Minutes of the 15th Meeting of
Faculty Board of Studies (FBoS) Engineering Sciences

Contents

Minutes of the 15th Meeting of the Faculty Board of Studies Engineering Sciences held on 19th March 2018 by VLC

Attendance:

BUIC

Present

1.	Prof. Dr. Muhammad Najam ul Islam	Dean ES	Chair
2.	Prof. Dr. Tehseen Ullah Khan	HOD(E&ES)	Member
3.	Associate Prof. Dr. Atif Raza Jafri	HOD(EE)	Member
4.	Associate Prof. Dr. Faisal Bashir	HOD(CS)	Member
5.	Associate Prof. Dr. Awais Majeed	HOD(SE)	Member
6.	Associate Prof. Dr. Amina Jameel	HOD(CE)	Member

BUKC

Present

7.	Prof. Dr. Haroon Rasheed	HOD(EE)	Member
8.	Associate Prof. Dr. Humera Farooq	HOD(CS)	Member
9.	Associate Prof. Dr. Sohaib Ahmed	HOD(C&SE)	Member
10.	Prof. Dr. Nargis Yasmeen	HOD EES	Member

BULC

11.	Asstt Prof. Mr Farhan Saeed Sherazi	HOD(CS&IT)	Member

In Attendance

12.	Prof. Dr. Muhammad Zafar	E&ES	BUIC
13.	Dr. Saleem Aslam	EE	BUIC

Proceedings

Preliminaries

1. The 15th Faculty Board of Studies, Engineering Sciences meeting took place on 19th March, 2018, with the quorum complete; the proceedings commenced at 12:00 hrs, with recitation from the Holy Quran.
2. The meeting was called by the chair to consider the revised roadmaps updated by HEC and the pressing requirements of EES department – BUKC to revise BS-GeoPhysics and BS-ES roadmaps.

New Items:

Item 1501: Revision of BS Computer Science roadmap

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

Summary of the Case

Revision of the Curriculum is continuous process, the Curriculum Division of HEC undertakes the revision of curricula after every three years through respective National Curriculum Revision Committees (NCRCs). The revised curricula of BS(CS) has been issued by HEC. Dean (ES) constituted the following inter-campus committee in February 2018 to review and update the BS(CS) roadmap:

i. Dr. Faisal Bashir – HOD, CS, IC – Chair
ii. Dr. Asim Qureshi – AsP, CS, LC
iii. Dr. Bilal Hameed – Sr. AP, CS, KC
iv. Ms. Siama Jawad – Cluster Head, CS, IC
v. Mr. Tahir Iqbal – Cluster Head, CS, LC
vi. Mr. M. Tariq Siddique – Cluster Head, CS, KC

The committee presented its recommendations, which were deliberated by the house in detail. With minor changes, the recommendations were approved inline with NCRC's revised roadmap.
The revised roadmap of BS(CS) program is attached Annex CS-Roadmap for implementation w.e.f. Fall 2018 intake.

Decision 1501
The agenda item is approved and forwarded to ACM for consideration.

Item 1502: Revision of BS Information Technology roadmap

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

Summary of the Case

Revision of the Curriculum is continuous process; the Curriculum Division of HEC undertakes the revision of curricula after every three years through respective National Curriculum Revision Committees (NCRCs). The revised curriculum of BS Information Technology has been issued by HEC. Dean (ES) constituted the following inter-campus committee to review and update the BS(IT) roadmap in February 2018:

i. Dr. Humera Farooq – HOD, CS, KC – Chair
ii. Mr. Farhan Sherazi – HOD, CS, LC
iii. Dr. Shagufta Henna – Sr. AP, CS, IC
iv. Dr. Asfand-e-Yar – Cluster Head (IT), IC
v. Dr. Abdul Hafeez – Cluster Head (IT), LC
vi. Ms. Aisha Danish – Cluster Head (IT), KC

Discussion

The committee presented its recommendations, which were deliberated by the house in detail. With minor changes, the recommendations were approved inline with NCRC's revised roadmap.
The revised roadmap of BS(IT) program attached at Annex IT-Roadmap for implementation w.e.f. Fall 2018 intake.

Decision 1502

The agenda item is approved and forwarded to ACM for consideration.

Item 1503: Revision of BSE roadmap

Sponsor: HOD(SE)BUIC & BUKC | Referral Authority: Inter-Campus Committee

Summary of the Case

Revision of curriculum is a continuous process. The Curriculum Division of HEC undertakes the revision of curricula after every three years through respective National Curriculum Revision Committees (NCRCs). The revised curricula of BS (Software Engineering) has been issued by HEC. Dean (ES) constituted an inter-campus committee to review and update the BSE roadmap in February 2018. The committee comprised of the following members:

i. Dr. Awais Majeed - HoD, SE-IC
ii. Dr. Sohaib Ahmed - HoD, SE-KC
iii. Dr. Shahid Nazir Bhatti - AsP, SE-IC
iv. Dr. Osama Rehman - Sr. AP, SE-KC
v. Dr. Raja M. Suleman - Sr. AP, SE-IC

After, due consideration and deliberation the committee has revised the roadmap of BSE program offered at BU in accordance with HEC guidelines. Most significant changes include:

1. Alignment of roadmap (semester wise course offering) as per HEC guidelines
2. Addition of courses in computing and software engineering core courses.
3. Addition of courses in Software Engineering electives
4. Addition and enhancement of lab component in Software Engineering electives as per PEC's observations in the recent re-accreditation visit of BSE program at BUKC.

Discussion

It is recommended that revised roadmap of BSE program attached at Annex BSE-Roadmap may be considered for implementation from Fall 2018 intake.

Decision 1503

The house forwarded the item to ACM for approval.

Item 1504: Duration of Final Exam for Engineering & Computer Sciences Department Undergrad Programs

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

Summary of the Case

- In Engineering Sciences (Engineering & Computer Sciecnes), the weightage of midterm exam is 20% and final exam is 50% while the durations are 1.5 hours and 2 hours respectively. In final exam, merely extra half an hour is provided to students for additional 30% weightage as compared to midterm.

- This segregation is irrational and faculty & students most of the time cannot include / attempt the full paper due to shortage of time. The faculty has to set lengthy paper of 50 marks due to unbalanced marks division or time distribution.

- The distribution and duration of the exams is key aspect for academic evaluation of the program. This is further emphasized in the Outcome Based Education (OBE) that has been adopted by BU – Engineering Programs.

Discussion:
The house recommended that the duration of undergrad final exams in the engineering & computer sciences departments (BS-CS, BS-IT, BCE, BEE, BSE) may be changed to 2.5 hours (150 minutes) w.e.f. Fall'2018.
The duration of final exams for the undergrad programs run by department of Earth & Environmental Sciences shall remain the same i.e. 2 hours for 40% weightage.

