Kumar (2005). Introduction to Data Mining.
3. Charu C. Aggarwal (2015). Data Mining: The Textbook
4. D. Hand, H. Mannila, P. Smyth (2001). Principles of Data Mining. MIT Press

Deep Learning

Course Name: Deep Learning

Credit Hours: 3 (3 Theory)

Pre-requisites: Artificial Neural Networks

Course Outline:

Basics of deep learning, learning networks, Shallow vs. Deep learning etc.; Machine learning theory –training and test sets, evaluation, etc. Theory of Generalization; Multi-layer perceptrons, error back-propagation; Deep convolutional networks, Computational complexity of feed forward and deep convolutional neural networks; Unsupervised deep learning including auto-encoders; Deep belief networks; Restricted Boltzman Machines; Deep Recurrent Neural Networks (BPTT, LSTM, etc.); GPU programming for deep learning CuDNN; Generative adversarial networks (GANs); Sparse coding and auto-encoders; Data augmentation, elastic distortions, data normalization; Mitigating overfitting with dropout, batch normalization, dropconnect; Novel architectures, ResNet, GoogleNet, etc

Reference Materials:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville (http://www.deeplearningbook.org/)
2. Deep learning with python by Francoise Chollet, ISBN-10: 9781617294433, 2017

Parallel and Distributed Computing

Credit Hours: 3 (3 Theory)

Pre-requisites: Operating Systems

Course Outline:

Asynchronous/synchronous computation/communication, concurrency control, fault tolerance, GPU architecture and programming, heterogeneity, interconnection topologies, load balancing, memory consistency model, memory hierarchies, Message passing interface

(MPI), MIMD/SIMD, multithreaded programming, parallel algorithms & architectures, parallel I/O, performance analysis and tuning, power, programming models (data parallel, task parallel, process-centric, shared/distributed memory), scalability and performance studies, scheduling, storage systems, synchronization, and tools (Cuda, Swift, Globus, Condor, Amazon AWS, OpenStack, Cilk, gdb, threads, MPICH, OpenMP, Hadoop, FUSE).

Reference Materials:

1. Distributed Systems: Principles and Paradigms, A. S. Tanenbaum and M. V. Steen, Prentice Hall, 2nd Edition, 2007
2. Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet, K Hwang, J Dongarra and GC. C. Fox, Elsevier, 1st Ed.

Pre-Requisite Courses for Elective Courses in BS(CS) and BS(IT) Programs

Course Code	Course Title	HEC/NCEAC Curriculum Pre-requisite Course	Recommended Pre-requisite Course Code	Recommended Pre-requisite Course Title
CSC 484	Content Management	NONE	NONE	NONE
CSL 484	Content Management Lab	NONE	NONE	NONE
SEN 422	Semantic Computing	NONE	NONE	NONE
SEN 421	Semantic Web	NONE	NONE	NONE
CSC 466	Introduction to Biometrics	NONE	NONE	NONE
CSL 466	Introduction to Biometrics Lab	NONE	NONE	NONE
SEN 455	Knowledge Based Management System	NONE	NONE	NONE
CSC 458	Management Information System	NONE	NONE	NONE
CEN 321	Microprocessor & Interfacing	-	CEN 120	Digital Logic Design
CEL 321	Microprocessor & Interfacing Lab	-	CEL 120	Digital Logic Design Lab
SEN 493	Multimedia Systems	NONE	NONE	NONE
SEL 493	Multimedia Systems Lab	NONE	NONE	NONE
CSC 449	Neural Networks& Fuzzy Logic	NONE	CSC 411	Artificial Intelligence
CEN 458	Robotics	NONE	NONE	NONE
CEL 458	Robotics Lab	NONE	NONE	NONE
ITC 457	Knowledge Management System & Technologies	NONE	NONE	NONE
SEN 427	Information Systems Auditing and Assurance	NONE	NONE	NONE

CSC 456	Distributed Computing	Operating Systems	CSC 320	Operating Systems
CSL 456	Distributed Computing Lab	Operating Systems	CSL 320	Operating Systems Lab
CEN 444	Digital Image Processing	NONE	NONE	NONE
CEL 444	Digital Image Processing Lab	NONE	NONE	NONE
CSC 486	Geographical Information System	NONE	NONE	NONE
CSL 486	Geographical Information System Lab	NONE	NONE	NONE
CSC 441	Natural Language Processing	NONE	CSC 411	Artificial Intelligence
SEN 310	Web Engineering	-	NONE	NONE
SEL 310	Web Engineering Lab	-	NONE	NONE
CSC 452	Data Mining	Database Management Systems	CSC 220	Database Management Systems
CSC 454	Data Warehousing	Database Management Systems	CSC 220	Database Management Systems
CSC 411	Artificial Intelligence	Discrete Structures	GSC 221	Discrete Mathematics
CEN 451	Data Encryption and Security	NONE	NONE	NONE
SEN 456	Usability Engineering	NONE	NONE	NONE

MARITIME TECHNOLOGIES

Course Code: MTE 101
(IDEE Elective)

Credit Hours: 2 + 0

Objectives:

The aim of this course is to provide a working knowledge of the principles, practice and management of present and future technologies in shipping industry.

Course Outline:

This course will discuss the fundamental engineering and related technologies relating to communications, power generation, propulsion, sea keeping, structures & ship systems that underpin the maritime industries.

Following area will be covered through this course:

Appreciation of Marine Machinery Systems; Materials; Casting, Welding, Non-destructive examination and measurement methods; Stress, Strain and Structural Analysis; Thermodynamic and Fluid Mechanics; Fuel, Combustion, Emissions and Environmental Considerations; Diesel Engines; Ship and Machinery Vibration and Noise; Ship Strength, Stability and Sea keeping; Ship Resistance and Propulsion; Ship Service Analysis; Energy Management; Electrical and Control Engineering; Condition Monitoring; Electronic Charting; Investigation and Failure Case Studies.

Recommended Books:

- Ehlers, S., Asbjornslett, B.E., Rodseth, O.J. and Berg, T.E. eds., 2014. Maritime-port technology and development. Crc Press.
- Benford, H., 1991. Naval Architecture for Non-Naval Architects. Society of Naval Architects & Marine Engineer.
- Soares, C.G., Garbatov, Y., Sutulo, S. and Santos, T.A., 2012. Maritime Engineering and Technology. CRC Press.
- Wijnolst, N., Wergeland, T., 2008. Shipping Innovation. Delft University Press

Elaboration of Mapping of Computer Science Department Vision and Mission

Vision

To become a center of excellence in Computer Science education with a strong research and teaching environment that responds swiftly to the challenges of the 21st century.

Mission

To provide quality education in both the theoretical and applied foundations of computer science and information technology in order to equip our students with necessary skills to contribute effectively in enhancing the nation's technological development to come at par with the global standards