Minutes

44th (Special) Meeting of the Academic Council

held on 16th June & 13th July 2023

Directorate of Academics

Bahria University Islamabad

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ACRONYMS AND ABBREVIATIONS USED IN THIS DOCUMENT

AACSB	Association to Advanced Collegiate School of Business
BBS	Bahria Business School
BH3S	Bahria Humanities and Social Sciences School
BSEAS	Bahria School of Engineering and Applied Sciences
BUAR	Bahria University Academic Rules
BUCPT	Bahria University College of Physical Therapy
BUDC	Bahria University Dental College
BUHSC	Bahria University Health Sciences Campus
BUIC	Bahria University Islamabad Campus
BUKC	Bahria University Karachi Campus
BULC	Bahria University Lahore Campus
BULS	Bahria University Law School
BUMDC	Bahria University Medical & Dental College
BUMC	Bahria University Medical College
CCH	Course Codes Handbook
CE	Computer Engineering
CH	Credit Hour(s)
CS	Computer Sciences
DA	Director Admissions
DAcad	Director Academics, BUHO
DASS	Director Admin, Safety & Security, BUHO
DIPP	Director Institute of Professional Psychology
DLC	Director Lahore Campus
DMktg	Director Marketing
EDC	Estimated Date of Completion
EE	Electrical Engineering
E&ES	Earth & Environmental Sciences
EP	Examination Policy
ES	Engineering Sciences
FHB	Faculty Handbook
FYP	Final Year Project
HS	Health Sciences
H&SS	Humanities & Social Sciences
IR	International Relations
MS	Management Sciences
NBEAC	National Business Education Accreditation Council
NCEAC	National Computing Education Accreditation Council
PFM	Permanent Faculty Member
PG	Postgraduate
PH	Public Health
PMDC	Pakistan Medical and Dental Council
PNC	Pakistan Nursing Council
PNNC	Pakistan Navy Nursing College
SCM	Supply Chain Management
SE	Software Engineering
SHB	Students Handbook
SRD	Students Record Database
UG	Undergraduate
URD	User Requirements Document
VFM	Visiting Faculty Member

ATTENDANCE

BUHO

Present

1.	Vice Admiral Asif Khaliq HI(M) (Retd)	Rector	in Chair
2.	Surg R/Admiral Najm Us Saqib Khan HI(M), T.Bt (Retd)	Pro-Rector (HS)	Member
3.	Rear Admiral Ahmed Fauzan HI(M) (Retd)	Pro-Rector (RIC)	Member
4.	Rear Admiral Muhammad Arshid Javed SI(M) (Retd)	Pro-Rector (Acad)	Member
5.	Cdre Muhammad Jalaluddin Qureshi SI (M), S.Bt (Retd)	Registrar	Member
6.	Dr Atif Raza Jafri	Dean ES/ Principal BSEAS-IC	Member
7.	Dr Muhammad Naveed	Dean MS/ Principal BBS-IC	Member
8.	Dr Adam Saud	Dean H&SS/ Principal BH3S-IC	Member
9.	Dr Muhammad Fayyaz	Dean Law/ Principal BULS	Member
10.	Cdre Asim Raza SI(M) (Retd)	Dir Academics	Member & Secy
11.	Cdre Nasrullah SI(M) (Retd)	Controller of Exams	Member
12.	Cdre M Masud Akram SI(M), S.Bt	Dir Admissions	Member
13.	Brig Asif Ali Asif (Retd	Dir Health Sciences	Member
14.	Dr Asad Waqar	Dir PGP	Member
15.	Mr Fazal Wahab	Dir DQA	Member
16.	Dr Saleem Aslam	Dir ORIC	Member
17.	Dr M. Awais Mehmood	Director IO	Member

In Attendance

18.	Dr Muhammad Zahid	Dean MS (Designate)
19.	Ms Sundal Mufti	Dir Student Affairs
20.	Mr Rizwan Aamir	Dir IT
21.	Mr Zulfiqar Ahmed Janjuwa	Dir LDC
22.	Cdr Zulfiqar Haider Malik PN (Retd)	Dy Registrar (Regulations & Statutes)
23.	Cdr Adnan Umer PN	Dy Director (Academics)

BUIC

Present

24.	Rear Admiral Zaka Ur Rehman HI(M) (Retd)	DG IC	Member
25.	Dr Junaid Imtiaz	HOD (EE) BSEAS-IC	Member
26.	Dr Syed M. Shahid Tirmazi	HOD (Islamic Stu)	Member
27.	Dr Shahzad Hassan	HOD (CE) BSEAS-IC	Member
28.	Dr Awais Majeed	HOD (SE) BSEAS-IC	Member
29.	Dr Said Akbar Khan	HOD (E&ES) BSEAS-IC	Member
30.	Dr Arif Ur Rehman	HOD (CS) BSEAS-IC	Member
31.	Dr Rizwana Amin	HOD (PP) BH3S-IC	Member
32.	Dr Shahzia Yousaf	HOD (PP) H-11-Campus	Member

In Attendance

33.	Dr Sumaira Kausar	Director COE-AI
34.	Lt Cdr M. Yaseen (Retd)	DD (Academics)

BUKC

Present

35.	Vice Adm K. G. Hussain HI(M) (Retd)	DG KC	Member
36.	Cdre Muzammil Hussain SI(M), SE (Retd)	Director Admin	Member
37.	Dr Mustaghis ur Rehman	Principal BBS-KC	Member
38.	Dr Sohaib Ahmed	Principal BSEAS-KC	Member
39.	Dr Oyoon A Razzaq	Principal BH3S-KC	Member
40.	Dr Salma Hamza	HOD (E&ES) BSEAS-KC	Member
41.	Dr Syed Safdar Ali	HOD (CS) BSEAS-KC	Member
42.	Dr Liaqat Ali	HOD (MS) KC	Member
43.	Dr Shoaib Mughal	HOD (CE) KC	Member
44.	Dr Asif Inam	HOD (Maritime Sci)	Member
45.	Dr Talat Sharafat Rehmani	HOD (H&SS) BH3S-KC	Member
46.	Dr Abdul Qadir	HOD (IS) BH3S-KC	Member
47.	Dr Osama Rehman	HOD (SE) KC	Member
48.	Dr Mukesh Kumar	HOD (EE) KC	Member
49.	Dr Muhammad Ashfaq	HOD (Media Studies) BH3S-KC	Member
50.	Dr Amir Feroz Shamsi	HOD (BBS) KC	Member

In Attendance

51.	Capt Zaheer Ahmed PN (Retd)	Director Academics KC
52.	Dr Waqar ud Din	DD ORIC
53.	Engr Erum Shafiq	Asstt Director QA

IPP

Present

54.	Dr Zainab Hussain Bhutto	Dean PP/ Principal IPP	Member
55.	Dr Kiran Bashir Ahmed	HOD (PP)	Member

BUIC

Present

56.	Cdre Jawad Ahmed Qureshi SI(M) (Retd)	Director BULC	Member
57.	Dr Adnan Hushmat	HOD (MS)	Member
58.	Dr Khawaja Qasim Maqbool	HOD (CS & IT)	Member
59.	Dr Urooj Sadiq	HOD (PP)	Member

In Attendance

60.	Muhammad Umair Saeed	Manager QA

BUHSC

Present

61.	Vice Admiral Ather Mukhtar HI(M) (Retd)	DG BUHSC	Member
62.	Maj Gen Prof Shehla M. Baqai HI(M) (Retd)	Dean HS/ Principal BUMC	Member
63.	Dr Wahab Bukh Kadri	Principal BUDC	Member
64.	Dr Khalid Aziz	Principal DPT	Member
65.	Dr Nasim Karim	Principal BUHSC-PGI	Member
66.	Dr Mahreen Lateef	Principal BUCAHS	Member
67.	Cdr Syeda Afshan	Principal PNNC	Member
68.	Capt Noaman Imam SI(M) (Retd)	Director Campus BUHSC-KC	Member
69.	Dr Khalid Mustafa	Vice Principal BUMC	Member
70.	Prof Abida Razzaq	Vice Principal PNNC	Member
71.	Dr Shakeel Ahmed	HOD (Paediatrics)	Member
72.	Dr Naheed Sultan	HOD (Surgery)	Member
73.	Dr Farzeen Mirza	HOD (Oral Pathology)	Member
74.	Dr Syed Ahmed Omer	HOD (Dental Material)	Member
75.	Dr Hasan Ali	HOD (Biochemistry)	Member
76.	Dr M Sajid Abbas Jaffri	HOD (Medicine)	Member
77.	Dr Arsalan Khalid	HOD (Oral Medicine)	Member
78.	Dr Shama Asghar	HOD (Operative Dentistry)	Member
79.	Dr Saman Hakeem	HOD (Prosthodontics)	Member
80.	Dr Beenish Fatima	HOD (Oral Biology)	Member
81.	Dr Sameer Shahid Ameen	HOD (Eye)	Member
82.	Dr Aisha Qamar	HOD (Anatomy)	Member
83.	Dr Farzeen Tanvir	HOD (Periodontology)	Member
84.	Dr. Inayat Hussain Thavar	HOD of Community Medicine	Member

In Attendance

85.	Dr M. Najamuddin Shabbir	Professor of Surgery
86.	Dr Bibi Kulsoom	Professor of Biochemistry
87.	Dr Shaikh Abdul Saeed	Professor of Physiology
88.	Dr Tasneem Fatima	Professor of Anatomy
89.	Dr Khadija Farrukh	Professor of (DME)

PRELIMINARIES

1. With the quorum of the Academic Council completed, the Secretary requested the Chair to commence the Academic Council Meeting (ACM) with his opening remarks. The Chair welcomed all the participants and asked for adherence to the time allocated for the meeting, for timely conclusion of the agenda items. He advised the participants to remain relevant and to-the-point throughout the proceedings.

2. The Secretary apprised the Council that 44th ACM had been convened to process some urgent academic matters, which could not be pended till the regular ACM (scheduled in October 2023). He further apprised that the Special meeting would cover the essential new agenda items only, followed by the progress of a review item, while the progress of the review items of the last (43rd) ACM will be covered in the next (45th) ACM.

3. Due to paucity of time and prior commitments (outstation) of the Chair on subsequent days, the meetings was concluded in two sessions, on 16 June 2023 and 13 July 2023 respectively.

NEW AGENDA ITEMS

Item 4401: Launch Proposal for New Programme in Islamic Studies – *Quran and Seerah*

Sponsor: Dean H&SS Referral Authority: FBOS

Summary of the Case

4. HEC has directed all HEIs to launch courses on Quran (*Tajweed* and *Tafseer*) and Seerah for all Muslim students as a mandatory degree award requirement of all undergraduate degree programmes with effect from Fall 2023 without making it part of the examinations or provision of additional marks; the course shall be non-credited. The Commission has further asked for a comprehensive compliance report with detailed delivery mechanism and protocols thereof duly approved by the concerned statutory body of the university; must be furnished to the HEC latest by 30 June 2023.

5. Above in view, Faculty of H&SS has designed the *Quran & Seerah* programme comprising of three modules (*Tajweed*; *Tafseer*; *Seerah*) and 8 new courses (*Tajweed*-1; *Tafseer*-5; *Seerah*-2) with feedback from all faculties and CUs. The launch proposal has been principally approved in a special meeting chaired by the Rector and attended by all CUs & Deans, for consideration by the Academic Council.

Discussion

6. HOD (IS) BH3S-IC presented the launch proposal as given at **Appendage 4401**. The Chair opened the discussion by emphasizing upon the importance of the programme for the Muslim youth. He asked all the participants for positive contribution to enable its adoption in an effective manner. The proposal was discussed threadbare and the following points amplified:

a. Implementation of the programme will be gradual, similar to the regular programmes, i.e. only the intakes of Fall 2023 semester will undertake the *Tajweed* course.

b. Compliance of the programme will be recorded on the transcript, similar to the Internship/ CSP.

c. *Tajweed* classes shall be on-campus. No. of students per session will be decided by respective HODs. However, overall programme cost will be controlled through large sections at CUs level.

d. *Tafseer* and *Seerah* classes shall be conducted in hybrid model, with 25% classes on-campus and 75% classes online (recorded lectures).

7. The following was proposed by the participants and consented by the Chair:

a. Prepared lectures may be placed online (LMS) for self-study by the students in their own time, subsequent to the actual conduct of lectures.

b. Authentic documentaries/ lectures on electronic media may be made part of the reference material for the proposed courses.

c. Contents of *Seerah* courses outline may be included in Jumma sermons, as & when considered appropriate.

d. Online lectures may also include online quiz, where appropriate.

e. Assessment methodology will be included in course outline, while replacing the word 'Pass' with some other suitable word, i.e. 'Qualified'.

f. For *Tajweed* course, assessment may be based on demonstration (oral recitation), while for *Tafseer* and *Seerah* courses the assessment may be based on assignments.

g. Rewards and competitions may also be included in the conduct of courses, as appropriate.

8. After detailed deliberations, the Council approved the proposed programme with the changes/ additions described in para 6 a. to g. above, for commencement from Fall 2023 intake.

Decision

9. Proposed programme in Islamic Studies (*Quran and Seerah*) is approved for inclusion in all UG academic programmes from Fall 2023 intakes, as per the detailed given at **Appendage 4401**, with the changes/ additions described in para 6 a. to g. above. HEC is to be intimated of the ACM approval along with details of courses and finalized methodology. Progress is to be reported.

Action Required	Action	Responsibility
Implementation of the Decision	All Deans, All Principals, CE, DA, DIT	Dean H&SS
Statutory Documents Affected	BU Prospectus, BU website, SRD	

Item 4402: Revamping of *BS in English* Roadmap

Sponsor: Dean H&SS Referral Authority: FBOS

Summary of the Case

10. BH3S-KC has proposed to revamp the *BS in English* roadmap to enable two streams within the same degree programme: *Linguistics* and *Literature*. The proposal has been deliberated by FBOS-HSS and recommended for approval by the Academic Council.

Discussion

11. The proposal was presented by HOD (SS) BH3S-KC, as given at **Appendage 4402**. The following changes were highlighted in the roadmap in conformance with the HEC 2017 curriculum for *BS in English* (previously adopted 2012 curriculum):

a. Upgrading the courses *Pakistan Studies* and *Islamic Studies* to 3 credit hours each (currently being 2 credit hours each). Correspondingly, total credit hours for the programme would be 135 (currently being 133).

b. Replacement of a course in 4th semester.

c. Choice of Major enabled from 7th semester (currently from 5th semester).

d. Thesis made option (previously compulsory).

12. The proposal was presented in the 1st session (held on 16 Jun23) and concluded in the 2nd session (held on 13 Jul 23), during which the Council approved the changes in the roadmap as presented.

Decision

13. Changes in the roadmap for *BS in English* are approved by the Council as presented and given at **Appendage 4402**, for adoption from Fall 2023 semester at BUIC and BUKC. Point dropped**.**

Action Required	Action	Responsibility
Implementation of the Decision	Principals BH3S-IC & KC, DA, CE, DIT	Dean H&SS
Statutory Documents Affected	Updating of Prospectus, BU website, SRD	

Item 4403: Review of Admission Criteria for *MS in Media Studies* at BUKC

Sponsor: Dean H&SS Referral Authority: FOBS

Summary of the Case

14. BH3S offers 2-years *MS in Media Studies* degree programme at BUIC and BUKC. HOD (Media Studies) BH3S-KC has proposed to relax the eligibility criteria for this programme by amending the specific education to any discipline, to tackle the low intake at BUKC. The proposal has been deliberated by FBOS-HSS and agreed that admission criteria for subject programme may be relaxed to accept the applicants from all academic backgrounds fulfilling the BU requirements for admissions; subject to approval by the Academic Council.

Discussion

15. HOD (Media Studies) BH3S-KC presented the proposed change in admission criteria as tabulated below:

Current Admission Criteria	Proposed Admission Criteria
16 years of education with Bachelors/ equivalent degree from HEC recognized university in Media Studies/ Political Science/ International Relations or any other discipline of Social Sciences with the minimum CGPA of 2.5/4.0 or 50% marks where CGPA is not given.	16 years of education with Bachelors/ equivalent degree from HEC recognized university in any discipline with the minimum CGPA of 2.5/4.0 or 50% marks where CGPA is not given.