Decision 1504:
The agenda item is recommended and forwarded to ACM for approval.

Item 1505: Revised roadmaps of BS-GeoPhysics, BS-Env Sciences

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

Summary of the Case

- The department of Earth & Environmental Sciences at BUKC was established in 2008 and has been offering BS-Geo Physics, BS-Geology and BS-Environment Sciences along with MS-Geo Physics, MS-Geology, MS-Environmental Sciences and PhD-Geo Physics & PhD-Environmental Sciences till Spring'2017.
- The BU management froze the BS-Geology and BS-ES & all PG programs (both MS and PhD Programs) w.e.f. Fall'17 admissions due to low intake.
- The department is currently offering BS-Geo Physics only for admissions and that didn't result in desired admissions in Fall'17.
- DG-BUKC asked the department and Dean-ES to study the feasibility of offering different programs in the department. The following was found in the study:
    - The department has specialist faculty members in all three sub-domain: Env Sciences, Geology and Geo-Physics.
    - Environmental Sciences is an emerging trend at national level and the students are interested to pursue the program at BS and MS level.
    - The curriculums of BS-Geo Physics and BS-Environmental Sciences have commonalities of about 50% (21 common courses out of total 45 in the existing roadmaps of BU). The roadmaps can be re-worked to align the common courses (semester-wise) in both the programs.
    - The campus should advertise all programs to attract maximum number of applicants, but should offer BS-Geo Physics and BS-Environmental Sciences at undergrad level.
    - The department has world class Geo-Physics Lab and is also running Environmental Research Centre (ERC) successfully with external projects being conducted at BUKC. The research centers and labs are the essential ingredients of PG programs, therefore the university should defreeze MS-Env Sciences & MS-Geo-Physics.
- In view of the above, the following was submitted to the house:
    - All BS (Geo-Physics, Geology, Env Sciences) and MS (Geo-Physics, Env Sciences) programs should be advertised.
    - BS-Geo-Physics and BS-Environmental Sciences (majority combined classes with re-worked roadmaps) should be offered w.e.f. Fall'18.
    - MS-Programs should only be offered subject to minimum strength as per BU rules.
    - The curriculum of BS-Geo-Physics & BS-Environmental should be re-worked and aligned by the departments at Karachi and Islamabad Campus.

Discussion
The EES – BUKC presented the revised roadmap for BS-GeoPhysics and BS-ES attached as appendage 1505. The EES departments at Islamabad campus partially agreed to the recommendations and suggested further revision in roadmaps.
Dean-ES suggested to include the elective courses in both the roadmaps as per academic norm across globe that in turn shall enhance the flexibility both for students and the department. He also

suggested aligning the social sciences, management sciences and natural sciences courses as much as possible in both the roadmaps.

Decision 1505

The following committee was constituted to review and prepare revised roadmaps of BS-Geo physics and BS Environmental Sciences to be presented in upcoming ACM.

i. Prof. Dr. M. Najam ul Islam (Dean ES)
ii. Prof. Dr. Tehseen Ullah Khan (HoD EES BUIC)
iii. Prof. Dr. Muhammad Zafar (FM EES BUIC)
iv. Prof. Dr. Nargis Yasmeen (HoD EES BUKC)

Closing the Meeting

There being no further points, the Chair brought the meeting to close at about 17:15 hrs, thanking the participants for their wholehearted participation.

Prof. Dr. M. Najam-ul-Islam
Dean (ES), Head FBoS
02 April, 2018

Distribution:

BUHQ:	Rector, Pro-Rector, Registrar 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:

Annex CS-Roadmap

BS (Computer Science) Road Map
Proposed for Fall 2018 & onwards

Semester 1:

Pre requisite	Course	Course Title	Lec	Lab	CR	CR/Sem
None	GSC-110	Applied Calculus and Analytical Geometry	3	0	3	16
None	CSC-110	Introduction to Information & Communication Technology	2	0	2	
None	CSL-110	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 – 114	Applied Physics	2	0	2	
None	GSL – 114	Applied Physics Lab	0	1	1	

Semester 2:

Pre requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
		Foreign Language Elective (University Elective-1)	3	0	3	17
ENG – 105	HSS – 120	Communication Skills	3	0	3	
CSC-113	CSC-210	Object Oriented Programming	3	0	3	
CSC-113	CSL-210	Object Oriented Programming Lab	0	1	1	
GSC-113	CEN-120	Digital Logic Design	3	0	3	
GSCL-113	CEL-120	Digital Logic Design Lab	0	1	1	
None	GSC-221	Discrete Mathematics	3	0	3	

Semester 3:

Pre requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
None	GSC-122	Probability and Statistics	3	0	3	17
GSC-110	GSC-211	Multivariable Calculus	3	0	3	
CEN-120	CEN-324	Computer Organization& Assembly Language	3	0	3	
CEN-120	CEL-324	Computer Organization& Assembly Language 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	

None	CSC-307	Professional Practices	3	0	3	

Semester 4:

Pre requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
		Social Science Elective (University Elective-II)	3	0	3	17
None	CSC-220	Database Management Systems	3	0	3	
None	CSL-220	Database Management Systems Lab	0	1	1	
None	CEN – 222	Data Communication and Networking	3	0	3	
None	CEL – 222	Data Communication and Networking Lab	0	1	1	
NONE	CSC-315	Theory of Automata	3	0	3	
GSC-110	GSC-210	Differential Equations	3	0	3	

Semester 5:

Pre requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
CSC-221	CSC-320	Operating Systems	3	0	3	18
CSC-221	CSL-320	Operating Systems Lab	0	1	1	
None	SEN-220	Software Engineering	3	0	3	
CSC-315	CSC-323	Compiler Construction	2	0	2	
CSC-315	CSL-323	Compiler Construction Lab	0	1	1	
CSC-221	CSC-321	Design and Analysis of Algorithms	3	0	3	
None	GSC-121	Linear Algebra	3	0	3	
None	ISL-101	Islamic Studies	2	0	2	

Semester 6:

Pre requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
CSC-210	CSC-325	Artificial Intelligence	3	0	3	16
CSC-210	CSL-325	Artificial Intelligence Lab	0	1	1	
GSC-210	GSC 320	Numerical Analysis	3	0	3	
HSS – 120	HSS – 320	Technical Writing & presentation skills	3	0	3	
		Elective-1 (3+0 or 2+1)	-	-	3	
		Elective-2 (3+0 or 2+1)	-	-	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	17
CSC-320	CEN-455	Parallel & Distributed Computing	3	0	3	
None	PAK-101	Pakistan Studies	2	0	2	
		Management Science Elective (University Elective-3	3	0	3	
		Elective-3 (3+0 or 2+1)	-	-	3	
		Elective-4 (3+0 or 2+1)	-	-	3	