16. DQA confirmed that the proposed amendment was not contrary to any HEC rule. He proposed to include some deficiency courses in the eligibility criteria, but Dean H&SS confirmed that the same was already complied in the adopted roadmap. After further discussion, the Council approved the amendment of admission criteria as given above.

Decision

17. Amendment in admission criteria for *MS in Media Studies* is approved as presented and tabulated in para 15. above. Point dropped.

Action Required	Action	Responsibility
Implementation of the Decision	Principals BH3S-IC & KC, DA, CE, DIT	Dean H&SS
Statutory Documents Affected	Updating of Prospectus, BU website, SRD	

Item 4404: Amendment in BUAR to Allow Students for Fresh Courses in Summer Semester

Sponsor: DAcad Referral Authority: BUHO

Summary of the Case

18. Students' applications are randomly processed as special cases for approval to register new courses during summer semesters, for completion of degree programme within the regular duration. BU Academic Rules (reproduced at **Appendage 4404-A**) do not allow registration of a new courses in the summer semester. However, HEC guidelines for UG programmes (relevant extract placed at **Appendage 4404-B** do not place a complete closure to such registrations. Rather, students are allowed to register 1-2 courses of up to 8 x CH during Summer semester for remedial work, improve grades or to cover academic deficiencies. As such, no bar is mentioned in the HEC guidelines on allowing any fresh/ new courses**.**

19. Some other HEIs formally allow registration of fresh/ new courses during the Summer semesters under specific situations. The same may be adopted by BU to facilitate its students, through suitable amendment in BU Academic Rules.

Discussion

20. DDAcad BUHO presented the proposal to allow the students to take fresh/ new courses in the Summer semester during the last year of regular programme duration, by amending the current BU Academic Rule 3.20.1 b. (**Appendage 4404-A**). DQA supported the proposal with the change that term 'Deficient' may be used instead of 'New' to avoid any ambiguity/ misuse of the rule for the courses that were yet to be offered. During subsequent deliberation, DAcad confirmed that standard requirement for the Summer semester courses w.r.t the minimum class size would be followed. After further discussion, the Council approved the proposed amendment for the deficient courses, with no caping on the earned grade.

Decision

21. Following amendment in BU Academic Rule 3.20.1 b. was approved for adoption from Summer 2023 semester, followed by ratification of the amendment by the Executive Committee:

Replace. There shall be no registration for Advanced/ New Courses.

With. There shall be no registration for the courses that are falling due in the next semester(s), as per academic roadmap. The students may register for the deficient courses (i.e. the courses to be qualified as per related roadmap at given juncture of time) during the last year of their regular programme duration, without a cap on the earned grades.

Action Required	Action	Responsibility
Implementation of the Decision	All Principals, DAcad, DA	DAcad
Statutory Documents Affected	BUAR, SHB	

Item 4405: Commencement of Weekly Online Classes

Sponsor: DQA Referral Authority: Case file

Summary of the Case

22. As a suitable measure to curtail financial expenses of BU CUs, it has been proposed by the Financial Analysis Committee constituted at BUHO that all UG/ PG classes of BUIC and BUKC may be conducted **online** once a week – preferably Wednesdays – as per the mechanism given at Appendage 4405. DQA will present the proposal for consideration by the Academic Council.

Discussion

23. The proposal was presented by DQA during the first session (held on 16 Jun 23), and reviewed for final decision in the next session (held on 13 Jul 23). DASS, BUHO explained that the Air University (E-9 Islamabad Campus) had attained the following savings through weekly online classes during the Spring 2023 semester:

a. Admin Expenses – Rs 29.91 Million per year
b. Personnel Travelling Expenses – Rs 115.28 Million per year

24. He further explained that BU CUs could attain substantial savings through weekly online classes as estimated below:

CU	Savings per Day	Savings per Month
BUIC (E-8)	Rs 0.36 M	Rs 1.43 M
BUIC (H-11)	Rs 0.09M	Rs 0.37 M
BUKC	Rs 0.51 M	Rs 2.06 M
Total	**Rs 1 M**	**Rs 4 M**

25. BUKC conveyed its inability to conduct online classes due to likely disruptions in internet connectivity and electrical power issues in civil area of Karachi, besides a compromise on the quality of education. Dean ES explained the limitations entailed for BS(CS) programme due to inadequate no. of labs. HOD (CS) BUIC further submitted the constraints in conduct of online classes due to large no. of students. Dean MS (Designate) suggested to follow the related HEC Policy (pertaining to Online Distance Learning). DAcad explained that the stated Policy was presently under review by HEC and covered complete programmes or courses offered online, whereas the subject proposal comprised of limited online classes based on the SOP already followed during the Covid-19 restrictions. DG BUIC strongly supported the proposal as a step towards the future learning.

26. After further discussion, the Chair directed to adopt the online classes for all semester based programmes in all CUs once a month, based on the methodology given at Appendage 4405. He further advised to enhance the frequency of online classes after the revised HEC ODL Policy was promulgated. The Council supported the same.

Decision

27. Online classes are to be conducted at all CUs for all semester based programmes once a month – first Wednesday of each month – from Fall 2023 semester, as per the methodology given at **Appendage 4405**. The progress, including savings details, is to be reviewed in next ACM.

Action Required	Action	Responsibility
Implementation of the Decision	All HCUs, DASS	DQA
Statutory Documents Affected	Nil	

Item 4406: Proposed Amendments in BUAR for Probation Policy

Sponsor: DQA Referral Authority: Case file

Summary of the Case

28. During financial analysis of Bahria University for improved financial viability of its Campuses, it has been noted that considerable fee revenue can be attained if the number of Dropped students in each semester is controlled. While departmental measures are already being taken for improvement of academically weak students, suitable review/ amendment of related Academic Rules can facilitate lesser Dropped cases. DQA will present the proposal for suitable amendment in BU Academic Rules to attain this aspect.

Discussion

29. DQA presented the proposal to amend BU Academic Rules as given at **Appendage 4406**. He explained that current Rules provides 2 chances to each student for improvement of grades prior being Dropped due to academics, as given below:

a. Probation – 1st time failing to achieve minimum CGPA (UG-2; MBA/MS/MPhil-2.5; PhD-3).
b. Chance – 2nd time failing to achieve minimum CGPA.
c. Dropped – 3rd time failing to achieve minimum CGPA.

30. It was further indicated that various other HEIs have lesser strict rules for such category, as indicated below:

a. NUST– Withdrawal after 7 or more F/XF or 4 x **consecutive** Probations.
b. FAST – Admission Closed after 3 x **consecutive** Probations.
c. SZABIST – Dismissal after majority ‘F’ in one semester or 3 x **consecutive** Probations.
d. Riphah University – Relegation (Dismissal) after 3 x **consecutive** Probations.
e. Air University – Dismissal after CGPA < 1.5 or 3 x **consecutive** Probations or ‘F’ Grades in 21 x CH.

31. The Council was proposed to amend the current Rules by adopting the following criteria for Dropped student as tabulated below:

Programme	Minimum CGPA	No. of Probations
Undergraduate	2.0	3 consecutive
Masters (MBA/ MS/ MPhil)	2.5	2 consecutive
Doctorate (PhD)_	3.0	2 consecutive

32. The proposal was deliberated at length. DG BUKC, DG BUIC, Dean PP shared their apprehensions as the revised rules may affect the quality of education because of prolonged retention of weak students. DQA and Dean ES explained the implications of the current rules, which was supported by Dean MS. Pro-Rector (Acad) highlighted the compassionate factor in the proposed amendment, favouring the students. After extensive deliberations, the Chair concurred to adopt the proposed amendments, while emphasizing that assessment criteria is to be kept stringent so that examinations standards are not compromised under any circumstances.

Decision

33. Proposed amendments in BU Academic Rules at **Appendage 4406** are approved for adoption from Spring 2023 semester results. Progress is to be reported.

Action Required	Action	Responsibility
Implementation of the Decision	All Principals, DAcad, DA, CE, DIT	DQA
Statutory Documents Affected	BUAR, SHB, BU website, SRD	

Item 4407: Launch Proposal for *Associate Degree in Business Administration*

Sponsor: Dean MS Referral Authority: FBOS

Summary of the Case

34. Dept of Management Sciences, BULC has proposed an Associate Degree programme in Business Administration to improve the financial viability of the Campus. The proposal has been evaluated by the FBOS-MS and recommended for approval by the Academic Council.

Discussion

35. The proposal was presented by HOD (MS) BULC in the 1st session (held on 16 Jun 23). Pro-Rector (RIC) asked for more specific statement of PLO 2. He also suggested to review the proposed fee structure to make it more conducive for the low-income segment of society. DQA highlighted the similarity of the proposed roadmap with first 4 semesters of BBA programme and shared apprehension that the launch proposal may affect the already low intake of the regular BBA programme due to lesser cost and programme duration. He proposed to include some skill set in the curriculum to make it different from the regular BBA programme. DLPDC highlighted the domain/ discipline of the Associate Degree programme being proposed, and suggested to make it more specialized/ specific. After further discussion, the Chair advised to approve the proposed programme in-principle, while resolving the observations in 2 weeks' time.

36. Discussion on the proposal was continued in the 2nd session (held on 13 Jul 23). HOD (MS) BULC confirmed that observations raised during the 1st session had been resolved, as given at **Appendage 4407**, and highlighted the emphasis on required market utility/ market analysis. Dean MS (Desig) proposed to design the course for connectivity with the regular BBA programme. HOD

(MS) BULC confirmed that the same had been complied. Dean MS (Desig) also suggested to review the software related requirement in the proposal, and offered hios assistance as the domain expert, which was agreed by the HOD. After further discussion, the Chair proposed to launch the programme in all CUs, which was concurred by the Council.

Decision

37. The proposal for *Associate Degree in Business Administration* was approved for launch at BULC, BUKC and BUIC (H-11) from Fall 2023 semester, as given at **Appendage 4407**, along with the review of software requirement. Progress is to be reported.

Action Required	Action	Responsibility
Implementation of the Decision	DBULC, DC BUIC (H-11), Principals BBS-IC & KC, DA, CE, DLPDC, DIT	Dean MS
Statutory Documents Affected	BU Prospectus, BU website, SRD	

Item 4408: Launch Proposal for *Advanced Diploma in Infant, Child and Adolescent Mental Health*

Sponsor: Dean PP Referral Authority: FBOS

Summary of the Case

38. The Dept of Psychology, BULC has proposed to launch an *Advanced Diploma in Infant, Child and Adolescent Mental Health* to improve the financial viability of the Campus. The proposal has been deliberated by the FBOS-PP and recommended for approval by the Academic Council.

Discussion

39. HOD (PP) BULC presented the proposal in the 2nd session (held on 13 Jul 23) as given at **Appendage 4408**. DQA enquired about the likely impact on MS (CP) intake and Transfer of Credit (TOC) cases, and was informed by the HOD (PP) BULC that no harmful effect was anticipated as the proposed programme was less hectic and offered lucrative job prospects with professional skill-set in much shorter timeframe. The HOD further explained that proposed course would be a unique programme, not compatible with the degree programme; hence no TOC intakes would be encountered. Dean PP indicated that some classes of the proposed programme could be merged with the UG/ PG programmes, hence making it financially more viable. Dean Law highlighted that the curriculum of the proposed diploma also facilitated the juvenal criminal system. Pro-Rector (Acad) proposed to launch the programme at BUIC (H-11) as well. Principal BSPP-IC highlighted the lab deficiency at H-11 Campus, required for the proposed programme. The Chair advised to cover the lab part at the E-8 Campus. DQA supported the launch proposal for all CUs, including the IPP. Director IPP suggested the launch at IPP in Spring 2024 semester. After further discussion, it was agreed to launch the proposed programme at all CUs from Fall 2023 semester.

Decision

40. Proposed *Advanced Diploma in Infant, Child and Adolescent Mental Health* is approved for launch at BULC, BUIC (H-11) with labs at E-8 Campus (as required) and IPP from Fall 2023 semester. Progress is to be reported.

Action Required	Action	Responsibility
Implementation of the Decision	DBULC, DC BUIC (H-11), Dir IPP, Principal BSPP-IC, DA, CE, DLPDC, DIT	Dean PP
Statutory Documents Affected	BU Prospectus, BU website, SRD	

Item 4409: Review of BU Retake Exams Rules

Sponsor: DG BUIC Referral Authority: FBOS

Summary of the Case

41. BU Academic Rules allow Retake of Midterm and Final exams to the students in case of self-hospitalization or bereavement in the immediate family (parents, grandparents, siblings, spouse and wards). The students have been noted to take undue advantage from the prevailing Rules by presenting fake medical certificates for self-hospitalization. Once their requests are rejected, they try to influence the system through various internal/ external sources. Such situation causes a lot of inconvenience and jeopardizes the credibility of the examination system.

42. Occasionally, the no. of retake applications is high and Retake for Midterm exams has to be conducted in parallel with normal classes. At times, difficulties are faced to arrange required classrooms and the invigilators to conduct Retakes for Midterm exams.

43. Further, no fee is presently being charged for Retake exams in BU CUs. While many other HEIs charge such fee, it is pertinent to mention that Retake Exam Fee was charged in BU earlier but abolished in 25th ACM. Revival of this fee is well justified as the University has to spend extra efforts and resources to conduct the Retake exams in each semester.

44. Considering the above stated, following changes in the current BU Academic Rules are proposed for Retake exams to discourage the requests on false accounts and to reduce the overall number of such cases:

a. There shall be no Retakes for Midterm exams as the students who miss these but still attain 75% or more total marks (including quizzes, assignments, and Final exams) can easily pass the respective course(s).

b. Retake of Final exams shall be continued as per existing policy. However, Rs 5,000 per course may be charged as the Retake Exam Fees to discourage the Retake cases on false reasons.

Discussion

45. The proposal was discussed threadbare in the 2nd session (held on 13 Jul 23), and views/ comments of other faculties were presented as given below:

a. **BUIC (H-11)**

i. Retake decisions should be reserved for serious and genuine cases, ensuring that only deserving students are allowed to retake exams.

ii. A fee should be associated with retake exams to discourage frivolous retakes and encourage students to adequately prepare for their initial attempt.

iii. In recognition of the additional effort required from faculty members to create new exam papers and solutions for individual retake exams, a financial benefit should be provided to compensate for their time.

iv. Abolishing retake of Midterm exam for MS/PhD is not supported as the weightage of midterm is 40% and passing marks of the MS program is 60%. Students with genuine reasons will fail the course.

b. **BUKC.** Status quo be maintained for the conduct of retake exams for the Mid and Final Terms Examinations. However, appropriate disciplinary action may be taken against the students who provide the fake certificates for self-hospitalization or death of close relatives.

c. **Dean HS.** A a chance of re-sit exam for both (Mid/Final) examination be given to student. To avoid misuse or give opportunity to genuine student, the fee per paper/ subject can be charged in both re-sit examinations e.g Rs. 1,000 to 1,500 per paper.

d. **Dean PP.** Status quo may be maintained. Moreover, students providing fake documents for retake exams may receive the appropriate disciplinary action accordingly.

46. Pro-Rector (RIC) raised concern that the proposed changes in the policy facilitated the violators. He reiterated that the CUs/ concerned Depts should enquire the cases of students' absence from exams for genuineness. The Chair asked for the reasons of adopting the current policy (whereas a fine was imposed earlier), and was informed by the DAcad that the fine was dropped to give supportive consideration to bereaved cases. The Chair enquired the fine amount previously imposed on the Retake cases, and was informed that Rs 3,000 Retake Examination Fee was discontinued in 25th ACM (held on 14-15 Oct 2015) through Agenda Item 2421 on the pretext that retakes were necessitated by genuine reasons, which were tough anyway, and there was no justification in charging the retake fee. However, Decision 25 (2421) abolished both the retake examination fee and honoraria for retake examiners. Pro-Rector (RIC) asked about the frequency of the Retake cases. DAcad BUIC (E-8) submitted that retakes of Mid-Term exams are on higher side, with more than 500 students during the Spring 2023 semester. However, the rate is much lower in the Finals, i.e. around 150 students. The core reason is due to that, student usually prefer for losing 25% marks instead of losing higher weightage in finals. HOD (SS) BUIC highlighted another implication regarding Retakes, that CLOs/ PLOs were structured for 8 weeks duration between the Mid-erm and Finals, including graded presentations, quizzes, etc. However, on conduct of a Mid-Term Retake, the teacher was left with only 5-weeks limited space for the Finals. Therefore, it appears more advantageous for students to prepare for most probable questions, excluding the pre midterms ones.