Semester 8:

Pre requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
NONE	ESC-499	Project-II	0	3	3	15
CEN – 222	CSC-407	Information Security	3	0	3	
		Economics Elective (University	3	0	3	
		Elective-5 (3+0 or 2+1)	-	-	3	
		Elective-6 (3+0 or 2+1)	-	-	3	
		Total Credit Hours				**133**

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

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 – 110	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
None	GSC – 114	Applied Physics	2	1	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 & Behavior	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

Computer Science Core Courses (24 credit hours)

Pre-requisite	Course Code	Course Title	Lec	Lab	CR
CSC-315	CSC-323	Compiler Construction	2	1	3
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	CEN-455	Parallel & Distributed Computing	3	0	3
CSC-210	CSC-325	Artificial Intelligence	3	1	4
None	CSC-315	Theory of Automata	3	0	3

Computer Science Support Courses (09 credit hours)

Pre-requisite	Course Code	Course Title	Lec	Lab	CR
GSC-110	GSC-210	Differential Equations	3	0	3
GSC-110	GSC-211	Multivariable Calculus	3	0	3
GSC-210	GSC-320	Numerical Analysis	3	0	3

Computer Science - List of Electives (18 Credit hours)

Pre-requisite	Course code	Course Title	Lec	Lab	CR
CSC-220	CSC-468	Advanced Databases	2	0	2
CSC-220	CSL-468	Advanced Databases Lab	0	1	1
CSC-321	CSC-521	Advanced Design and Analysis of Algorithm	3	0	3
CSC-220	CSC-488	Big Data Analytics	2	0	2
CSC-220	CSL-488	Big Data Analytics Lab	0	1	1
CSC-210	CSC-459	Client Server Programming	2	0	2
CSC-210	CSL-459	Client Server Programming Lab	0	1	1
CSC-210	CSC-444	Computer Graphics	2	0	2
CSC-210	CSL-444	Computer Graphics Lab	0	1	1
SEN-310	CSC-484	Content Management	2	0	2
SEN-310	CSL-484	Content Management Lab	0	1	1
CEN-222	CEN-451	Data Encryption and Security	3	0	3
CSC-220	CSC-452	Data Mining	3	0	3
CSC-220	CSC-454	Data Warehousing	3	0	3
CSC-210	CEN-444	Digital Image Processing	2	0	2
CSC-210	CEL-444	Digital Image Processing Lab	0	1	1
EEN-313	EEN-325	Digital Signal Processing	2	0	2
EEN-313	EEL-325	Digital Signal Processing Lab	0	1	1
CSC-313	CSC-319	Game Development and Design	2	0	2
CSC-313	CSL-319	Game Development and Design Lab	0	1	1
CSC-221	CSC-486	Geographical Information System	2	0	2
CSC-221	CSC-486	Geographical Information System Lab	0	1	1
SEN-220	SEN-320	Human Computer Interaction	2	0	2
SEN-220	SEL-320	Human Computer Interaction Lab	0	1	1
CSC-325	CSC-466	Introduction to Biometrics	2	0	2
CSC-325	CSL-466	Introduction to Biometrics Lab	0	1	1
CSC-220	CSC-342	Introduction to Cloud Computing	3	0	3
CSC-220	CSC-487	Introduction to Data Science	2	0	2
CSC-220	CSL-487	Introduction to Data Science Lab	0	1	1
CSC-325	SEN-455	Knowledge Based Management System	3	0	3

SEN-213	CSC-458	Management Information System	3	0	3
CEN-221	CEN-321	Microprocessor & Interfacing	2	0	2
CEN-221	CEL-321	Microprocessor & Interfacing Lab	0	1	1
CSC-210	CSC-341	Mobile Application Development	2	0	2
CSC-210	CSL-341	Mobile Application Development Lab	1	0	1
CSC-444	SEN-493	Multimedia Systems	2	0	2
CSC-444	SEL-493	Multimedia Systems Lab	0	1	1
CSC-325	CSC-441	Natural Language Processing	3	0	3
CSC-325	CSC-449	Neural Networks& Fuzzy Logic	3	0	3
NONE	GSC-445	Operations Research	3	0	3
CSC-320	CEN-453	Real Time System	3	0	3
CSC-325	CEN-458	Robotics	2	0	2
CSC-325	CEL-458	Robotics Lab	0	1	1
SEN-310	SEN-422	Semantic Computing	3	0	3
SEN-310	SEN-421	Semantic Web	3	0	3
GSC-210	EEN-313	Signals and Systems	2	0	2
GSC-210	EEL-313	Signals and Systems Lab	0	1	1
GSC-121	CEN-450	Simulation and Modeling	2	0	2
GSC-121	CEL-450	Simulation and Modeling Lab	0	1	1
SEN-220	SEN-457	Software Design and Architecture	2	0	2
SEN-220	SEL-457	Software Design and Architecture Lab	0	1	1
SEN-220	SEN-458	Software Requirement Engineering	3	0	3
SEN-220	SEN-410	Software Project Management	3	0	3
SEN-220	SEN-420	Software Quality Assurance	3	0	3
SEN-220	SEN-447	Software Testing	3	0	3
CSC-323	CSC-451	Theory of Programming Languages	3	0	3
SEN-320	SEN-456	Usability Engineering	3	0	3
CEN-222	CSC-489	Ubiquitous Computing	3	0	3
CSC-210	CSC-313	Visual Programming	2	0	2
CSC-210	CSL-313	Visual Programming Lab	0	1	1
CSC-113	SEN-310	Web Engineering	2	0	2
CSC-113	SEL-310	Web Engineering Lab	0	1	1

Course Description

Course Title: **Applied Physics**
Course Code: **GSC-113**
Pre-Requisite: **None**
Content: Electric force and its applications and related problems, conservation of charge, charge quantization, Electric fields due to point charge and lines of force. Ring of charge, Disk of charge, A point charge in an electric field, Dipole in a n electric field, The flux of vector field, The flux of electric field, Gauss' Law, Application of Gauss' Law, Spherically symmetric charge distribution, A charge isolated conductor, Electric potential energy, Electric potentials, Calculating the potential from the field and related problem Potential due to point and continuous charge distribution, Potential due to dipole, equipotential surfaces, Calculating the field from the potential ,Electric current, Current density, Resistance, Resistivity and conductivity, Ohm's law and its applications, The Hall effect, The magnetic force on a current, The Biot- Savart law, Line of B, Two parallel conductors, Amperes' s Law, Solenoid, Toroids, Faraday's experiments, Faraday's Law of Induction, Lenz's law, Motional emf, Induced electric field, Induced electric fields, The basic equation of electromagnetism, Induced Magnetic field, The displacement current, Reflection and Refraction of light waves, Total internal reflection, Two source interference, Double Slit interference, related problems, Interference from thin films, Diffraction and the wave theory, related problems, Single-Slit Diffraction, related problems, Polarization of electromagnetic waves, Polarizing sheets, related problems.