47. DG BUIC apprised that the Retake option is not given by most of the foreign universities. He also highlighted that the option for Mid-Term exams is not given by many local universities as well. He further explained the constraints in ascertaining genuineness in cases of grandparents' death and medical certificates of the students. BUKC emphasized that Retake conditions are aligned for emergencies/ trauma and verification of cases is accordingly ensured at the CU level. The Chair acknowledged that the fee for Retake exams covers additional efforts and may also deter its misuse. Dean ES explained that disallowing Retakes for Mid-Term exams would also contribute in lesser chances of misuse in the Final exams. Pro-Rector (RIC) opined that the Retakes for Mid-Term exams may be abolished if not specifically required. The DQA indicated that

Retakes were conducted as per the HEC policy; however, a suitable fee may be charged as considered appropriate. The suggestion was supported by the CE as well.

48. After further discussion, it was agreed that a suitable fee may be imposed to bear the expenses for conduct of Retake exams, and not as a deterrence. An amount of Rs 3,000 was consented by the Council for all Retakes (Mid-term and Final exams) with effect from the next semester.

Decision

49. An amount of Rs 3,000 (three thousand rupees) per subject is to be charged for the conduct of each Retake exam (Mid-Term and Final) from the student, effective from Fall 2023 semester. Compliance of the same is to be promulgated through the Registrar Notification, and suitable amendment made in BUAR. Progress is to be reported.

Action Required	Action	Responsibility
Implementation of the Decision	Registrar, DAcad, All CUs, DA, DIT	Treasurer
Statutory Documents Affected	BUAR, SHB, BU website	

Item 4410: Launch Proposal for New Programme *Bachelor of Science In Robotics & Intelligent Systems*

Sponsor: Dean ES Referral Authority: BUHO

Summary of the Case

50. Dept of Elect Engg, BSEAS-KC has proposed a new UG Degree programme, *Bachelor of Science in Robotics & Intelligent Systems,* to improve the financial viability of the School. The proposal has been evaluated by the FBOS-MS and recommended for adoption at BUKC as well as BUIC (H-11); subject to approval by the Academic Council.

Discussion

51. HOD (EE) BSEAS-KC presented the proposal as given at **Appendage 4410**. The proposal was approved in-principle in the 1st session (held on 16 Jun 23) for initiation of the admission process for Fall 2023 semester. Details of the proposal were discussed in the 2nd session (held on 13 Jul 23). Pro-Rector (ORIC) indicated concern on the required mechanical workshop infrastructure and its related expenses. HOD (EE) BUKC explained that the workshop was not required to the extent of mechanical manufacturing. Dean ES further explained that the proposed programme was designed to cater for the market needs of the software and AI applications in already developed robotics. DQA indicated that the basis for the proposed programme was to cater the low intakes in EE programmes, which could not be adequately addressed by conducting the programme in the evening (as proposed). Dean ES explained that space availability at BUKC could be enabled only during the evening timings. Principal BSEAS-KC highlighted that evening programme could be conducted at any time in the afternoon, and not necessarily after 5 PM. After further discussion, the Council approved to launch the programme as proposed, with a review of its progress after 2 semesters.

Decision

52. The programme *Bachelor of Science in Robotics & Intelligent Systems* is approved for launch at BULC, BUKC and BUIC (H-11) in Fall 2023 semester as proposed (details at **Appendage 4410**). Progress of the first 2 semesters (Fall 2023 and Spring 2024) is to be reported.

Action Required	Action	Responsibility
Implementation of the Decision	DBULC, Principals BSEAS-IC & KC, DA, CE, DIT	Dean ES
Statutory Documents Affected	BU Prospectus, BU website, SRD	

Item 4411: Launch Proposal for New Programme *Bachelor of Science in Power and Renewable Energy*

Sponsor: Dean ES Referral Authority: FBOS

Summary of the Case

53. The Dept of Elect Engg, BSEAS-KC has proposed a new UG degree programme, *Bachelor of Science in Power and Renewable Energy,* to improve the financial viability of the School. The proposal has been evaluated by the FBOS-MS and recommended for adoption at BUKC as well as BUIC (H-11); subject to approval by the Academic Council.

Discussion

54. HOD (EE) BSEAS-KC presented the proposal for approval by the Council, as given at **Appendage 4411**. The proposal was approved in-principle in the 1st session (held on 16 Jun 23) for initiation of the admission process for Fall 2023 semester. Details of the proposal were discussed in the 2nd session (held on 13 Jul 23). During initial discussion, programme cost shown for the University of Agriculture, Faisalabad was considered to be verified. Projected no. of students in all 4 semesters was also considered to be reviewed. Pro-Rector (RIC) asked about the difference between the proposed and the current curriculum of Power stream of BEE already being offered. He suggested to replace the proposed programme with the offered Power stream as being more current. He also advised to survey the market need from the government promulgated projections. The HOD (EE) explained that Power stream could not be replaced as it conformed to the PEC requirements, including 60% marks for eligibility, whereas the proposed programme has the eligibility with 50% marks. DQA indicated that Power stream was still a successful programme and that the other steams of BEE (*Electronics* and *Telecom*) needed to be reviewed. He suggested to include the renewable energy related courses of proposed programmes in electives for the BEE programmes, instead of launching a new programme. DORIC supported the suggestion, indicating that first 6 semesters of the proposed and the current programmes of BEE have the similar roadmaps. DPGP contested the suggestion by indicating that the Power stream in BEE covered the electrical power whereas the proposed programme comprised of other types of power. DAcad highlighted that the proposed programme diluted the focus on revamping of the BEE programmes that were currently aware already the same. DQA also shared concern on launching the proposed programme in the evenings.

55. After further discussion, the Council decided to get the proposal reviewed, keeping in view the above-mentioned observations.

Decision

56. The proposal may be reviewed by FBOS-ES, keeping in view the observations mentioned in para 55 above. It may be submitted as fresh agenda item, as and when deemed appropriate. Point dropped.

Action Required	Action	Responsibility
Implementation of the Decision	Principal BSEAS-KC	Dean ES
Statutory Documents Affected	Nil	

REVIEW ITEM

Item 4122: Methodology for Improvement of Underperforming Students

Sponsor: DAcad Referral Authority: Case file

Summary of the Case

57. Standardized methodology for improvement of academically weak students in BU semester-based programmes is under finalization against ACM agenda item 4122. As decided in the last/ 43rd ACM, the Acad Dte has finalized the proposed methodology**,** which has been consented by all Deans after necessary improvements. DAcad will present the finalized methodology for approval by the Academic Council and adoption from Fall 2023 semester.

Discussion

58. DAcad presented the standardized methodology and recommendations for its adoption, as given at **Appendage 4122,** in the 2nd session (held on 13 Jul 23). Dean ES asked for its IT based application. DIT assured that the same could be enabled based on finalsied user requirement. DAcad suggested that IT based application may be pursued after the proposed methodology has been well adopted. PR-Rector (RIC) questioned the need of the proposed methodology for the students of higher education, as they should be themselves responsible enough to take care of their academic performance. Dean MS indicated that tutoring was a requirement of AACSB accreditation. DQA emphasized that assistance to underperforming students was required by all accreditation bodies. Dean PP objected on the endorsement of Well Being Centre (WBC) on the students' evaluation (included in proposed methodology), as it compromised the confidentiality of such assessments. DAcad explained that assessment compliance was necessary to be recorded, while actual assessment may not be mentioned on the processing form. The Chair enquired whether similar policy was adopted by other HEIs. Dean MS (Desig) confirmed the same, with examples of some other HEIs.

59. After further discussion, the Council approved the adoption of proposed methodology for improvement of underperforming students in all semester-based programmes, from Fall 2023 semester.

Decision

60. Proposed methodology for improvement of underperforming is approved as given at **Appendage 4122**, for adoption in all semester-based programmes from Fall 2023 semester. Promulgation of the same is to be undertaken through Registrar Notification, followed by inclusion in suitable statutory document. Progress is to be reported**.**

Action Required	Action	Responsibility
Implementation of the Decision	All Deans, All Principals, Registrar	DAcad
Statutory Documents Affected	To be finalsied by DAcad	

ANY OTHER ITEM

Item 4412: Adoption of HEC Graduation Education Policy 2023

Sponsor: DPGP Referral Authority: Pro-Rector (RIC)

Summary of the Case

61. HEC has promulgated the Graduation Education Policy 2023 on 10 July 2023, which covers the guidelines for Postgraduate programmes (including PhD) to be adopted by all HEIs from Fall 2023 semester. Pro-Rector (RIC) requested the Chair at the end of 2nd session (held on 13 Jul 23) to allow the presentation of the Policy for approval by the Academic Council, which is required as per the HEC instructions for the Policy.

Discussion

62. DPGP presented the proposal to adopt the new Policy for adoption from Fall 2023 semester. The Chair asked for the details of the new Policy. DPGP submitted that the Policy had been circulated to all the Deans, CUs and relevant BUHO Directors. The DQA proposed to form a committee under DPGP to adopt the new Policy through required amendments in BU statutory documents. The Chair asked for a separate presentation to cover this aspect.

Decision

63. The HEC Graduation Education Policy 2023 is to be presented separately for adoption from Fall 2023 semester. Progress is to be reported.

Action Required	Action	Responsibility
Implementation of the Decision	DPGP	Pro-Rector (RIC)
Statutory Documents Affected	To be suggested by DPGP	

CLOSING OF THE MEETING

64. After covering all the discussion items, the Secy presented the following timelines for follow-up actions prior the next/ regular ACM, which were approved by the Chair for adoption by all concerned:

a. Progress Report on Action Items of 44th ACM – 11 September 2023

b. Scheduled dates of 45th ACM – 11 & 12 October 2023

65. The Chair concluded the meeting by thanking all the participants for their wholehearted participation and appreciated a thorough conduct of the ACM.

66. There being no other point, the meeting was adjourned.

ASIM RAZA SI(M)
Commodore (Retd)
Director Academics
Secy Academic Council

Dated: 25 August 2023

Appendage 4401

LAUNCH PROPOSAL NEW PROGRAMME PROPOSAL – QURAN AND SEERAH

A. ACADEMIC DETAILS	
1	**Faculty/Department:** Bahria Humanities and School of Social Sciences (BH3S)
2	**Name of the Programme:** Bachelor in Quran and Seerah
3	**Mission of the Programme:** ● To inculcate and equip the students with authentic knowledge and understanding of Islam derived directly from the Quran and the Seerah of the Holy Prophet Muhammad (PBUH).
4	**Objectives of the Programme:** ● To help students understand the teaching of Quran particularly regarding faith, worship, dealing and ethics. (عقائد، عبادات، معاملات اور اخلاقیات) ● To acquaint them with the life of the Prophet Muhammad (PBUH) as a role model in order to help them build their personalities and good character.
5	**Outcomes of the Programme:** ● Students are able to recite, understand and apply the teachings of Quran in their lives ● Students are able to seek guidelines from the life of Holy Prophet (PBUH) in day to day matters. ● Students are able to contribute in the society in a positive way.
6	**Rationale for the Programme:** As per the instructions received by the HEC, all Pakistani universities as well as Degree Awarding Institutes (DAIs) are advised to introduce courses on Translation, Tafsir and Tajweed of Quran and Seerah courses as mandatory (non-credited) on BS level in order to acquaint students with the genuine knowledge of Islam as well as its concept of morality, social justice and mannerism. The department of Islamic studies was bestowed with this task by the competent authorities of BU as a result of which the department has devised the following program..
7	**Brief Description of the Programme:** The program consists of three modules, namely Tajweed, Tafsir, and Seerah. Program has eight courses in total which are spread over 04 years duration of all UG degree programs. Tajweed to be taught on campus during the first semester only. In Tafsir module topical and thematic exegesis is focused upon covering five courses during 2-6 semesters. Seerah module to be taught during 7th and 8th semesters.
8	**Duration:** 4 Years (8 Semesters)
9	**Venue(s): On Site/Off Site/Both On & Off Site** *(Tick one; if Off Site, give details)* **On Site & Off Site (due to Covid-19):** On Campus and Online
10	**Programme Scheduling Format:** Every Semester
11	**Proposed Date of Commencement:** Fall- 2023 (Subject to NOC from HEC)
12	**Mode of Study/Examination:** Unassessed
13	**Medium of Instruction:** Urdu and English

14	**Additional Faculty Member(s) Required:** *(Indicate if there is a requirement for additional faculty members, fulltime/visiting, along with qualifications.)* Yes - The Dept requires FMs with Diploma in Tajweed and PG in Quran and Seerah.
15	**Additional Skilled-Worker(s) Required:** *(Indicate if there is a requirement for additional Skilled Staff, fulltime/part-time, along with their qualifications/skill sets.):* **Nil**
16	**Additional Classroom(s) required:** *(The requirement is to include the number of classrooms and their capacities.) :* Nil (Existing classrooms of HSS department will be utilized)
17	**Additional Requirement for Laboratories:** *(The requirement is to include the number of laboratories, their equipment and their capacities.)* **: Nil**
18	**Additional Requirement for Books, Subscriptions, Memberships to Online Research Sites/ Repositories:** Yes Rs 500, 000
19	**Minimum Entry Level:** Not Applicable
20	**Admission Criteria:** Not Applicable
21	**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).* Unassessed
22	**Number of Admissions Expected for First Intake:** Unassessed
23	**Number of Admissions Planned/Expected for Subsequent Intakes:** Not Applicable
24	**Complete Plan of Studies, inclusive of complete Roadmap:** Complete plan for is attached with this document for reference (Annex – A).
25	**Course Outlines, Descriptions, Pre-Requisites & Readings (Compulsory & Recommended)** *(Attach as Annex 'A')* Complete Outline is attached with this document for reference (Annex – B).