Books:
Fundamentals of Physics (Extended), 10th edition, Resnick and Walker
Narciso Garcia, Arthur Damask, Steven Schwarz., "Physics for Computer Science Students", Springer Verlag, 1998

Annex IT-Roadmap

Bahria University
BS Information Technology Road Map
Proposed for Fall 2018 & onwards

Eligibility Criteria:
The minimum requirements for admission in a BSIT are at least 50% marks in Intermediate (HSSC) examination with Mathematics or equivalent qualification with Mathematics certified by IBCC.

Semester 1

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

Semester 2

Pre-requisite	Course Code	Course Title	Lec	Lab	CR	CR/Sem
CSC – 113	CSC – 210	Object Oriented Programming	3	0	3	

CSC – 113	CSL – 210	Object Oriented Programming Lab	0	1	1	
ENG – 105	HSS – 120	Communication Skills	3	0	3	
None	GSC – 221	Discrete Mathematics	3	0	3	16
		Foreign Language Elective (University Elective-1)	3	0	3	
GSC – 114	CEN – 122	Digital Design	2	0	2	
GSC – 114	CEL – 122	Digital Design Lab	0	1	1	

Semester 3

Pre-requisite	Course Code	Course Title	Lec	Lab	CR	CR/Sem
CSC – 113	CSC – 221	Data Structures & Algorithms	3	0	3	
CSC – 113	CSL – 221	Data Structure & Algorithms Lab	0	1	1	
None	CEN – 222	Data Communication and Networking	3	0	3	
None	CEL – 222	Data Communication and Networking	0	1	1	17
None	CSC – 307	Professional Practices	3	0	3	
None	GSC – 121	Linear Algebra	3	0	3	
None	GSC – 122	Probability & Statistics	3	0	3	

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	
None	CSC – 407	Information Security	3	0	3	17
None	CSC - 220	Database Management Systems	3	0	3	
None	CSL - 220	Database Management Systems Lab	0	1	1	
None	SEN –220	Software Engineering	3	0	3	
		Social Science Elective (University Elective-2)	3	0	3	

Semester 5

Pre-requisite	Course Code	Course Title	Lec	Lab	CR	CR/Sem
SEN-220	ITC – 311	IT Project Management	3	0	3	16
CEN – 222	ITC – 312	System and Network Administration	3	0	3	
CEN – 222	ITL – 312	System and Network Administration Lab	0	1	1	
None	ITC-226	Web Systems & Technologies	2	0	2	
None	ITL-226	Web Systems & Technologies	0	1	1	
SEN -220	SEN-458	Software Requirement Engineering	3	0	3	
		Economics Elective (University Elective-3)	3	0	3	

Semester 6

Pre-requisite	Course Code	Course Title	Lec	Lab	CR	CR/Sem
CSC-220	ITC-321	Enterprise Systems	3	0	3	
None	ITC-324	IT Infrastructure	3	0	3	
HSS – 120	HSS – 320	Technical Writing & presentation skills	3	0	3	18
		Management Science Elective (University Elective-4)	3	0	3	
		Elective 1 (3+0 or 2+1)	-	-	3	
		Elective 2 (3+0 or 2+1)	-	-	3	

Summer:

Pre-requisite	Course code	Course Title	Lec	Lab	CR	CR/Sem
		Internship	0	0	0	0

Semester 7

Pre-requisite	Course Code	Course Title	Lec	Lab	CR	CR/Sem
CEN – 222	ITC-411	Cyber Security	3	0	3	18
None	PAK-101	Pakistan Studies	2	0	2	
CSC-220	ITC – 424	Database Administration and Management	3	0	3	
CSC – 220	ITC – 424	Database Administration and Management Lab		1	1	
None	ESC-498	Project – I	0	3	3	
		Elective 3 (3+0 or 2+1)	-	-	3	
		Elective 4 (3+0 or 2+1)	-	-	3	

Semester 8

Pre-requisite	Course Code	Course Title	Lec	Lab	CR	CR/Sem
None	ESC-499	Project – II	0	3	3	15
CSC – 320	ITC – 422	Virtual Systems and Services	3	0	3	
CSC – 320	ITL – 422	Virtual Systems and Services Lab	0	1	1	
None	ISL-101	Islamic Studies	2	0	2	
		Elective 5 (3+0 or 2+1)	-	-	3	
		Elective 6 (3+0 or 2+1)	-	-	3	

Total Credit Hours: 133

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	EEN – 434	Computer Networks	3	1	4
EEN-434	CSC – 407	Information Security	3	0	3
None	ESC-498	Final Year Project	0	6	6

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 – 110	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
None	GSC – 114	Applied Physics	2	1	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 & Behavior	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

IT Core Courses (24 credit hours)

Pre-requisite	Course Code	Course Title	Lec	Lab	CR
CEN – 222	ITC-411	Cyber Security	3	0	3
CSC – 220	ITC – 424	Database Administration and Management	3	1	4
SEN – 220	ITC-311	Information Technology Project Management	3	0	3
None	ITC-324	Information Technology Infrastructure	3	0	3
CEN – 222	ITC – 312	System and Network Administration	3	1	4
CSC – 320	ITC-422	Virtual Systems and Services	3	1	4
None	ITC-226	Web System and Technologies	2	1	3

IT Support Courses (09 credit hours)

Pre-requisite	Course Code	Course Title	Lec	Lab	CR
CSC-220	ITC-321	Enterprise Systems	3	0	3
GSC – 114	CEN – 122	Digital Design	2	1	3
SEN -220	SEN-458	Software Requirement Engineering	3	0	3

List of Information Technology Elective Courses (18 credit hours)

Pre-requisite	**Course code**	**Course Title**	**Lec**	**Lab**	**CR**
CSC – 210	CSC – 313	Visual Programming	2	0	2
CSC – 210	CSCL – 313	Visual Programming Lab	0	1	1