B. FINANCIAL DETAILS

1	**Source of Funding:** **BU: Fully**
2	**Degree Duration:** **Annual or Semester System:** Semester System: Minimum 08 semesters (4 years) **Total Number of Credit Hours:** 120
3	**Expected fee to be charged based on Cost & Benefits Analysis:** *(show working)* **Tajweed Ul Quran:**

Semester	No of Classes	Rate Per Hour	Total
Fall 2023	83	1800 × 16 = 28000	23, 90400
Spring 2024	66	1800 × 16 = 28000	18, 48000
		Total (01 Year)	42,38400

Quran and Seerah:

Semester	No of Classes	Rate Per Hour	Total
Spring 2024	83	1800 ×4 = 7200	597, 600
Fall 2024	149	1800 × 4 = 7200	107, 2800
Spring 2025	215	1800 × 4 = 7200	154, 8000

Fall 2025	298	1800 × 4 = 7200	214, 5600	
Spring 2026	364	1800 × 4 = 7200	2620, 800	
Fall 2026	447	1800 × 4 = 7200	321, 8400	
Spring 2027	513	1800 ×4 = 7200	369, 3600	
		Total	14,896,800	

4	**Expected Number of students for 1st & 2nd Intakes:** Not Applicable
5	**Expected Earning from first two Intakes (B5):** *(Show working)* Not Applicable
6	**Expected Earnings for the Next Five Years (B6):** *(show working)* Not Applicable
7	**Total Estimated Salaries of all Additional Human Resources per annum (B7):** Salary of VFM (as per Campus working)
8	**Cost of Additional Laboratory Equipment/Tools (B8):** *(show working)* None
9	**Cost of Additional Classrooms (B9):** *(Include furniture, technical aids etc)* Responsibility of Campus
10	**Cost of Additional Books, Subscription & Memberships to on-line Sites/Repositories (B10):** (*show details)* **Rs** 100, 000
11	**Off-Site rental Expenses and Cost of other Fixtures (B11):** *(Show details)* None
12	**Miscellaneous Expenses required for Starting the Program (B12):** - Advertisement: - Printing & Stationery: - Admin Cost: - Any other **Total: None**
13	**Annual Recurring Expenditures in Subsequent Years (B13):** - Salaries: - Rentals: - Subscriptions/Memberships: - Advertisements: - Printing & Stationery: - Admin Cost - Any other **Total: None**
14	**Total Cost of the Programme (B14):** [Add B (7) to B (12)] B(7) + B (12) = Rs 15. 320, 640
15	**Net Cost of the Programme (B15):** [Subtract B (1) from B (14)] 15. 320, 640
16	**Net Earnings in First Year (B16:** [Subtract B (15) from B (5)] None

Appendage 4402

NEW ROADMAP BS ENGLISH PROGRAM AT BUIC & BUKC

Semester 1

S.No	Pre-Requisite	Course Code	Course Title	Credit Hours
1		ENG 101	Functional English	3
2		PAK 104	Pakistan Studies	3
3		PSY 107	Introduction to Psychology	3
4		HSS 107	Introduction to Philosophy	3
5		ENG 108	Introduction to EnglishLiterature 1 (Drama & Poetry)	3
6		ENG 109	Introduction to Linguistics	3
			Total Credit Hours	**18**

Semester 2

S.No	Pre-Requisite with Course code	Course Code	Course Title	Credit Hours
1	ENG 101 Functional English	ENG 102	English Writing Skills	3
2		ISL 102	Islamic Studies	3
3		HSS 111	Introduction to InternationalRelations	3
4		MAT 105	Mathematics	3
5		ENG 112	Phonetics and Phonology	3
6		ENG 110	History of English Literature I Medieval to Romantics	3
			Total Credit Hours	**18**

Semester3

S. No	Pre- Requisite with Course code	Course Code	Course Title	Credit Hours
1		ENG 213	Oral Communication and Presentation Skills	3
2		MGT 206	Entrepreneurship	3
3		BES 204	Introduction to Computer Application	3
4		ENG 202	Morphology and Syntax 1	3
5	ENG 108 Introductionto English Literature 1 (Drama &Poetry)	ENG 203	Introduction to Literature II (Novel& Prose)	3
6		ECO 205	Economics	3
			Total Credit Hours	**18**

Semester 4

S. NO	Pre-Requisite with Course code	Course Code	Course Title	Credit Hours
1	ENG 102 English Writing Skills	ENG 207	Advance Academic reading &Writing skills	3
2		QTM 212	Introduction to statistics	3
3		ENV 105	Introduction to EnvironmentalStudies	3
4		ANT 230	Gender Studies	3
5		ENG 210	Semantics	3
6	ENG 110 History of English Literature I (Medieval to Romantics)	ENG 211	History of English Literature II(Romantics to Present Age)	3
			Total Credit Hours	**18**

Semester 5

S. NO	Pre-Requisite with Course code	Course Code	Course Title	Credit Hours
1		ENG 307	Classics in Drama	3
2		ENG 311	Pedagogical Grammar	3
3		ENG 306	Literary Criticism and Theory	3
4		ENG 303	Classical Poetry (14-18 century)	3
5		ENG 312	Discourse Analysis	3
6	Morphology and Syntax I (ENG 202)	ENG 309	Morphology and Syntax II	3
			Total Credit Hours	**18**

Semester 6

S. No	Pre-Requisite with Course code	CourseCode	Course Title	Credit Hours
1		ENG 305	Research Methodology	3
2		ENG 314	Lexical Studies	3
3		ENG 310	Sociolinguistics	3
4		ENG 304	Novel (18-19 Century)	3
5		ENG 308	Romantic Poetry	3
			Total Credit Hours	**15**

Majors (Literature)

Semester 7

S. No	Pre-Requisite with Course code	CourseCode	Course Title	Credit Hours
1		ENG 401	Contemporary Literature 1 (Poetry& Drama)	3
2		ENG 402	South Asian Literature	3
3			Literature Elective 1	3
4			Literature Elective II	3
5			Literature Elective III	3
			Total Credit Hours	**15**

Semester 8

S. NO	Pre-Requisite with Course code	CourseCode	Course Title	Credit Hours
1		ENG 403	American / Canadian Literature	3
2		ENG 409	Contemporary Literature II (Prose &Novel)	3
3			Literature Elective IV	3
4			Literature Elective V	3
5			Literature Elective VI	3
			Total Credit Hours	**15**

Majors (Linguistics)

Semester 7

S.NO	Pre-Requisite with Course code	CourseCode	Course Title	Credit Hours
1		ENG405	Stylistics	3
2		ENG413	Pragmatics	3
3			Linguistics Elective 1	3
4			Linguistics Elective II	3
5			Linguistics Elective III	3
			Total Credit Hours	**15**

Semester 8

S. NO	Pre- Requisite with Course code	Course Code	Course Title	Credit Hours
1		ENG 313	Psycholinguistics	3
2		ENG 414	Introduction to Applied Linguistics	3
3			Linguistics Elective IV	3
4			Linguistics Elective V	3
5			Linguistics Elective VI	3
			Total Credit Hours	**15**

Note:

- From semester 7 onwards, students will opt for either Literature or Linguistics specialization.
- Research is optional for students. Students will study 2 Elective courses of 3 credit hours each in lieu of Research.
- Internship of 6-9 weeks after 4th Semester.
- Proposed Roadmap is recommended to be implemented from Spring 2022 intake in BUIC and Fall 2023 intake in BUKC

Summary (Credit Distribution)

Categories	No. of Courses	Credit Hours	
Foundational Courses	4	12	
Pakistan and Islamic Studies Courses	2	6	
General Courses	10	30	
Core	23	69	
Electives (Specialization)	6	18	
	2/0	6/0	
Total Credit Hours		**135**	

- Research is optional for students. Students will study 2 Elective courses of 3 credit hours each in lieu of Research.

S. NO	Course Code	Internship	Credit Hours /Non-Credit Hours
1	SDW 496	Internship	Non-Credit Hours

FOUNDATIONAL		
S.NO	**Course Code**	**Course Title**
1	ENG 101	Functional English
2	ENG 102	English Writing Skills
3	ENG 213	Oral Communication andPresentation Skills
4	ENG 207	Advance Academic reading &Writing skills

Pakistan and Islamic Studies Courses		
S.NO	**Course Code**	**Course Title**
1	PAK 104	Pakistan Studies
2	ISL 102	Islamic Studies

GENERAL COURSES		
S. NO	**Course Code**	**Course Title**
1	PSY 107	Introduction to Psychology
2	HSS 107	Introduction to Philosophy
3	HSS 111	Introduction to InternationalRelations
4	MAT 105	Mathematics
5	MGT 206	Entrepreneurship
6	BES 204	Introduction to Computer Application
7	ECO 205	Economics
8	QTM 212	Introduction to statistics
9	ENV 105	Introduction to EnvironmentalStudies
10	ANT 230	Gender Studies

CORE COURSES (Literature & Linguistics)		
S.NO	**Course Code**	**Course Title**
1	ENG 108	Introduction to English Literature-1 (Drama & Poetry)
2	ENG 109	Introduction to Linguistics
3	ENG 112	Phonetics and Phonology
4	ENG 110	History Of English Literature 1 (Medieval to Romantics)
5	ENG 202	Morphology and Syntax 1
6	ENG 203	Introduction to Literature II (Novel & Prose)
7	ENG 211	History of English Literature 11 (Romantics to Present Age)
8	ENG 210	Semantics
9	ENG 307	Classics in drama
10	ENG 311	Pedagogical Grammar
11	ENG 306	Literary criticism & Theory
12	ENG 303	Classical Poetry (14-18 century)
13	ENG 312	Discourse Analysis
14	ENG 309	Morphology and Syntax II
15	ENG 305	Research Methodology
16	ENG 314	Lexical Studies
17	ENG 310	Sociolinguistics
18	ENG 304	Novel (18-19 Century)
19	ENG 308	Romantic Poetry

LITERATURE CORE COURSES IN 7th & 8th SEMESTER		
S. NO	**Course Code**	**Course Title**
1	ENG 401	Contemporary Literature 1 (Poetry& Drama)
2	ENG 402	South Asian Literature
3	ENG 403	American / Canadian Literature
4	ENG 409	Contemporary Literature II (Prose &Novel)

LINGUISTICS CORE COURSES IN 7th & 8th SEMESTER		
S. NO	**Course Code**	**Course Title**
1	ENG 405	Stylistics
2	ENG 413	Pragmatics
3	ENG 313	Psycholinguistics
4	ENG 414	Introduction to Applied Linguistics

LIST OF ELECTIVES –LITERATURE			LIST OF ELECTIVES- LINGUISTICS		
S.NO	**COURSE CODE**	**COURSE TITLE**	**S.NO**	**COURSE CODE**	**COURSE TITLE**
1	ENG 410	Post-Colonial Literature	1	ENG 406	Language Learning Theories
2	ENG 411	Literary Discourse & Journalistic Writing	2	ENG 407	Syllabus Designing and Testing
3	ENG 451	African Literature	3	ENG 408	TEFEL-I
4	ENG 452	Continental Literature	4	ENG 412	TEFEL-II
5	ENG 453	Fantasy	5	ENG 471	Computational Linguistics
6	ENG 454	Islam and Western Literature	6	ENG 472	Corpus Linguistics
7	ENG 455	Journalist Discourse	7	ENG 473	Critical Pedagogy
8	ENG 456	Literary Essays	8	ENG 474	Educational Technology
9	ENG 457	Literature of War and Conflict	9	ENG 475	Forensic Linguistics
10	ENG 458	Literature, Culture and Media	10	ENG 476	History of Modern Linguistics
11	ENG 459	Modern Drama and Novel	11	ENG 477	Language and Education
12	ENG 460	Modern Poetry	12	ENG 478	Language and Gender
13	ENG 461	Pakistani Literature in English I	13	ENG 479	Language Testing
14	ENG 462	Pakistani Literature in English II	14	ENG 480	Linguistic Survey of Pakistan
15	ENG 463	Popular Fiction	15	ENG 481	Linguistics and Law
16	ENG 464	Russian Literature	16	ENG 482	Linguistics and Translation
17	ENG 465	Shakespeare Studies	17	ENG 483	Second Language Acquisition
18	ENG 515	Western Literature	18	ENG 484	Technology in Language Teaching
19	ENG 516	World Literature	19	ENG 485	Testing and Evaluation
20	ENG 517	Feminist Literature	20	ENG 486	Varieties of English
21	ENG 518	Comparative Studies	21	ENG 520	English for Specific Purposes
			22	ENG 521	Translational Studies
			23	ENG 522	English Language Teaching
			24	ENG 523	Media Discourse Analysis

8/3/2023

Roadmap of BS English (Existing, & New)

1

Introduction

- BS-English Program has two major streams-Literature and Linguistics. Students opt for streams from 5th semester onward. However, there are many courses which are either irrelevant to a stream or overlap between the two streams. Furthermore, there is a slight difference of credit hours between IC and KC programs.
- In order to align the roadmaps at both campuses and to make the Program better, revised roadmap is presented for approval.
- After approval, students will now opt for their specialization from 7th semester onward.
- Thesis is optional in 7th and 8th semesters. Students can take thesis of 06 credit hours in lieu of two courses of 3 credit hours each.
- Internship (non-credited) of minimum 06 weeks after 4th Semester.
- 40 hours of CSP is mandatory.

2

Credit Distribution

Categories	No. of Courses	Credit Hours	
Foundational Courses	4	12	
Pakistan and Islamic Studies Courses	2	6	
General Courses	10	30	
Core	23	69	
Electives (Specialization)	6	18	
Internship (non-credited) minimum 06 weeks Students can take thesis of 06 credit hours in lieu of two courses of 3 credit hours each			
Total Credit Hours 135			

3

Foundational and Pak/Islamic Studies

FOUNDATIONAL		
S.#	Course Code	Course Title
1	ENG 101	Functional English
2	ENG 102	English Writing Skills
3	ENG 213	Oral Communication and Presentation Skills
4	ENG 207	Advance Academic reading & Writing skills
Pakistan and Islamic Studies Courses		
S.#	Course Code	Course Title
1	PAK 104	Pakistan Studies
2	ISL 102	Islamic Studies

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General Courses

S.#	Course Code	Course Title
1	PSY 107	Introduction to Psychology
2	HSS 107	Introduction to Philosophy
3	HSS 111	Introduction to International Relations
4	MAT 105	Mathematics
5	MGT 206	Entrepreneurship
6	HES 204	Introduction to Computer Application
7	ECO 205	Economics
8	QTM 212	Introduction to statistics
9	ENV 105	Introduction to Environmental Studies
10	ANT 230	Gender Studies

5

S.#	Course Code	Course Title
1	ENG 108	Introduction to English Literature-I (Drama & Poetry)
2	ENG 109	Introduction to Linguistics
3	ENG 112	Phonetics and Phonology
4	ENG 110	History Of English Literature I (Medieval to Romantics)
5	ENG 202	Morphology and Syntax I
6	ENG 203	Introduction to Literature II(Novel & Prose)
7	ENG 211	History of English Literature- II (Romantics to Present Age)
8	ENG 210	Semantics
9	ENG 307	Classics in drama
10	ENG 311	Pedagogical Grammar
11	ENG 306	Literary criticism & Theory
12	ENG 303	Classical Poetry (14-18 century)
13	ENG 312	Discourse Analysis
14	ENG 309	Morphology and Syntax II
15	ENG 305	Research Methodology
16	ENG 314	Lexical Studies
17	ENG 310	Sociolinguistics
18	ENG 304	Novel (18-19 Century)

6

	COURSE CODE	COURSE TITLE	S.#	COURSE CODE	COURSE TITLE
1	ENG 410	Post-Colonial Literature	1	ENG 406	Language Learning Theories
2	ENG 411	Literary Discourse & Journalistic Writing	2	ENG 407	Syllabus Designing and Testing
3	ENG 451	African Literature	3	ENG 408	TEFEL-I
4	ENG 452	Continental Literature	4	ENG 412	TEFEL-II
5	ENG 453	Fantasy	5	ENG 471	Computational Linguistics
6	ENG 454	Islam and Western Literature	6	ENG 472	Corpus Linguistics
7	ENG 455	Journalistic Discourse	7	ENG 473	Critical Pedagogy
8	ENG 456	Literary Essays	8	ENG 474	Educational Technology
9	ENG 457	Literature of War and Conflict	9	ENG 475	Forensic Linguistics
10	ENG 458	Literature, Culture and Media	10	ENG 476	History of Modern Linguistics
11	ENG 459	Modern Drama and Novel	11	ENG 477	Language and Education
12	ENG 460	Modern Poetry	12	ENG 478	Language and Gender
13	ENG 461	Pakistani Literature in English-I	13	ENG 479	Language Testing
14	ENG 462	Pakistani Literature in English II	14	ENG 480	Linguistic Survey of Pakistan
15	ENG 463	Popular Fiction	15	ENG 481	Linguistics and Law
16	ENG 464	Russian Literature	16	ENG 482	Linguistics and Translation
17	ENG 465	Shakespeare Studies	17	ENG 483	Second Language Acquisition
18	ENG 515	Western Literature	18	ENG 484	Technology in Language Teaching
19	ENG 516	World Literature	19	ENG 485	Testing and Evaluation
20	ENG 517	Feminist Literature	20	ENG 486	Varieties of English
21	ENG 518	Comparative Studies	21	ENG 520	English for Specific Purposes
			22	ENG 521	Translational Studies
			23	ENG 522	English Language Teaching
			24	ENG 523	Media Discourse Analysis

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Semester 1

Proposed

S#	Pre-Requisite	Course Code	Course Title	Credit Hours
1		ENG 101	Functional English	3
2		PAK 104	Pakistan Studies	3
3		PSY 107	Introduction to Psychology	3
4		HSS 107	Introduction to Philosophy	3
5		ENG 108	Introduction to English Literature I(Drama & Poetry)	3
6		ENG 109	Introduction to Linguistics	3
			Total Credit Hours 18	

Existing

Course Code	Course Title	Credit Hours
ENG-105	Functional English (English-I)	3
PAK-101	Pakistan Studies	2
HSS-102	Introduction to Philosophy	3
HSS-107	Introduction to Psychology	3
ENG-103	Introduction to Literature-I (Drama & Poetry)	3
ENG-104	Introduction to Linguistics	3
	Total Credit Hours 17	

8

2

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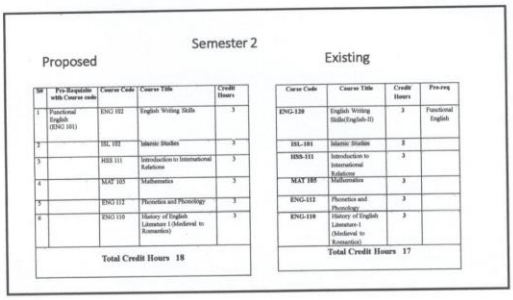


Semester 2

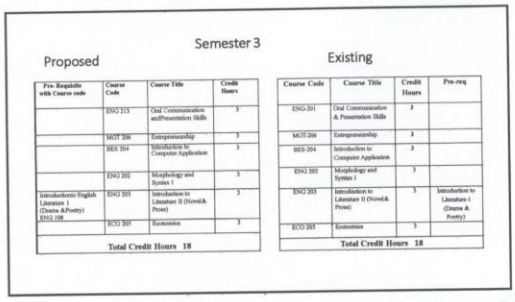
Proposed

Sl#	Pre-Requisite with Course code	Course Code	Course Title	Credit Hours
1	Functional English (ENG 101)	ENG 102	English Writing Skills	3
2		ISL 102	Islamic Studies	3
3		HSS 111	Introduction to International Relations	3
4		MAT 105	Mathematics	3
5		ENG 112	Phonetics and Phonology	3
6		ENG 110	History of English Literature I (Medieval to Romantics)	3
	Total Credit Hours 18			

Existing

Course Code	Course Title	Credit Hours	Pre-req
ENG-120	English Writing Skills(English-II)	3	Functional English
ISL-101	Islamic Studies	2	
HSS-111	Introduction to international Relations	3	
MAT 105	Mathematics	3	
ENG-112	Phonetics and Phonology	3	
ENG-110	History of English Literature-1 (Medieval to Romantics)	3	
	Total Credit Hours 17		

9



Semester 3

Proposed

Pre-Requisite with Course code	Course Code	Course Title	Credit Hours
	ENG 213	Oral Communication andPresentation Skills	3
	MGT 206	Entrepreneurship	3
	BES 304	Introduction to Computer Application	3
	ENG 202	Morphology and Syntax I	3
Introductionto English Literature I (Drama &Poetry) ENG 108	ENG 203	Introduction to Literature II (Novel& Prose)	3
	ECO 205	Economics	3
Total Credit Hours 18			

Existing

Course Code	Course Title	Credit Hours	Pre-req
ENG-201	Oral Communication & Presentation Skills	3	
MGT-206	Entrepreneurship	3	
BES-204	Introduction to Computer Application	3	
ENG 202	Morphology and Syntax I	3	
ENG 203	Introduction to Literature II (Novel& Prose)	3	Introduction to Literature-I (Drama & Poetry)
ECO 205	Economics	3	
Total Credit Hours 18			

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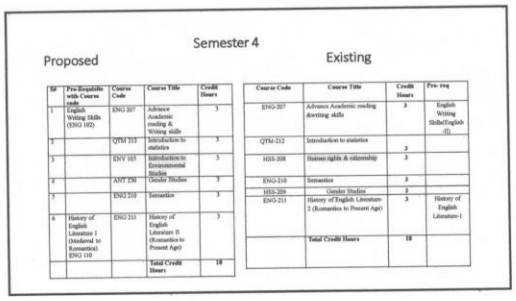


Semester 4

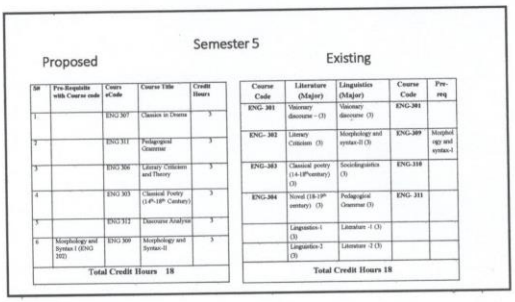
Proposed

Sl#	Pre-Requisite with Course code	Course Code	Course Title	Credit Hours
1	English Writing Skills (ENG 102)	ENG 207	Advance Academic reading & Writing skills	3
2		QTM 212	Introduction to statistics	3
3		ENV 105	Introduction to Environmental Studies	3
4		ANT 230	Gender Studies	3
5		ENG 210	Semantics	3
6	History of English Literature I (Medieval to Romantics) ENG 110	ENG 211	History of English Literature II (Romantics to Present Age)	3
			Total Credit Hours	18

Existing

Course Code	Course Title	Credit Hours	Pre-req
ENG-207	Advance Academic reading &writing skills	3	English Writing Skills(English -II)
QTM-212	Introduction to statistics	3	
HSS-208	Human rights & citizenship	3	
ENG-210	Semantics	3	
HSS-209	Gender Studies	3	
ENG-211	History of English Literature-2 (Romantics to Present Age)	3	History of English Literature-1
	Total Credit Hours	18	

11



Semester 5

Proposed

Sl#	Pre-Requisite with Course code	Course eCode	Course Title	Credit Hours
1		ENG 307	Classics in Drama	3
2		ENG 311	Pedagogical Grammar	3
3		ENG 306	Literary Criticism and Theory	3
4		ENG 303	Classical Poetry (14th-19th Century)	3
5		ENG 312	Discourse Analysis	3
6	Morphology and Syntax I (ENG 202)	ENG 309	Morphology and Syntax-II	3
	Total Credit Hours 18			

Existing

Course Code	LIterature (Major)	Linguistics (Major)	Course Code	Pre-req
ENG. 301	Visionary discourse – (3)	Visionary discourse (3)	ENG-301	
ENG- 302	Literary Criticism (3)	Morphology and syntax-II (3)	ENG-309	Morphology and syntax-I
ENG-303	Classical poetry (14-18thcentury) (3)	Sociolinguistics (3)	ENG-310	
ENG-304	Novel (18-19th century) (3)	Pedagogical Grammar (3)	ENG- 311	
	Linguistics-1 (3)	Literature -1 (3)		
	Linguistics-2 (3)	Literature -2 (3)		
	Total Credit Hours 18			

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Semester 6

Proposed

S#	Pre-Requisite with Course code	Course Code	Course Title	Credit Hours
1		ENG 305	Research Methodology	3
2		ENG 314	Lexical Studies	3
3		ENG 310	Sociolinguistics	3
4		ENG 304	Novel (18-19 Century)	3
5		ENG 308	Romantic Poetry	3
Total Credit Hours 15				

Existing

Course Code	Literature (Major)	Linguistics (Major)	Course Code	Pre-req
ENG- 305	Research Methodology (3)	Research Methodology (03)	ENG-305	
ENG-306	Literary Criticism and theory(3)	Discourse analysis (3)	ENG-312	Literary criticism
ENG-307	Classics in drama (3)	Psycholinguistics (3)	ENG- 313	
ENG-308	Romantic poetry (19-20th century) (3)	Lexical studies (3)	ENG- 314	
	Linguistics-3 (3)	Literature -3 (3)		
Total Credit Hours 15				

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Semester 7 (Literature)

Proposed

S#	Pre-Requisite	Course Code	Course Title	Credit Hours
1		ENG 401	Contemporary Literature 1 (Poetry & Drama)	3
2		ENG 402	South Asian Literature	3
3			Literature Elective 1	3
4			Literature Elective II	3
5			Literature Elective III	3
Total Credit Hours 15				

Existing

Course Code	Course Title	Credit Hours
ENG-401	Contemporary literature-1(poetry& drama)	3
ENG-402	South Asian literature	3
ENG-403	American and Canadian literature	3
	Elective-I	3
	Elective- 2	3
Total Credit Hours 15		

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Semester 8 (Literature)

Proposed

S#	Pre-Req uisite	Course Code	Course Title	Credit Hours
1		ENG 403	American / Canadian Literature	3
2		ENG 409	Contemporary Literature II (Prose & Novel)	3
3			Literature Elective- IV	3
4			Literature Elective- V	3
5			Literature Elective- VI	3
Total Credit Hours 15				

Existing

Course Code	Course Title	Credit Hours
ENG-409	Contemporary literature-II (Prose & Novel)	3
ENG-410	Post-colonial literature	3
ENG-411	Literary discourse & journalistic writing	3
	Elective-III	3
	Elective-IV	3
Total Credit Hours 15		

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Semester 7 (Linguistics)

Proposed

S#	Course Code	Course Title	Credit Hours
1	ENG405	Stylistics	3
2	ENG413	Pragmatics	3
3		Linguistics Elective I	3
4		Linguistics Elective II	3
5		Linguistics Elective III	3
	Total Credit Hours 15		

Existing

Course Code	Course Title	Credit Hours
ENG 405	Stylistics	3
ENG 406	Language learning theories (3)	3
ENG 408	TEFEL-1	3
	Elective-I	3
	Elective-II	3
Total Credit Hours 15		

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Semester 8

(Linguistics)

Proposed

Sl#	Pre-Requisite	Course Code	Course Title	Credit Hours
1		ENG 313	Psycholingusitics	3
2		ENG 414	Introduction to Applied Linguistics	3
3			Linguistics Elective IV	3
4			Linguistics Elective V	3
5			Linguistics Elective VI	3
Total Credit Hours 15				

Existing

	TEFEL-2	Credit Hours
ENG-412		
ENG-413	Pragmatics	3
ENG-414	Introduction to Applied Linguistics	3
ENG-407	Syllabus designing and testing (3)	3
	Elective-III	3
	Elective-IV	3
Total Credit Hours 15		

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Recommended Changes

	Proposed	Existing
Credit Hours	135	133
Division of stream	7th Semester onwards	5th Semester onwards
Thesis	06 Credit Hours in lieu of 2 Courses divided in 7th and 8th semester	06 Credit Hours in lieu of 2 Courses divided in 7th and 8th semester

18

Recommendation

- Proposed Roadmap is recommended for the approval and to be implemented from Spring 2022 intake in BUIC and Fall 2023 intake in BUKC

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Appendage 4404-A

EXTRACT FROM BU ACADEMIC RULES 2016

Chapter 3 – General Academic Rules

3.20 Summer Session Rules

3.20.1 Registration of courses in a summer session shall be regulated as follows:

a. In summer semester, registration of courses shall be for retaking failed courses and/or for improvement of Grades less than B (including B-), on improvement maximum grade award shall be capped at B+

B+	≥ 75%	< 80%
B	≥ 71 %	< 75 %
B-	≥ 68 %	< 71 %

b. There shall be no registration for Advance/ New Courses.

c. Registration shall be limited to a maximum of two courses. Registration in a third course may be permitted, by the Campus Head/ Head of the CU, to the students who risk lapsing into the time-bar category if the third course is not allowed to them.

d. Students granted Waiver to Time Bar shall be ineligible to take any missing/ shortfall courses in the summer session.

Appendage 4404-B

EXTRACT FROM HEC POLICY GUIDELINES FOR IMPLEMENTATION OF UNIFORM SEMESTER SYSTEM IN HEI'S OF PAKISTAN

4 FALL/SPRING SEMESTER

4.1 There will be two regular semesters (fall, spring) in an academic year. Fall/Spring semesters will spread over 16-18 weeks (inclusive of 1 – 2 weeks for exams). Summer Semester will be of 8 – 9 weeks of concentrated study for completing remedial course work.

4.2 HEIs are at liberty to enroll students (if they fulfill their admission criteria) for Fall/Spring semester or for any single course and issue transcript with letter grades at the end of the semester. Depending on the availability of staff and necessary facilities HEIs can offer a summer session. Students can enroll maximum of 2 Theory courses or 1 lab course during summer sessions.

4.3 Foreign students under student exchange programme will be enrolled for any semester or for any single course and HEIs will issue transcript with letter grades at the end of the semester. Admission offer letter of the foreign student will be forwarded to HEC for issuance of NOC.

Appendage 4405

PROPOSED MECHANISM FOR CONDUCT OF ONLINE WEEKLY CLASSES

1. All students/ scholars will attend online classes from their residence.

2. BU PFMs/ VFMs/ Professors of Practice will take online classes from their residence.

3. All BUSAS of the CUs and BUHO will perform respective admin/ staff work from their residence. In this regard, all Directors will ensure the availability of necessary resources (hardware, software, etc) for their staff to smoothly perform their duties online from home.

4. All Deans, Principals, HODs, ASA and Cluster Heads will monitor their online classes from home.

5. All HODs will further ensure in making the classes timetables that no course is conducted completely online during the entire duration of the semester.

6. Labs would not be scheduled on Wednesdays, so that the online day is followed accordingly.

7. Directors Admin of the CUs and BUHO will ensure security of the buildings and infrastructure during online days as per related SOPs and with presence of essential staff.

8. A Reception Desk at all CUs will remain open to handle the visitors or alumni queries and direct request for online handling to concerned Points of Contact in academic and administrative departments.

Appendage 4406

PROPOSED AMENDMENTS IN BU ACADEMIC RULES 2016 FOR PROBATION POLICY

<table>
<tr><th>BUAR 2016 Chapter 7 – Examinations</th><th>Proposed Amendments</th></tr>
<tr>
<td>
7.10 Probation, Chance & Drop Rules for Underperforming Students

7.10.1 In any semester, a student shall be placed on Probation on failing to achieve the minimum CGPA (GPA if it is the first semester) stipulated for the programme, as follows:

<table>
<tr><th>Programme</th><th>Minimum CGPA</th></tr>
<tr><td>a. Undergrad programmes</td><td>2.0</td></tr>
<tr><td>b. MBA/MS/MPhil programmes</td><td>2.5</td></tr>
<tr><td>c. PhD coursework</td><td>3.0</td></tr>
</table>

7.10.2 The same student shall be placed on Chance on failing to achieve the clause 7.10.1 minima for the second time, in any semester, and shall be Dropped from the programme on failing to achieve the minima at clause 7.10.1 for the third time, in any semester. A student whose CGPA falls below the clause 7.10.1 minima any time after availing one Probation and one Chance, in any semester, shall be Dropped.

7.10.3 Undergraduates of BU academic programs enrolled in CUs administratively and financially under the Naval Headquarters are to follow relevant PN rules for Relegation/ Withdrawal.
</td>
<td>
7.10 Academic Probation and Dropped Rules for Underperforming Students

7.10.1 In any semester, a student shall be placed on Probation on failing to achieve the minimum CGPA (GPA if it is the first semester) stipulated for the programme, as follows:

<table>
<tr><th>Prog</th><th>Min CGPA</th><th>No. of Probations</th></tr>
<tr><td>UG</td><td>2.0</td><td>3 Consecutive</td></tr>
<tr><td>MBA/MS/MPhil</td><td>2.5</td><td>2 Consecutive</td></tr>
<tr><td>PhD</td><td>3.0</td><td>2 Consecutive</td></tr>
</table>

7.10.2 After each Probation, a formal warning letter is to be issued to the student by concerned HOD and a copy (duly signed/ acknowledged by the student) retained in the HOD office for record purpose.

7.10.3 The student shall be Dropped from the programme on attaining the maximum consecutive Probations as tabulated in clause 7.10.1.

7.10.4 If a student on Probation improves his/ her CGPA equal to or higher than the minimum required CGPA mentioned in clause 7.10.1 above, he/ she shall be taken out of the Probation regime, for a fresh count in case of another Probation in the later semester.

7.10.5 Students on consecutive academic Probation (One for PhD/ MS/M Phil Scholars and Two for UG students) will be registered for a new course/ semester after recommended by the HOD and approved by the concerned Principal.