ITC – 226	ITB-471	E-Commerce	3	0	3
ITC – 311	ITC-525	Business Processing Re-engineering	3	0	3
ITC – 321	ITC-457	Knowledge Management System & Technologies	3	0	3
CSC – 220	CSC-487	Introduction to Data Science	2	0	2
CSC – 220	CSL-487	Introduction to Data Science Lab	0	1	1
CSC-220	CSC-452	Data Mining	3	0	3
CSC-220	CSC-454	Data Warehousing	3	0	3
CSC-210	CSC-411	Artificial Intelligence	2	0	2
CSC-210	CSL-411	Artificial Intelligence lab	0	1	1
SEN-310	SEN-421	Semantic Web	3	0	3
CSC-310	CSC-456	Distributed Computing	2	0	2
CSC-310	CSL-456	Distributed Computing Lab	0	1	1
CSC-221	CSC-486	Geographical Information System	2	0	2
CSC-221	CSC-486	Geographical Information System Lab	0	1	1
CSC-210	CSC-342	Parallel Programming	2	0	2
CSC-210	CSL-342	Parallel Programming lab	0	1	1
SEN-220	SEN-411	Software Testing	3	0	3
CSC-210	CSC-459	Client Server Programming	2	0	2
CSC-210	CSL-459	Client Server Programming Lab	0	1	1
CSC-210	CEN-444	Digital Image Processing	2	0	2
CSC-210	CEL-444	Digital Image Processing Lab	0	1	1
CSC-210	CSC-444	Computer Graphics	2	0	2
CSC-210	CSL-444	Computer Graphics Lab	0	1	1
CSC-220	CSC-468	Advanced Databases	2	0	2
CSC-220	CSL-468	Advanced Databases Lab	0	1	1
SEN-320	SEN-456	Usability Engineering	3	0	3
CSC-210	CSC-341	Mobile Application Development	2	0	2
CSC-210	CSL-341	Mobile Application Development Lab	1	0	1
CSC – 220	CSC-426	Business Intelligence and Analytic	3	0	3
ITC – 321	SEN-427	Information Systems Auditing and Assurance	3	0	3
SEN – 220	SEN-428	Service Oriented Architecture	3	0	3
SEN-220	SEN-420	Software Quality Assurance	3	0	3
CEN – 122	CEN-323	Computer Organization & Assembly Language	2	0	2
CEN – 122	CEL-323	Computer Organization & Assembly Language	0	1	1

Course Description

Course Title: **Applied Physics**
Course Code: GSC – 113
Pre-Requisite: None

Content: Electric force and its applications and related problems, conservation of charge, charge quantization, Electric fields due to point charge and lines of force. Ring of charge, Disk of charge, A point charge in an electric field, Dipole in a n electric field, The flux of vector field, The flux of electric field, Gauss' Law, Application of Gauss' Law, Spherically symmetric charge distribution, A charge isolated conductor, Electric potential energy, Electric potentials, Calculating the potential from the field and related problem Potential due to point and continuous charge distribution, Potential due to dipole, equipotential surfaces, Calculating the field from the potential , Electric current, Current density, Resistance, Resistivity and conductivity, Ohm's law and its applications, The Hall effect, The magnetic force on a current, The Biot- Savart law, Line of B, Two parallel conductors, Amperes' s Law, Solenoid, Toroids, Faraday's experiments, Faraday's Law of Induction, Lenz's law, Motional emf, Induced electric field, Induced electric fields, The basic equation of electromagnetism, Induced Magnetic field, The displacement current, Reflection and Refraction of light waves, Total internal reflection, Two source interference, Double Slit interference, related problems, Interference from thin films, Diffraction and the wave theory, related problems, Single-Slit Diffraction, related problems, Polarization of electromagnetic waves, Polarizing sheets, related problems.

Books:

- Fundamentals of Physics Extended, 10th Edition Wiley, 2015
- Narciso Garcia, Arthur Damask, Steven Schwarz., "Physics for Computer Science Students", Springer Verlag, 1998
- Physics for Scientists and Engineers, Technology Update, 9th Edition, 2015

Course Title: **Enterprise Systems**
Course Code: **ITC-321**
Pre-Requisite: Database Management System

Content: Fundamentals of an Enterprise and Industries artifacts. Introduction to Enterprise Resource Planning (ERP). ERP Implementation life cycle methodologies and strategy. Business processes, architecture, User Interface Designs and their modeling. ERP Security, workflows, data integration, applications migration and data migration. Study of business modules Human Resource, Procurement, Sales and Distribution, Material Management, and Manufacturing. Concepts and tools of designing and implementing an ERP system. Emerging trends in ERP and special topics such as Supply Chain Management (SCM), Customer Relationship Management (CRM), Business Intelligence (BI).

Books:

- Design of Enterprise Systems: Theory, Architecture, and Methods By Ronald E. Giachetti CRC Press, 2016, ISBN 1439882894
- Handbook of Research in Enterprise Systems SAGE by Sanjay Kumar, Publications India, 2011, ISBN 8132107616

Course Title: **Information Technology Project Management**
Course Code: **ITC - 311**
Pre-Requisite: Software Engineering
Content: Introduction to Project Management. The Project Management and Information Technology Context. The Project Management Process Groups. Project Integration Management. Project Scope Management. Project Time Management. Project Cost Management. Project Quality Management. Project Human Resource Management. Project Communications Management. Project Risk Management. Project Procurement Management. Project Management Tools
Books:
Information Technology Project Management: Providing Measurable Organizational Value by Jack T. Marchewka, 5th Edition, Wiley, 2016.
Information Technology Project Management by Kathy Schwalbe, 6th Edition, 2010, ISBN-10: 1111221758

Course Title: **Information Technology Infrastructure**
Course Code: **ITC-324**
Pre-Requisite: None
Content: Definition of IT Infrastructure, Non-functional Attributes, Availability Concepts, Sources of Unavailability, Availability Patterns. Performance. Security Concepts. Data centres. Servers: Availability, Performance, Security. Networking: Building Blocks, Availability, Performance, Security. Storage: Availability, Performance, Security. Virtualization: Availability, Performance, Security. Operating Systems: Building Blocks, Implementing Various OSs, OS availability, OS Performance, OS Security. End User Devises: Building Blocks, Device Availability, Performance, Security. IT Infrastructure Management. Service Delivery Processes. Service Support Processes. Ethics, Trends, organizational and technical issues related to IT infrastructure.
Books:

- IT Infrastructure Architecture - Infrastructure Building Blocks and Concepts, Third Edition by Sjaak Laan, 2011, ISBN 1291250794
- IT Architect: Foundation in the Art of Infrastructure Design: A Practical Guide for It Architects, John Yani Arrasjid, 2016

Course Title: **Cyber Security**
Course Code: **ITC-411**
Pre-Requisite: **Data Communication and Networking**

Content: Basic security concepts, Information security terminology, Malware classifications, Types of malware. Server side web applications attacks. Cross-site scripting, SQL Injection, Cross-site request forgery, Planning and policy, Network protocols and service models. Transport layer security, Network layer security, Wireless security, Cloud & IoT security.

Books:

- Cybersecurity for Beginners by Raef Meeuwisse, 2nd Edition, 2017
- Cybersecurity and Cyberwar: What Everyone Needs to Know, by P.W. Singer and Allan Friedman, Oxford University Press, 2014
- Cyber Security and IT Infrastructure Protection by John R. Vacca, Elsevier, 2013

-Course Title: Virtual Systems and Service
Course Code: **ITC-422**
Pre-Requisite: Operating Systems

Content: This course will investigate the current state of virtualization in computing systems. Virtualization at both the hardware and software levels will be examined, with emphasis on the hypervisor configurations of systems such as Vmware, Zen and Hyper-V. The features and limitations of virtual environments will be considered, along with several case studies used to demonstrate the configuration and management of such systems. Para-virtualized software components will be analyzed and their pros and cons discussed. Processor and peripheral support for virtualization will also be examined, with a focus on emerging hardware features and the future of virtualization.

Books:

- Virtualization Essentials by Matthew Portnoy, 2nd Edition, Sybex Publisher, 2016
- Virtual Machines: Versatile Platforms for Systems and Processes, by Jim Smith and Ravi Nair, Morgan Kaufmann Series, 2005

Course Title: **Database Administration and Management**
Course Code: **ITC-327**
Pre-Requisite:

Content: Introduction to advance data models such as object relational, object oriented. File organizations concepts, Transactional processing and Concurrency control techniques, Recovery techniques, Query processing and optimization, Database Programming, Integrity and security, Database Administration, Physical database design and tuning, Distributed database systems, Emerging research trends in database systems.

Books:

- Database Administration: The Complete Guide to DBA Practices and Procedures, by Craig S. Mullins, 2nd Edition, 2012
- Modern Database Management by Jeff Hoffer, Venkataraman Ramesh and Heikki Topi, 12th Edition, 2015

Annex BSE-Roadmap

Bachelor of Software Engineering

(Applicable from Fall 2018 Intake)

Curriculum Revision History

#	Revisions	ACM Approval Date
1	Adjustment of Electives (pre-requisites, adjustment of elective courses semester offering and shifting of courses to different elective categories) Changes applicable from Fall 2017	28th ACM
2	Revision in Domain Electives (addition of new domain of Data Science and adjustment of courses) Changes applicable from Fall 2017	30th ACM
3	Revision of Roadmap in line with HEC's New Curriculum Guidelines (2017) and observations of PEC in recent re-accreditation visits. Most significant changes include: 1. Alignment of roadmap (semester wise course offering) as per HEC guidelines 2. Addition of courses in computing and software engineering core courses. 3. Addition of courses in Software Engineering electives 4. Addition and enhancement of lab component in Software Engineering electives as per PEC's observations.	Presented for Approval in 31st ACM

Bachelor of Software Engineering Program

Vision Statement of the Department

Department of Software Engineering aims to be recognized as a leader in Software Engineering education and research through excellence in modern education and targeted research in emerging areas of Software Engineering.

Program Mission - Bachelor of Software Engineering

The mission of Bachelor of Software Engineering program is to prepare technically strong Software Engineers who can contribute effectively towards the nation, society and the world at large through effective problem solving skills, application of engineering knowledge, leadership and healthy lifelong learning attitude.

Program Educational Objectives

Software Engineering department aims to deliver a strong and coherent Software Engineering program for the development of skilled Software Engineers. The curriculum is inline with PEC and HEC regulations to equip students with latest skills for industry and research activities. Software Engineering graduates should achieve the following educational objectives:

PEO-1: Graduates should demonstrate competence to apply Software Engineering knowledge & practices in various phases of software/system development life cycle in their respective professional career.

PEO-2: Graduates should demonstrate an ability to work as a member and/or leader in a team with a strong sense of societal context, professional ethics and effective communication skills in professional practice.

PEO-3: Graduates should demonstrate sustained learning by pursuing life-long learning through graduate studies, professional development or managerial/leadership skills.

Program Learning Outcomes

PLO 1: Engineering Knowledge: An ability to apply knowledge of computer science, software engineering fundamentals and an engineering specialization to the solution of complex software engineering problems.

PLO 2: Problem Analysis: An ability to identify, formulate, research literature and analyze complex software engineering problems reaching substantiated conclusions using software engineering principles, natural sciences and engineering sciences.

PLO 3: Design/Development of Solutions: An ability to design solutions for complex software engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PLO 4: Investigation: An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis, and interpretation of experimental data, and synthesis of information to derive valid conclusions.

PLO 5: Modern Tool Usage: An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.

PLO 6: The Engineer and Society: An ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.

PLO 7: Environment and Sustainability: An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

PLO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PLO 9: Individual and Team Work: An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.

PLO 10: Communication: An ability to communicate effectively, orally as well as in writing, on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PLO 11: Project Management: An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.

PLO 12: Lifelong Learning: An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

Eligibility Criteria

FSc Pre-Engineering/FSc with Math, Physics and Computer Science or equivalent with minimum 60% marks.

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
Non-Engineering Courses (Minimum)	40
Engineering Courses (Maximum)	94

Curriculum Alignment with National Qualifications Framework (Recommended Scheme of Studies by PEC)

Domain	Knowledge Area	Total Courses	Total Credits	% Overall Cr Hrs
Non-Engineering	Mathematics & Science Foundation Core (Maths/Science)	4	12	**29.85%**
	General Education Core (Humanities)	6	16	
	General Education Electives (Humanities & Management Sciences)	4	12	
	Sub Total	**14**	**40**	
Engineering	Computing Core Courses	11	39	**70.15%**
	Software Engineering Core Courses	8	24	
	Software Engineering Elective Courses	5	15	
	Final Year Project	2	6	
	Supporting Electives (Interdisciplinary Courses)	3	10	
	Sub Total	**29**	**94**	
	Grand Total	**43**	**134**	**100%**

Semester Wise Breakdown of Courses

1st Year - SEMESTER 1						
#	**Pre-Req**	**Course Code**	**Course Title Total**	**Credit Hours**	**Theory**	**Lab**
1	None	CSC 110	Computing Fundamentals	3	2	1
2	None	CSC 113	Computer Programming	4	3	1
3	None	GSC 110	Applied Calculus & Analytical Geometry	3	3	0
4	None	ENG 105	Functional English	3	3	0
5	None	GSC 114	Applied Physics	3	2	1
			Semester Credit Hrs	**16**	**13**	**3**