7.10.6 When a student is readmitted with credit exemptions (only for C+ and above grades) from a previous admission, the maximum duration allowed to complete the degree programme will be counted from the date of first admission.
</td>
</tr>
</table>

Appendage 4407

LAUNCH PROPOSAL FOR ASSOCIATE DEGREE IN BUSINESS ADMINISTRATION

	A. ACADEMIC DETAILS
1	**Faculty/Department:** Management Sciences Department
2	**Title of the Program: (to be printed on Degree/Transcript) Associate** Degree Program in Business Administration
3	**Mission of the Program:** To equip the students with adequate business knowledge and to inculcate soft-skills which would help them take an early start of their professional career
4	**Program Educational Objectives (PEOs)** 1. To prepare students with basic level business knowledge and tools 2. To equip students with personal and professional skills 3. To prepare students for professional employability & ethics
5	**Program Learning Outcomes (PLOs)** 1. Business Knowledge – Provision of basic knowledge of Accounting, finance, marketing, & human resource management fundamentals 2. Problem Analysis – Ability to analyze various basic business problems 3. Design/Development of Solution – Ability to design solution to the basic business problems 4. Communication Skills: Ability to communicate effectively, orally as well as in writing, on complex business activities with the business community and with society at large, such as being able to comprehend and write effective reports and design documentation and make effective presentations. 5. Modern Tool Usage: Hands-on experience of various business tools 6. Ethics – Ability to understand and adopt business ethics
6	**Rationale for the Program:** 1. ADP in Business Administration is specially designed for students: • Who are interested in learning business administration but do not have enough time and resources to invest in four years BBA program will enroll in 2-year ADP in Business Administration Program. • Who want to start their professional career earlier 1. ADP program may help in strengthening our BBA program 2. ADP(BA) will be an affordable and accessible way for students to begin their education in business administration and gain the skills necessary to enter the workforce or transfer to a four-year degree program 3. The program exposes students to emerging technologies and trends in the field of business administration, preparing them to adapt to a constantly evolving technological landscape 4. The program is designed to meet the needs of students with diverse backgrounds and learning styles, providing them with the support and resources necessary to achieve their goals

7	**Brief Description of the Program:** This is a 2 -year post intermediate associate degree program, designed to get a fundamental business education. It will build a strong foundation in various aspects of business such as management, marketing, finance, and human resource management along with some general education courses. Upon successful completion of this two years program, students can start work on various entry-level positions such as administrative assistant, customer representative, sales representative and assistant account officer etc. Graduate can also continue their education by pursuing a bachelor degree in business administration or a related field.
8	**Duration:** 2 years
9	**Venue(s): On Site/Off Site/Both On & Off Site: On-Site**
10	**Program Scheduling Format:** **Morning/Evening/Weekend: Morning** **Semester/Annual/ : Fall semester**
11	**Proposed Date of Commencement: Fall 2023**
12	**Mode of Study/Examination: Full-time class room lectures.**
13	**Additional Faculty Member(s) Required:** *(Indicate if there is a requirement for additional faculty members, fulltime/visiting, along with qualifications.)* **No**
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.)* **No**
15	**Additional Classroom(s) required:** *(The requirement is to include the number of classrooms and their capacities.)* **No**
16	**Additional Requirement for Laboratories:** *(The requirement is to include the number of laboratories, their equipment and their capacities.)* **No**
17	**Additional Requirement for Books, Subscriptions, Memberships to Online Research Sites/ Repositories: No**
18	**Minimum Qualification for Admission:** Intermediate (12 Years min 50% marks)
19	**Admission Eligibility Criteria: (to be aligned with accreditation/regulatory bodies)** Minimum 50 % marks in HSSC/FSc/ICS/ICOM/A-Level or equivalent ADP students will be allowed to be admitted in BBA 5th semester based on the university TOC rules.
20	**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).* **No**
21	**Number of Admissions Expected for First Intake:** 20
22	**Number of Admissions Planned/Expected for Subsequent Intakes:** 2nd Intake – 20

	3rd Intake – 25 4th Intake – 25 5th Intake – 25
23	**Referred by:** *(delete which is inapplicable)* **FBOS**: *(Indicate the FBOS meeting reference and Item No)* **Competent Authority**: *(Indicate the File No & date; reproduce the decision)*
24	**Complete Plan of Studies, inclusive of complete Roadmap:** *(Attach as Annex 'B')*
25	**Course Outlines, Descriptions, Pre-Requisites & Readings (Compulsory & Recommended)** *(Attach as Annex 'C')*

B. FINANCIAL DETAILS	
1	**Source of Funding:** • **BU: Fully/Partially: Fully** • **Public Sector (B1): Fully/Partially** *(provide complete details; attach MOU, agreement etc.)* **Fully** • **NNGO (B1): Fully/Partially** *(provide complete details; attach MOU, agreement etc.)* • **INGO (B1): Fully/Partially** *(provide complete details; attach MOU, agreement etc.)* • **UN/IGO (B1): Fully/Partially** *(provide complete details; attach MOU, agreement etc.)*
2	**Degree Duration:** 2 Years **Annual or Semester System:** Semester System **Semester**: Fall **Number of Semester:** 4 **Total Number of Credit Hours:** 72
3	**Expected fee to be charged based on Cost & Benefits Analysis:** *(show working)* - **Total Program Fee (4 Semesters) = Rs. 299,000/-** - Admission Fee = Rs. 15,000/- - Misc. Charges = Rs. 750 0/- - Caution Money (Refundable) = Rs. 10,000/- - Degree Fee = Rs. 15,000/- - Total Credit Hours = 72 - Per Credit Hour Fee = Rs. 3,400/- - Per Semester Fee (Avg.) = Rs. 74,750/-
4	**Expected Number of students for 1st & 2nd Intakes: 20 (First), 25 (Second**) - 1st Intake = 20 Students - 2nd Intake = 25 Students
5	**Expected Earning from first two Intakes (B5):** *(Show working)* **(Annual Intake)** - **Intake Students Total Students Revenue** - 1st 20 20 Rs. 2,990,000/- - 2nd 25 45 Rs. 6,727,500/-
6	**Expected Earning for the Next Five Years (B6):** *(show working)* - **Intake Students Total Students Revenue**

	1st	25	20	Rs. 2,990,000/-
	2nd	25	45	Rs. 6,727,500/-
	3rd	25	50	Rs. 7,475,000/-
	4th	25	50	Rs. 7,475,000/-
	5th	25	50	Rs. 7,475,000/-
7	**Total Estimated Salaries of all Additional Human Resources per annum (B7):** *(Show working)* ***First Intake - 1700*48*3*2=*** **Rs.489,600*** **Second & Subsequent Intakes – 1700*48*6*2 = Rs. 979,200** ***ADP courses are mapped & merged with BBA courses. The average academic cost is shared between ADP and BBA programs. No additional human resources will be engaged. Exiting resources will be utilized.**			
8	**Cost of <u>Additional</u> Laboratory Equipment/Tools (B8):** *(show working)* ***No***			
9	**Cost of Additional Classrooms (B9):** *(Include furniture, technical aids etc)* ***No***			
10	**Cost of Additional Books, Subscription & Memberships to on-line Sites/Repositories (B10):** (*show details)* **No**			
11	**Off-Site rental Expenses and Cost of other Fixtures (B11):** *(Show details)* **No**			
12	**Miscellaneous Expenses required for Starting the Program (B12): No**			
	- Printing & Stationery - Admin Cost - Any other - **Total NIL**			
13	**Annual Recurring Expenditures in Subsequent Years (B13):** - Salaries: 979,200 * - Rentals: - Subscriptions/Memberships: - Advertisements: /- - Printing & Stationery: - Admin Cost - - Any other - - **Total: 979,200** ***ADP Courses are mapped & merged with BBA courses. The average academic cost is shared between ADP and BBA programs. No additional human resources will be engaged. Existing resources will be utilized**			
14	**Total Cost of the Program (B14):** [Add B(7) to B(12)] - Rs. 979,200 (Per annum cost* 2)			
15	**Net Cost of the Program (B15):** [Subtract B(1) from B(14)] Rs. 979,200			
16	**Net Earnings in First Year (B16:** [Subtract B(15) from B(5)] Rs. 2,500,400/-			

17	**Projected Annual Gross Earning in Subsequent Years (B 17):** *(show details & working; add 10% towards all expenses in subsequent years.)* Rs. 7,475,000/-
18	**Projected Annual Net Earning in Subsequent Years:** *[Subtract B(13) from B(17)]* - Rs. 6,495,800/-

ROADMAP OF ASSOCIATE DEGREE PROGRAM (ADP) IN BUSINESS ADMINISTRATION

University Vision

To become a knowledge and creativity driven international university that contributes towards development of society.

University Mission

To ensure academic excellence through deliverance of quality education and applied research in a collegiate environment having strong linkages with industry and international community to meet the societal challenges.

Department Vision

To develop business professionals with competencies to lead and innovate for sustainable societal development.

Department Mission

We nurture responsible business professionals and entrepreneurs by providing quality education and applied research through immersive and collaborative learning and teaching environment, with strong industry linkages for sustainable societal impact.

Program Educational Objectives (PEOs)

To prepare students with basic level business knowledge and tools
To equip students with personal and professional skills
To prepare students for professional employability and ethics

Program Learning Outcomes (PLOs)

Business Knowledge – Provision of basic knowledge of Accounting, finance, marketing, & human resource management fundamentals
Problem Analysis – Ability to analyze various basic business problems
Design/Development of Solution – Ability to design solution to the basic business problems
Communication Skills: Ability to communicate effectively, orally as well as in writing, on complex business activities with the business community and with society at large, such as being able to comprehend and write effective reports and design documentation and make effective presentations.
Modern Tool Usage: Hands-on experience of various business tools
Ethics – Ability to understand and adopt business ethics

PEOs & PLOs Mapping

PLO		PEO 1	PEO 2	PEO 3
PLO 1	Business Knowledge	✓		
PLO 2	Problem Analysis	✓		
PLO 3	Design/Development of Solution	✓		
PLO 4	Communication Skills		✓	
PLO 5	Modern Tool Usage		✓	
PLO 6	Ethics			✓

NEW ROADMAPS & COURSE CODES

ADP in Business Administration

Admission Eligibility Criteria: Intermediate (12 Years min 45% marks)

Campus: Lahore
Department: Management Sciences
Program Title: ADP in Business Administration
Program Level: Undergraduate
Total Duration of Program: 2 Years
Total Number of semesters: 4
Total Credit Hours: 72

Areas	Credit Hours	Courses
Business Core	33	11
Mathematics & Supporting	24	8
General Education Requirement	15	5
Total	**72**	**24**

Semester-1

Sr. No.	Course Code	Course Title	Credit Hours
1	ENG 101	Functional English	3
2	MKT 110	Principles of Marketing	3
3	QTM 101	Business Mathematics I	3
4	ECO 110	Microeconomics	3
5	MGT 111	Principles of Management	3
6	MIS 161	IT in Business (word, excel)	3
		Total Credit Hours	**18**

Semester-2

Sr. No.	Course Code	Course Title	Credit Hours
1	ENG 102	English Writing Skills	3
2	QTM 120	Business Mathematics II / Numeracy Skills	3
3	HSS 202	Introduction to Sociology	3

4	ECO 121	Macroeconomics	3
5	QTM 110	Business Statistics	3
6	ACC 101	Principles of Accounting	3
		Total Credit Hours	**18**

Semester-3

Sr. No.	Course Code	Course Title	Credit Hours
1	ENG 213	Oral Communication (Public Speaking)	3
2	QTM 205	Statistical Inference and Quantitative Research	3
3	ACC 102	Financial Accounting	3
4	ISL 201 / SOC 360	Islamic Socio-Economic Studies / Ethics	3
5	MKT 231	Marketing Management	3
6	MGT 242	Organizational Theory and Behavior	3
		Total Credit Hours	**18**

Semester-4

Sr. No.	Course Code	Course Title	Credit Hours
1	MGT 211	Self-Management	3
2	ACC 203	Cost Accounting	3
3	BCM 204	Business Communication	3
4	FIN 201	Fundamentals of Finance	3
5	LAW 319	Business Law	3
6	SOC 350	Business Ethics	3
7	SDW 496	Internship (3+3 weeks)	0
		*20 CSP Hours	
		Total Credit Hours	**18**

*Every student enrolled in ADP program, is required to serve the community for 20 hours

Appendage 4408

LAUNCH PROPOSAL FOR ADVANCED DIPLOMA IN INFANT, CHILD AND ADOLESCENT MENTAL HEALTH

It has been observed that many students who have completed BS in Psychology and other related disciplines are interested in applying for an advanced programme to continue their studies in the field of Professional Psychology. However they do not have the time or resources to complete a full-fledged degree. While other Universities have offered such programs, the demand exceeds the supply and this Advanced Diploma carries the attraction of evidence based practices in Psychodiagnosis, Psychological Assessment as well as Psychotherapy.

	A. ACADEMIC DETAILS
1	**Faculty/Department:** Professional Psychology
2	**Name/Title of the Program (as to be written on transcript and degree):** Advanced Diploma in Infant, Child, and Adolescent Mental Health
3	**Mission of the Program:** The mission of the program is to develop knowledge base of the students while putting emphasis on building promising psychological practices with practical implications in the area of infant, child and adolescent psychology.
4	**Objectives of the Program:** 1. To enhance the understanding of mental illness and wellness relevant to infants, children and adolescents living in different environments. 2. To develop theoretically grounded psychological skills for psychodiagnosis and assessment in the field of infant, child and adolescent mental health 3. To facilitate a thorough ethical understanding of therapeutic approaches to mental health and wellbeing with a focus on evidence-based practices.
5	**Outcomes of the Program:** 1. Competently apply the knowledge of mental illness and wellness across different settings with specific populations. 2. Professionally use psychological skills for psychodiagnosis and assessment in the field of infant, child and adolescent mental health. 3. Become ethical practitioners using evidence based practices to deal with mental health issues in infants, children and adolescents.
6	**Rationale for the Program:** • Working with Infant, children and adolescents requires specialized knowledge, skills and competencies, and requires an understanding of the unique context of infant child and adolescent treatment options. • Advanced Diploma in Infant, Child and Adolescent Mental Health is designed to take into account and address majority of the issues specific to working with Infant, Child and Adolescent in order to equip future mental health professionals with the necessary knowledge, skills and competencies.

	• Unlike other graduate degree programs of Psychology which are generalized program to deal with every kind of psychological problems, this specialized diploma will help to produce professionals who are trained specifically for infants, children and adolescents. Thus their employability would be specific to all organizations concerned with child and adolescents like schools, children hospitals, NGOs etc. • Moreover an eligibility requirement of 16-years of education, make it more favorable for government and private sector (e.g., special schools, hospitals NGOs main-stream schools etc.) jobs.
7	**Brief Description of the Program:** • Advanced Diploma in Infant, Child and Adolescent Mental Health is a 1-year diploma. It is comprised of 2 Semesters with 24 Credit Hours Coursework = 21 Credit Hours Internship = 03 Credit Hours Total = 24 Credit Hours
8	**Duration:** 1 year
9	**Venue(s): On Site/Off Site/Both On & Off Site***:* 1st Semester: On site; 2nd Semester: Both on and off site (Students will visit hospital settings, mental health facilities and special education schools for Internship in Semester 2)
10	**Program Scheduling Format:** Evening
11	**Proposed Date of Commencement:** Fall 2023
12	**Mode of Study/Examination:** As per existing examination criteria and BU policy
13	**Additional Faculty Member(s) Required:** One Permanent Faculty member
14	**Additional Skilled-Worker(s) Required: Nil**
15	**Additional Classroom(s) required:** 2 class rooms with the capacity of 10-15 students
16	**Additional Requirement for Laboratories: Nil**
17	**Additional Requirement for Books, Subscriptions, Memberships to Online Research Sites/ Repositories: Nil**
18	**Minimum Entry Level/Eligibility criteria:** • Minimum 16 years of education in the relevant field of Psychology with a minimum of 50% marks (in annual system) or CGPA 2.5/4.0 (in semester system). • The Relevant fields include: BS Psychology BS Behavioral Sciences (with psychology major) BS Clinical Psychology MA/MSc Psychology • BU Admission Test or GAT (General) with minimum 50% marks required at the time of admission.
19	**Admission Criteria:** • Minimum 16 years of education in the relevant field of Psychology with a minimum of 50% marks (in annual system) or CGPA 2.5/4.0 (in semester system). • BU Admission Test or GAT (General) with minimum 50% marks required at the time of admission

20	**Additional/Different Examination Requirement: Nil**
21	**Number of Admissions Expected for First Intake: 10**
22	**Number of Admissions Planned/Expected for Subsequent Intakes:** **Semester** / **Expected Intake** **Fall 2023** / 10 **Spring 2024** / 10
23	**Referred by:** *(HOD DPP BULC)*
24	**Complete Plan of Studies, inclusive of complete Roadmap:** Attached as Annex 'B'
25	**Course Outlines, Descriptions, Pre-Requisites & Readings (Compulsory & Recommended)** Attached as Annex 'C'

B. FINANCIAL DETAILS

1	**Source of Funding**: BU: Fully
2	**Degree Duration:** 1 year **Annual or Semester System:** 2 Semesters
3	**Expected fee to be charged based on Cost & Benefits Analysis: Rs. 1,74,800/-** **Semester** / **Duration** / **1 (Semester)** / **2 (Semester)** / **Total** **Fall 2023** / **C. Hrs** / **12** / **12** / **24** / 01 Year / 94000 / 80800 / **174800**
4	**Expected Number of students for 1st & 2nd Intakes:** 20 (10 students per intake)
5	**Expected Earning from first two Intakes (B5):** Rs. 2,688,000/-
6	**Expected Earnings for the Next Five Years (B6):** **Semester Wise Revenue** **Per semester** / **No. of Students** / **Income** Fall 2023 / 10 / 940,000 /- Spring 2024 / 20 / 1,748,000/- **G. Total** / / 2,688,000/-
7	**Total Estimated Salaries of all Additional Human Resources per annum (B7):** **1st and 2nd intake:** • One Permeant Faculty member o 75,000 * 12 = **Rs. 900,000 /-** **For Placement Supervisor (*Internship Cost)*** 300 per student * 56 days * 10 No. of student = **Rs.168,000/-** **Total expense for 1 year:** 900,000 + 168,000 = **Rs. 1,068,000/-**
8	**Cost of Additional Laboratory Equipment/Tools (B8): Nil**
9	**Cost of Additional Classrooms (B9): Nil**

10	**Cost of Additional Books, Subscription & Memberships to on-line Sites/Repositories (B10): Nil**
11	**Off-Site rental Expenses and Cost of other Fixtures (B11): Nil**
12	**Miscellaneous Expenses required for Starting the Program (B12):** - Advertisement: 1,50,000 - Printing & Stationery: Rs. 1,50,000 - Admin Cost: Rs. 1,50,000 - Any other: Nil
	- Total: Rs.4,50,000
13	**Annual Recurring Expenditures in an Year (B13):**

First Year			
Year	**Expenses (with 10% add)**		**Gross Earning (Fee)**
Fall 2023-Spring 2024	Salaries	1,068,000	
	Advertisement	150000	
	Printing & Stationary	150000	
	Admin Cost	150000	
	Total	**1,518,000**	**2,688,000**

14	**Total Cost of the Program (B14): [Add B(7) to B(12)]** **Rs. 1,518,000/-**
15	**Net Cost of the Program (B15):** [Subtract B(1) from B(14)] **Rs. 1,518,000/-**
16	**Net Earnings in First Year (B16): [Subtract B(15) from B(5)]** **Rs. 1,170,000 /-**
17	**Projected Annual Gross Earning in an Year (B 17):**

Per Year	**No. of Students**	**Income**	**Gross Earning in an Year**
Fall 2023	10	940,000	2,688,000/-
Spring 2024	20	1,748,000	

18 **Projected Annual Net Earning in an Year:** *[Subtract B(13) from B(17)]*

	First Year		
	Expenses	**Gross Earning (Fee)**	**Net Earning**
Total	1,518,000	2,688,000	1,170,000

ROADMAP
ADVANCED DIPLOMA IN INFANT, CHILD, AND ADOLESCENT MENTAL HEALTH

Semester I			
Sr. No.	**Course Code**	**Course Title**	**Total Credit Hrs**
1	CPY 601	Child and Adolescent Development	3
2	CPY 602	Child and Adolescent Psychopathology	3
3	CPY 603	Psychological Assessment in Child and Adolescent Mental Health	3
4	CPY 604	Applied Behavior Analysis	3
			12

Semester II			
Sr. No.	**Course Code**	**Course Title**	**Total Credit Hrs**
1	CPY 605	Infant Mental Health and Early Environments	3
2	CPY 606	CBT with Children and Adolescents	3
3	CPY 607	Art and Play Therapy with Children and Adolescents	3
4	CPY 608	Internship	3
			12

Coursework = 21 Credit Hours

Internship = 03 Credit Hours

Total = 24 Credit Hours

Appendage 4410

LAUNCH PROPOSAL FOR BACHELOR OF SCIENCE IN ROBOTICS & INTELLIGENT SYSTEMS

A. ACADEMIC DETAILS	
1	**Faculty/Department:** Faculty of Engineering and Sciences, Bahria University Islamabad and Karachi Campus, Electrical Engineering Department
2	**Name of the Program:** Bachelor of Science in Robotics & Intelligent Systems – BS RIS
3	**Mission of the Program:** To produce robotics and intelligent system graduates with contemporary interdisciplinary approach keeping pace with changing technologies.
4	**Program Educational Objectives:** The graduates of BS Robotics & Intelligent Systems will be able to: • Exhibit the essential understanding and demonstration capabilities which relates to the fundamental concepts of robotics and intelligent systems. • Become technically sound robotic workforce trained on modern robotic tools capable of managing the operations of robotic systems in diverse range of (national/international) industries. • Effectively communicate with management, coworkers, customers, clients and others in diverse environments and uphold the work ethics. • Pursue advance degree and maintain professional competency through lifelong learning
5	**Program Learning Outcomes:** **Professional Knowledge:** An ability to apply knowledge of Robotics and Intelligent systems fundamentals to the solutions of domestic and commercial problems. **Problem Analysis:** An ability to identify, formulate, review, and analyze the robotics and intelligent systems related problems to reach substantiated conclusions using principles of natural sciences and engineering. **Design/Development of Solutions:** An ability to design solutions that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. **Investigation:** An ability to investigate 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. **Modern Tool Usage:** An ability to create, select and apply appropriate techniques, resources, and modern tools, including prediction and modeling, with an understanding of the limitations. **Environment, Society and Sustainability:** An ability to understand the impact robotics and intelligent systems solutions in societal and environmental contexts and demonstrate knowledge for sustainable development. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of professional practice. **Individual and Teamwork:** An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings. **Communication:** An ability to communicate effectively 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.

<table>
<tr><td></td><td>Project Management: An ability to demonstrate effective management skills to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
Lifelong Learning: An ability to recognize importance of and pursue lifelong learning in the broader context of innovation and technological developments.</td></tr>
<tr><td>6</td><td>Rationale for the Program:
As the world is becoming more and more technologically advanced, students need to learn the demanding technology. The BS Robotics and Intelligent Systems program will prepare the students for job market by fostering their technology literacy. Due to its interdisciplinary nature, which calls for knowledge in a wide range of subjects, robotics and intelligent systems is an appealing approach to meet the industry demand.</td></tr>
<tr><td>7</td><td>Brief Description of the Program:
The curriculum of BS RIS program includes the course work in robot modelling and control of industrial based manipulators, controlling of mobile robots as well as introduce the programming skills and AI, necessary to work with robots in different fields.</td></tr>
<tr><td>8</td><td>Duration: 4 years</td></tr>
<tr><td>9</td><td>Venue(s): ✔ On Site/Off Site/Both On & Off Site (Tick one; if Off Site, give details)

• H-11, Islamabad Campus Sector E-8
• Engineering Block, Bahria University, 13 National Stadium Road, Karachi</td></tr>
<tr><td>10</td><td>Program Scheduling Format: Evening (Bi-Annual)</td></tr>
<tr><td>11</td><td>Proposed Date of Commencement: Fall 2023</td></tr>
<tr><td>12</td><td>Mode of Study/Examination: Mode of study of BS Robotics and Intelligent Systems 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 hoursof Final Year Project.</td></tr>
<tr><td>13</td><td>Additional Faculty Member(s) Required: For intake of two batches per annum 6 faculty members (2 PhD and 4 MS) are required for the BS RIS program.
Following faculty member are already available, whereas, rest of the HR will be inducted asper schedule mentioned in section B7.

• Dr. Abdul Attayyab Khan, Ph.D.
• Dr. Taimoor Zafar
Research Interests: Robotics, Tactile Sensing, Machine Learning

<table>
<tr><th>Year</th><th>No. of FMs</th><th>PhD</th><th>MS</th></tr>
<tr><td>First Year</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Second Year</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Third Year</td><td>2</td><td>-</td><td>2</td></tr>
<tr><td>Fourth Year</td><td>2</td><td>-</td><td>2</td></tr>
</table>
Total 6 FMs (2 PhD and 4 MS) are required after program maturity may be required.</td></tr>
<tr><td>14</td><td>Additional Skilled-Worker(s) Required: (Indicate if there is a requirement for additional Skilled Staff, fulltime/part-time, along with their qualifications/skill sets.) Nil</td></tr>
<tr><td>15</td><td>Additional Classroom(s) required: Total 4 class rooms will be required, with the following breakdown.
Classrooms available to the Electrical Department are sufficient to execute the program.</td></tr>
</table>

16	**Additional Requirement for Laboratories:** The computer labs may be shared with CS and SE department. The CE department has Robotics lab and it will be shared. Moreover, it may be expanded/upgraded during the 3rd year of the program, if necessary.
17	**Additional Requirement for Books, Subscriptions, Memberships to Online Research Sites/ Repositories:** 100 Book Title.
18	**Minimum Entry Level:** Minimum 50% marks in Intermediate (HSSC) Examination (Pre-Engg./Comp Science/ Pre- Medical/DAE (all relevant field)) or equivalent qualifications with Mathematics certified by IBCC. **Deficiency:** For Pre-Medical students, the following deficiency course 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)
19	**Admission Criteria:** Matric/O-level : 10% Intermediate/A-level: 40% Entry Test Score: 50%
20	**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 vague).*
21	**Number of Admissions Expected for First Intake:** 20 admissions for first intake.
22	**Number of Admissions Planned/Expected for Subsequent Intakes:** 20 admissions per intake.
23	**Referred by:** Dean engineering sciences
24	**Complete Plan of Studies, inclusive of complete Roadmap:** Complete plan for BS Robotics andIntelligent Systems Program is attached with this document for reference (Annex-A)
25	**Course Outlines, Descriptions, Pre-Requisites & Readings (Compulsory & Recommended)** Course outlines for BS Robotics and Intelligent Systems are attached with this document forreference (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**
Fall 2023	20	0	20	138,250	0	2,765,000	0	**2,765,000**
Spring 2024	20	20	40	138,250	81,250	2,765,000	1,625,000	**4,390,000**
Fall 2024	20	40	60	138,250	81,250	2,765,000	3,250,000	**6,015,000**
Spring 2025	20	60	80	138,250	81,250	2,765,000	4,875,000	**7,640,000**
Fall 2025	20	80	100	138,250	81,250	2,765,000	6,500,000	**9,265,000**
Spring 2026	20	100	120	138,250	81,250	2,765,000	8,125,000	**10,890,000**
Fall 2026	20	120	140	138,250	81,250	2,765,000	9,750,000	**12,515,000**
Spring 2027	20	140	160	138,250	81,250	2,765,000	1,1375,000	**14,140,000**

*5000 Rs per credit hour and 16.25 credit hours per semester (Total 130 credit hours)

**For first semester: 27K admission fee, 10K Misc. expenditures, and 20K refundable security fee shall be applicable

4	**Expected Number of students for 1st & 2nd Intakes:** 40 students (20 students per intake)

5 **Expected Earning from first two Intakes (B5): Rs. 7,155,000.0**

Students			Fee per student			Total Fee		
Semester	**Fresh**	**Existing**	**Total**	**Fresh**	**Existing**	**Fresh**	**Existing**	**Total**
Fall 2023	20	0	20	138,250	0	2,765,000	0	**2,765,000**
Spring 2024	20	20	40	138,250	81,250	2,765,000	1,625,000	**4,390,000**

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

Students			Fee per student			Total Fee		
Semester	**Fresh**	**Existing**	**Total**	**Fresh**	**Existing**	**Fresh**	**Existing**	**Total**
Fall 2024	20	40	60	138,250	81,250	2,765,000	3,250,000	**6,015,000**
Spring 2025	20	60	80	138,250	81,250	2,765,000	4,875,000	**7,640,000**
Fall 2025	20	80	100	138,250	81,250	2,765,000	6,500,000	**9,265,000**
Spring 2026	20	100	120	138,250	81,250	2,765,000	8,125,000	**10,890,000**
Fall 2026	20	120	140	138,250	81,250	2,765,000	9,750,000	**12,515,000**
Spring 2027	20	140	160	138,250	81,250	2,765,000	1,1375,000	**14,140,000**

Total 3 years earnings: Rs. 60, 465,000/-

Total earnings per annum: Rs. 16,905,000/-

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

Semester	Regular FM (MS*)	Visiting FM* (Credit)	Per Semester Salary
Fall 2023	0	15	600,000.00
Spring 2024	0	30	1,200,000.00
Fall 2024	0	46	1,840,000.00
Spring 2025	0	64	2,560,000.00
Fall 2025	1	73	3,520,000.00
Spring 2026	2	81	3,840,000.00
Fall 2026	3	87	4,080,000.00
Spring 2027	4	94	4,360,000.00

* MS 100K per month and 2500 VFM Per hour (average)

Total estimated salaries per annum of HR: Rs. 5,500,000 (per annum)

8 **Cost of Additional Laboratory Equipment/Tools (B8):**

The CE department has Robotics lab and it may be shared. Moreover, it may be expanded/upgraded during the 3rd year of the program. The approximate cost may be 5 million.

9 **Cost of Additional Classrooms (B9):** N/A

10 **Cost of Additional Books, Subscription & Memberships to on-line Sites/Repositories (B10):**
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. 100,000. – Printing & Stationary: Rs. 50,000. – Admin Cost: – Zero Visit: Total: Rs. 150,000
13	**Annual Recurring Expenditures in Subsequent Years (B13):** – Salaries: Rs. 5,500,000 (per annum) – Rentals: Nil – Subscriptions/Memberships: Nil – Advertisements: Rs. 100,000. – Printing & Stationary: Rs. 50,000. – Admin Cost: – Accreditation Fee: Total: Rs. 5,650,000.
14	**Total Cost of the Program (B14):** [Add B(7) to B(12)] Rs. 6,900,000.00 (Per Year)
15	**Net Cost of the Program (B15):** [Subtract B(1) from B(14)] Rs. 6,900,000.0 (Per year)
16	**Net Earnings in First Year (B16):** [Subtract B(15) from B(5)] Rs. 255,000.00

BS ROBOTICS & INTELLIGENT SYSTEMS (BS-RIS) ROADMAP

Campus:	**Karachi and Islamabad**
Department:	**Department of Electrical Engineering**
Program Title:	**BS**
Program Level:	**Bachelor**
Total Duration of Program:	**4 years**
Total Number of Semesters:	**8 semesters**
Total Number of Credit Hours:	**130**
Number of Credit Hours per Semester:	**15-18**

Areas	Courses	Credit Hours
Robotics and Intelligent Systems Core Courses	**20**	**69**
Robotics and Intelligent Systems Elective Courses	**4**	**14**
Computing Courses	**3**	**12**
Mathematics and Supporting courses	**5**	**15**
General Education Courses	**6**	**14**
Management Science Course	**1**	**3**
Social Science Course	**1**	**3**
Total	**40**	**130**

Semester-1:

S.No.	Pre-Requisite	Course Code	Course Title	Credit Hours	Theory	Lab
1	None	GSC 113	Applied Physics	3	3	0
2	None	GSL 113	Applied Physics Lab	1	0	1
3	None	GSC 110	Applied Calculus & Analytical Geometry	3	3	0
4	None	ISL 101/ HSS 116	Islamic Studies/ Ethics	2	2	0
5	None	ENG 100	English-I	2	2	0
6	None	GSC 115	Circuit Analysis	3	3	0
7	None	GSL 115	Circuit Analysis Lab	1	0	1
Total Credit Hours in Semester-1				**15**	**13**	**2**