1st Year - SEMESTER 2						
#	Pre-Req	Course Code	Course Title Total	Credit Hours	Theory	Lab
1	-	GSC 221	Discrete Mathematics	3	3	0
2	CSC 113	CSC 210	Object Oriented Programming	4	3	1
3	-	SEN 120	Introduction to Software Engineering	3	3	0
4	ENG 105	HSS 120	Communication Skills	3	3	0
5	-	ISL 101	Islamic Studies/Ethics	2	2	0
6	-	CEN 122	Digital Design	3	2	1
			Semester Credit Hrs	**18**	**16**	**2**

2nd Year - SEMESTER 3						
#	Pre-Req	Course Code	Course Title Total	Credit Hours	Theory	Lab
1	CSC 210	CSC 221	Data Structures & Algorithms	4	3	1
2	SEN 120	SEN 211	Software Requirement Engineering	3	3	0
3	None	SEN 212	Human Computer Interaction	3	3	0
4	None	GSC 121	Linear Algebra	3	3	0
5	CEN 122	CEN 221	Supporting Elective – I	4	3	1
			Semester Credit Hrs	**17**	**15**	**2**

2nd Year - SEMESTER 4						
	Pre-Req	Course Code	Course Title Total	Credit Hours	Theory	Lab
1	CSC 221	CSC 320	Operating Systems	4	3	1
2	None	GSC 122	Probability & Statistics	3	3	0
3	CSC 113	CSC 220	Database Management Systems	4	3	1
4	SEN 211	SEN 221	Software Design & Architecture	3	2	1
5			University Elective I	3	3	0
			Semester Credit Hrs	**17**	**14**	**3**

3rd Year - SEMESTER 5						
#	Pre-Req	Course Code	Course Title Total	Credit Hours	Theory	Lab
1	None	HSS 320	Technical Writing & Presentation Skills	3	3	0
2	None	CEN 222	Data Communication & Networking	4	3	1
3	SEN 221	SEN 311	Software Construction	3	2	1
4			University Elective II	3	3	0
5			SE Elective I	3	-	-
6	None	PAK 101	Pakistan Studies	2	2	0
			Semester Credit Hrs	**18**	**15**	**3**

3rd Year - SEMESTER 6						
	Pre-Req	**Course Code**	**Course Title Total**	**Credit Hours**	**Theory**	**Lab**
1	CSC 113	SEN 310	Web Engineering	3	2	1
2	SEN 120	SEN 321	Software Quality Engineering	3	3	0
3		CSC 407	Information Security	3	3	0
4			SE Elective II	3	-	-
5			SE Elective III	3	-	-
6			Supporting Elective II	3	-	-
			Semester Credit Hrs	**18**		

4th Year - SEMESTER 7						
#	**Pre-Req**	**Course Code**	**Course Title Total**	**Credit Hours**	**Theory**	**Lab**
1		ESC 498	Project I	3	0	3
2	SEN 120	SEN 410	Software Project Management	3	3	0
3	None	HSS 422	Engineering Ethics	3	3	0
4	SEN 311	SEN 411	Software Re-Engineering	3	3	0
5			SE Elective IV	3	-	-
			Semester Credit Hrs	**15**		

4th Year - SEMESTER 8						
#	**Pre-Req**	**Course Code**	**Course Title Total**	**Credit Hours**	**Theory**	**Lab**
1		ESC 499	Project II	3	0	3
2			SE Elective V	3	-	-
3			University Elective III	3	-	-
4			University Elective IV	3	-	-
5			Supporting Elective III	3	-	-
			Semester Credit Hrs	**15**		
			Total Credit Hours	**134**		

Software Engineering Supporting Elective

This category of courses is equips students with knowledge related to supporting aspects of Software Engineering ranging from mathematics, natural sciences and engineering. Students are required to take 3 courses to cover this domain.

SE SUPPORTING ELECTIVE COURSES					
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 110	GSC 320	Numerical Analysis	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
SEN 120	SEN 449	Business Process Automation	3	3	0
CSC 320	CEN 449	System Programming	3	2	1
GSC 110	SEN 323	Formal Methods in Software Engineering	3	3	0
None	CSC 448	Introduction to Bio-Informatics	3	3	0
	CEN 463	Robotics	3	2	1
SEN 321	SEN 429	Fault Tolerant Systems	3	0	0
CSC 320	CEN 453	Real Time Systems	3	3	0
None	CSC 448	Introduction to Bio-Informatics	3	3	0
None	CSC 315	Theory of Automata	3	3	0
CSC 221	CSC 321	Design and Analysis of Algorithms	3	3	0
CSC 315	CSC 323	Compiler Construction	3	2	1
CEN 122	CEN 221	Computer Architecture & Organization	4	3	1
CSC 320	CEN 321	Microprocessors & Interfacing	4	3	1
GSC 113	EEN 210	Basic Electronics	4	3	1
GSC 110	CSC 453	Information Theory	3	3	0

Elective Software Engineering Courses -15 Credit Hours

This category comprises of courses that provide in depth knowledge relevant to the areas of Software Engineering and applied computing domains. Students have to take five courses from this category with at least 2 courses comprising of lab components.

SOFTWARE ENGINEERING ELECTIVE COURSES * At least 2 courses with lab components will be offered					
Pre-Req	**Course Code**	**Course Title Total**	**Credit Hours**	**Theory**	**Lab**
CSC 113	CSC 313	Visual Programming	3	2	1
None	SEN 448	Software Applications For Mobile Devices	3	2	1
CSC 113	CSC 445	Principles of Programming Languages	3	3	0
CSC 210	SEN 328	Game Application Development	3	2	1
SEN-310	SEN 421	Semantic Web	3	2	1
None	SEN 324	Software Metrics & Estimation	3	3	0
SEN-210	SEN 440	Software Engineering Economics	3	3	0
CSC-113	SEN 441	Mathematical Tools For Software Engineering	3	3	0
None	SEN 450	Design Pattern	3	3	0
None	SEN 452	Agile Development	3	3	0
SEN 320	SEN 456	Usability Engineering	3	3	0
None	CSC 411	Artificial Intelligence	3	2	1
	SEN 443	Introduction to Soft Computing	3	2	1
GSC 122	CSC 441	Natural Language Processing	3	3	0
	SEN 331	Scientific Computing	3	3	0
None	SEN 330	Agent Based Computing	3	3	0
None	SEN 459	Mobile and Pervasive Computing	3	3	0
None	SEN 325	Cloud Computing	3	3	0
CSC 210	CSC 456	Distributed Computing	3	2	1
None	CEN 451	Data Encryption & Security	3	3	0
None	SEN 460	IoT Application Development	3	2	1
CSC 220	CSC 460	Data Mining	3	2	1
CSC 220	CSC 454	Data Warehousing	3	3	0
	CSC 487	Introduction to Data Science	3	3	0
None	SEN 332	Big Data Analytics	3	3	0
SEN 120	CSC 458	Management Information Systems	3	3	0
CSC 220	SEN 326	Advanced Database Management Systems	3	2	1
None	SEN 455	Knowledge Based Management Systems	3	3	0
None	SEN 453	Information System Audit	3	3	0
CSC 220	SEN 327	Distributed Database Systems	3	3	0
None	CSC 444	Computer Graphics	3	2	1
	SEN 329	Digital Animation	3	3	0
None	SEN 493	Multimedia Systems	3	3	0
GSC 121	CEN 445	Digital Image Processing	3	2	1
CEN 445	CSC 464	Computer Vision	3	3	0

University Electives

This category consists of cross domain courses ranging from social sciences, management sciences, finance and economy. Student shall take 4 courses from this category to complete 12 credits of University Elective courses.

UNIVERSITY ELECTIVE COURSES					
Pre Req	**Course Code**	**Course Title**	**Total Credit Hours**	**Theory**	**Lab**
Languages					
None	HSS 452	English Literature	3	3	0
None	HSS 459	Foreign Language (Arabic, French, etc)	3	3	0
Finance & Economy					
None	ECO 457	Economics	3	3	0
None	HSS 461	Accounting & Finance	3	3	0
Management Sciences					
None	MGT 111	Principles of Management	3	3	0
None	HSS 453	Human Resource Management	3	3	0
None	HSS 456	Organizational Behavior	3	3	0
None	HSS 421	Entrepreneurship & Leadership	3	3	0
Social Sciences					
None	HSS 202	Introduction to Sociology	3	3	0
None	HSS 111	Introduction to International Relations	3	3	0
None	HSS 115	Introduction to Media Studies	3	3	0
None	HSS 201	Introduction to Anthropology	3	3	0
None	PSY 101	Introduction to Psychology	3	3	0

Course Outlines of Newly Added Courses

Course Title: Applied Physics
Course Code: GSC 114
Credit Hours: (2+1)
Course Description:
This course provide introduction about basic ideas/concepts of physical sciences which would help them in better understanding of the applications of these sciences in Engineering and technology. Salient topics include Electricity & Magnetism, Electronics, Engineering Mechanics and Modern Physics.

Recommended Books/Reading Materials:

1. Krane Resnick Halliday, "Physics", Volume 1&2, 5Th Ed, Wiley 2007.

Course Title: Digital Design
Course Code: CEN 122
Credit Hours: (2+1)
Course Description:
This Course is an introductory course in Digital Logic Design. Principles and concepts of a digital system are taught to lay the foundation to all other computer hardware courses. Covered Topics would include Introduction to Digital Systems, Boolean Algebra and Logic Gates, Combinational Logic and MSI Circuits, Sequential Logic Circuits, Memories and Programmable Logic Devices (PLDs).

Recommended Books/Reading Materials:

1. M. Morris Mano & Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog" 6th Edition, Pearson 2017.

Course Title: Software Re-Engineering
Course Code: SEN 411
Credit Hours: (3+0)
Course Description:
Salient topics include the terminology and the processes pertaining to software evolution, fundamental re-engineering techniques to modernize legacy systems including source code analysis, architecture recovery, and code restructuring, software refactoring strategies, migration to Object Oriented platforms, quality issues in re-engineering processes, migration to network-centric environments, and software integration, reverse engineering, program comprehension, source code transformation and refactoring strategies, software maintenance and re-engineering economics.
Recommended Books/Reading Materials:

1. Chris Birchall, "Re-engineering Legacy Software", Manning Publications, 2016.
2. Priyadarshi Tripathy and Kshirasaga Naik, "Software Evolution and Maintenance: A Practitioner's Approach", Wiley, 2014.

Course Title: Fault Tolerant Systems
Course Code: SEN 429
Credit Hours: (3+0)
Course Description:
A system availability and reliability is dependent on its fault tolerance. This course specifically focuses on how software & system reliability can be enhanced by implementing techniques for fault detection, recovery and prevention. Important topics include important concepts of faults, errors and failures, tactics to implement fault tolerance through various design patterns, extensive coverage of fault detection patterns, error recovery patterns, error mitigation patterns and fault treatment patterns.

Recommended Books/Reading Materials:

1. Robert S. Hanmer, "Patterns for Fault Tolerant Software" John Wiley & Sons, 2007.

Course Title: Stochastic Processes
Course Code: GSC 440
Credit Hours: (3+0)
Course Description:
Discrete Markov chains, classification of states, first passage and recurrence times, absorption problems, stationary and limiting distributions. Chapman-Kolmogorov equations, Long run behavior of Markov chains, Absorption probabilities and expected times to absorption, Statistical aspects of Markov chains, The mover-stayer model, Application of a Markov chain and mover-stayer model to modeling repayment behavior of bank loans' grantees. Markov Processes in continuous time: Poisson processes, birth-death processes. Poisson process The Kolmogorov differential equations, Limiting behavior of continuous time Markov chains The Q matrix, forward and backward differential equations, imbedded Markov Chain, stationary distribution. renewal theory, Brownian Motion and its generalizations, Discrete time martingales, Conditional expectation, Definition of a martingale and examples, Optional stopping theorem, Stochastic calculus.

Recommended Books/Reading Materials:

1. Durrett, Richard, "Essentials of stochastic processes", Springer Science & Business Media, 2nd Ed, 2012.
2. Sheldon M. Ross, "Introduction to Probability Models", 11th Ed, Academic Press 2014.
3. G.F. Lawler, "Introduction to Stochastic Processes", 2nd Ed, Chapman and Hall, 2006.

Course Title: IoT Application Development
Course Code: SEN 460
Credit Hours: (2+1)
Course Description:
This course focuses on application development for IoTs. The salient topics included are introduction to embedded systems, Major hardware components of IoT, IoT operating systems, programming languages, Software architecture for IoT, Python for Raspeberry Pi, Node JS, Mircoservices for IoTs, Cloud services and cloud integration, Data Analytics, hardware interfacing,

Recommended Books/Reading Materials:

1. Peter Waher, "Learning Internet of Things", Packt Publishing, 2015.
2. Perry Lea **"**Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security", Packt Publishing, 2018.