Semester-2

S.No.	Pre-Requisite	Course Code	Course Title	Credit Hours	Theory	Lab
1	GSC 110	GSC 210	Differential Equations	3	3	0
2	None	CSC 113	Computer Programming	3	3	0
3	None	CSL 113	Computer Programming Lab	1	0	1
4	None	CEN 120	Digital Logic Design	3	3	0
5	None	CEL 120	Digital Logic Design Lab	1	0	1
6	None	ENG 134	Communication Skills	2	2	0
7	None	EEL 113	Engineering Workshop	1	0	1
8	None	EEL 121	Engineering Drawing & CAD	1	0	1
Total Credit Hours in Semester-2				**15**	**11**	**4**

Semester-3:

S.No.	Pre-Requisite	Course Code	Course Title	Credit Hours	Theory	Lab
1	GSC 110	GSC 220	Complex Variable & Transforms	3	3	0
2	CSC 113	CSC 210	Object Oriented Programming	3	3	0
3	CSC 113	CSL 210	Object Oriented Programming Lab	1	0	1
4	GSC 115	EEN 224	Electronic Devices and Circuits	3	3	0
5	GSC 115	EEL 224	Electronic Devices and Circuits Lab	1	0	1
6	None	GSC 121	Linear Algebra	3	3	0
7	None	MSC 231	Engineering Mechanics	3	3	0
Total Credit Hours in Semester-3				**17**	**15**	**2**

Semester-4:

S.No.	Pre-Requisite	Course Code	Course Title	Credit Hours	Theory	Lab
1	None	RIS 231	Introduction to Robotics	3	3	0
2	None	RIL 231	Introduction to Robotics Lab	1	0	1
3	CSC 210	CSC 221	Data Structures & Algorithm	3	3	0
4	CSC 210	CSL 221	Data Structures & Algorithm Lab	1	0	1
5	CSC 210	AIC 201	Artificial Intelligence	3	3	0
6	CSL 210	AIL 201	Artificial Intelligence Lab	1	0	1
7	None	EEN 313	Signal & Systems	3	3	0
8	None	EEL 313	Signal & Systems Lab	1	0	1
9	None	PAK 105	Pakistan Studies	2	2	0
Total Credit Hours in Semester-4				**18**	**14**	**4**

Semester-5:

S.No.	Pre-Requisite	Course Code	Course Title	Credit Hours	Theory	Lab
1	CEN 120	CEN 440	Embedded Systems Design	3	3	0
2	CEN 120	CEL 440	Embedded Systems Design Lab	1	0	1
3	None	GSC 122	Probability and Statistics	3	3	0
4	XXXX	XXXX	Social Sciences Elective-I	3	3	0
5	EEN 313	EEN 412	Linear Control System	3	3	0
6	EEN 313	EEL 412	Linear Control System Lab	1	0	1
7	None	RIS 241	Sensors & Actuators	3	3	0
8	None	RIL 241	Sensors & Actuators Lab	1	0	1
Total Credit Hours in Semester-5				**18**	**15**	**3**

Semester-6:

S.No.	Pre-Requisite	Course Code	Course Title	Credit Hours	Theory	Lab
1	None	ENG 321	Technical Writing	2	2	0
2	EEN 313	CEN 444	Digital Image Processing	3	3	0
3	EEN313	CEL 444	Digital Image Processing Lab	1	0	1
4	CSC 210	RIS 361	Robotic System & Programming	3	3	0

5	CSC 210	RIL 361	Robotic System & Programming Lab	1	0	1
6	AIC 201	AIC 301	Machine Learning	2	2	0
7	AIC 201	AIL 301	Machine Learning Lab	1	0	1
8	XXX	XXX	RIS Elective I	3	3	0
Total Credit Hours in Semester-6				**16**	**13**	**3**

Semester-7:

S.No.	Pre-Requisite	Course Code	Course Title	Credit Hours	Theory	Lab
1	EEN 412	RIS 362	Robot Modelling & Control	3	3	0
2	EEN 412	RIL 362	Robot Modelling & Control Lab	1	0	1
3	XXX	XXX	RIS Elective II	3	3	0
4	XXX	XXX	RIS Elective II Lab	1	0	1
5	AIC 301	RIS 474	Introduction to Deep Learning	3	3	0
6	AIC 301	RIL 474	Introduction to Deep Learning Lab	1	0	1
7	None	FYP 400	Project -I	3	0	3
Total Credit Hours in Semester-7				**15**	**9**	**6**

Semester-8:

S.No.	Pre-Requisite	Course Code	Course Title	Credit Hours	Theory	Lab
1	XXXX	XXXX	RIS Elective III	3	3	0
2	CSC 112	RIS 363	Internet of things (IoT)	3	3	0
3	None	XXXX	Management Elective-I	3	3	0
4	XXXX	XXXX	RIS Elective IV	3	3	0
6	XXXX	XXXX	RIS Elective IV Lab	1	0	1
7	None	FYP 400	Project-II	3	0	3
Total Credit Hours in Semester-8				**16**	**12**	**4**

Total Credit Hours: 130

List of Courses

Computing Courses (12 credit hours)

Sr. No	Pre-req	Course Code	Course Title	Theory	Lab	CR
1	None	CSC 113	Computer Programming	3	0	3
2	None	CSL 113	Computer Programming Lab	0	1	1
3	CSC 113	CSC 210	Object Oriented Programming	3	0	3
4	CSC 113	CSL 210	Object Oriented Programming Lab	0	1	1
5	CSC 210	CSC 221	Data Structures & Algorithm	3	0	3
6	CSC 210	CSL 221	Data Structures & Algorithm Lab	0	1	1

Mathematics and Supporting courses (15 credit hours)

Sr. No	Pre-req	Course Code	Course Title	Theory	Lab	CR
1	None	GSC 110	Applied Calculus& Analytical Geometry	3	0	3
2	GSC 110	GSC 210	Differential Equations	3	0	3
3	GSC 110	GSC 220	Complex Variable & Transform	3	0	3
4	None	GSC 121	Linear Algebra	3	0	3
5	None	GSC 122	Probability and Statistics	3	0	3

General Education Courses (14 credit hours)

Sr. No	Pre-req	Course Code	Course Title	Theory	Lab	CR
1	None	GSC 113	Applied Physics	3	0	3
2	None	GSL 113	Applied Physics Lab	0	1	1
3	None	ISL 101/HSS 116	Islamic Studies/ Ethics	2	0	2
4	None	ENG 100	English-I	2	0	2
5	None	ENG 134	Communication Skills	2	0	2
6	None	PAK 105	Pakistan Studies	2	0	2
7	None	ENG 321	Technical Writing	2	0	2

Robotics and Intelligent Systems Core Courses (69 credit hours)

Sr. No	Pre-req	Course Code	Course Title	Theory	Lab	CR
1	None	GSC 115	Circuit Analysis	3	0	3
2	None	GSL 115	Circuit Analysis Lab	0	1	1
3	None	CEN 120	Digital Logic Design	3	0	3
4	None	CEL 120	Digital Logic Design Lab	0	1	1
5	None	EEL 113	Engineering Workshop	0	1	1
6	None	EEL 121	Engineering Drawing & CAD	0	1	1
7	GSC 115	EEN 224	Electronic Devices and Circuits	3	0	3
8	GSC 115	EEL 224	Electronic Devices and Circuits Lab	0	1	1
9	None	MSC 231	Engineering Mechanics	3	0	3
10	CEN 120	CEN 440	Embedded Systems Design	3	0	3
11	CEN 120	CEL 440	Embedded Systems Design Lab	0	1	1
12	None	AIC 301	Machine Learning	2	0	2
13	None	AIL 301	Machine Learning Lab	0	1	1
14	None	EEN 313	Signal & Systems	3	0	3
15	None	EEL 313	Signal & Systems Lab	0	1	1
16	None	RIS 231	Introduction to Robotics	3	0	3
17	None	RIL 231	Introduction to Robotics Lab	0	1	1
18	EEN 313	EEN 412	Linear Control System	3	0	3
19	EEN 313	EEL 412	Linear Control System Lab	0	1	1
20	None	RIS 241	Sensors & Actuators	3	0	3
21	None	RIL 241	Sensors & Actuators Lab	0	1	1
22	EEN 313	CEN 444	Digital Image Processing	3	0	3

23	EEN 313	CEL 444	Digital Image Processing Lab	0	1	1
24	CSC 210	RIS 361	Robotic System &Programing	3	0	3
25	CSC 210	RIL 361	Robotic System &Programing Lab	0	1	1
26	CSC 210	AIC 201	Artificial Intelligence	3	0	3
27	CSC 210	AIL 201	Artificial Intelligence Lab	0	1	1
28	EEN 412	RIS 362	Robot Modeling & Control	3	0	3
29	EEN 412	RIL 362	Robot Modeling & Control Lab	0	1	1
30	AIC 301	RIS 474	Introduction to Deep Learning	3	0	3
31	AIC 301	RIL 474	Introduction to Deep Learning Lab	0	1	1
32	CSC 112	RIS 363	Internet of things (IoT)	3	0	3
33	None	FYP 400	Project -I	0	3	3
34	None	FYP 400	Project -II	0	3	3

Social Science Course (3 credit hours)

Sr. No	Pre-req	Course Code	Course Title	Theory	Lab	CR
1	None	HSS 422	Engineering Ethics	3	0	3
2	None	HSS 202	Introduction to Sociology	3	0	3
3	None	BES 103	Critical Thinking	3	0	3
4	None	HSS 456	Organizational Behavior	3	0	3
5	None	HSS 111	Introduction to International Relations	3	0	3

Management Science Course (3 credit hours)

Sr. No	Pre-req	Course Code	Course Title	Theory	Lab	CR
1	None	MGT 206	Entrepreneurship	3	0	3
2	None	MGT 652	Leadership	3	0	3
3	None	MGT 111	Principles of Management	3	0	3
4	None	HSS 411	Engineering Economics & Management	3	0	3
5	None	MGT 425	Project Management in Engineering	3	0	3

Robotics & Intelligent Systems Elective Courses

Sr.No	Pre-req	Course Code	Course Title	Theory	Lab	CR
1	RIS 231	RIS 481	Machine Vision & Robotics	3	0	3
2	RIS 241	RIS 482	Introduction to Haptics	3	0	3
3	RIS 362	RIS 483	Introduction to Humanoid Robots	3	0	3
4	RIS 362	RIS 484	Advanced Modelling of Robotics	3	0	3
5	GSC 121	RIS 485	Optimal Kinematic Design of Robots	3	0	3
6	RIS 361	RIS 486	Distributive Robotics/Swarm Robotics	3	0	3
7	RIS 477	CSC 410	Introduction to Cloud Computing	3	0	3
8	MSC 241	RIS 489	Mechanics of Materials	3	0	3
9	RIS 231	RIS 486	Swarm Robotics	3	0	3
10	None	RIS 471	Robot Process Automation	3	0	3

11	None	RIS 471	Robot Process Automation Lab	0	1	1
12	None	RIS 473	Introduction to R Programming	3	0	3
13	None	RIL 473	Introduction to R Programming Lab	0	1	1
14	CEN 444	CSC 464	Computer Vision	3	0	4
15	CEN 444	CSL 464	Computer Vision Lab	0	1	1
16	RIS 477	RIS 475	Human Robot Interaction	3	0	3
17	RIS 477	RIL 475	Human Robot Interaction Lab	0	1	1
18	RIS 477	RIS 476	Artificial Neural Network	3	0	3
19	RIS 477	RIL 476	Artificial Neural Network Lab	0	1	1
20	RIS 477	RIS 487	AI for Computer Games	3	0	3
21	RIS 477	RIL 487	AI for Computer Games Lab	0	1	1
22	CSC 419	RIS 488	Chatbots	3	0	3
23	CSC 419	RIL 488	Chatbots Lab	0	1	1

COUSE OUTLINES

Introduction to Robotics	
Course	RIS 231
Credit Hours:	3+1
Prerequisite:	
Objectives:	Students will learn the basics to model, simulate and design various robotic systems (with an emphasis on robotic manipulators). The course material and associated lab-work is aimed to enable the students to simulate the kinematic and dynamic responses as well as the control of such systems. It is also desired that the students are motivated by getting introduced to state-of-the-
Course Learning Outcomes (CLOs):	**CLO 1:** (C3): **Implement** the position and orientation of different robotic manipulators using homogeneous transformations techniques. **CLO 2:** (C3): **Solve** forward and inverse kinematics of robotic manipulators. **CLO 3:** (C4) **Analyze** the problems related to robot-dynamics, path planning and trajectory generation **CLO 4:** Use modern tools and test equipment to **assemble** different types of robotic systems and measure their performance. (Covered in Lab Course).

Course Outline:	**Week 1.** Overview of robots; History, Taxonomy & Configurations, Applications; Current Trends in Robotics Modeling in Frequency Domain **Week 2.** The 8 Problems of Robotic Manipulators **Week 3.** Representations and Homogeneous Transformations 4 Forward Position Kinematics: Denavit-Hartenberg Representation; Examples **Week 4.** Inverse Position Kinematics: Kinematic Decoupling; Geometric IK Approach **Week 5.** Skew Symmetric Matrices; Angular Velocity: Addition of Angular Velocities; Linear Velocity of a Point Attached to a Moving Frame **Week 6.** Derivation of the Jacobian; Examples **Week 7.** Singularities; Inverse Velocity and Acceleration **Week 8.** Path Planning: Introduction; Work-space and Configuration-space; Potential Fields Method **Week 9.** Local Minima Avoidance; Probabilistic Road Maps **Week 10.** Introduction to Trajectory Planning **Week 11.** Dynamics: Euler-Lagrange Equations **Week 12.** General Expressions for Kinetic and Potential Energy **Week 13.** Equations of Motion; Examples; Concluding Remarks on Robotic Manipulators Various sources **Week 14.** Robot Control and Sensing systems, Robot-Vision, Robot-Programming and Interfacing, Fundamentals of Robot-Design and Robot-Test, End-effector Design **Week 15.** Mobile Robotics: Dynamics, Control, Task Allocation, **Week 16.** Heterogeneous Mobile Robotic Systems
Resources:	Textbook: • M.W. Spong and M. Vidyasagar. Robot Dynamics and Control. John Wiley & Sons, 2004 • M.W. Spong and S. Hutchinson. Robot Modeling and Control. John Wiley & Sons, 2005 Reference Book: • S.B. Niku. Introduction to Robotics: Analysis, Systems, Applications. Pearson education. Pearson Education Asia, 2001 • R. Murphy. Introduction to AI Robotics. A Bradford book MIT
Tools	• MATLAB/Simulink

Mapping of CLO to PLOs

CLOs	MAPPED PLO	LEVEL
CLO 1: Implement the position and orientation of different robotic manipulators using homogeneous transformations.	PLO 1	C3
CLO 2: Solve forward and inverse kinematics of robotic manipulators.	PLO 2	C3
CLO 3: Analyze the problems related to robot-dynamics, path planning and trajectory generation	PLO 3	C4

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

Engineering Mechanics	
Course Code:	MSC 231
Credit Hours:	3+0
Prerequisite:	None
Objectives:	This course discusses the study of objects that are either at rest or moving with a constant velocity. Statics is important in the development of problem-solving skills. The course addresses to think about how forces and bodies act and react to one another. The student will learn how to analyze word problems, pull out the important information and then solve them. The course is restricted 2-D (planar) mechanisms.
Course Learning Outcomes (CLOs):	**CLO 1:** (C2): **Illustrate** the skills to use scalar and vector analytical techniques for analyzing forces in statically determinate structures. **CLO 2:** (C3) **Apply** fundamental concepts of kinematics and kinetics of particles to the analysis of simple practical problems. **CLO 3:** **(C3): Analyze** and develop free-body diagrams for any system of forces in two and three dimensions

Course Outline:	**Week 1.** Introduction to Kinematics (a mathematical description of motion only) **Week 2.** Introduction to Kinetics (determine motion in problems involving the concepts of force and energy). **Week 3.** Vector Operations, Coplanar Forces – Cartesian & Scalar Notation **Week 4.** 3d Vectors & Coordinate, Direction Angles, Transverse & Azimuth Angles, Position Vectors **Week 5.** Force Directed Along a Line, Dot Product, and Projection Along a Line. **Week 6.** Structures: Difference between trusses, frames and beams **Week 7.** 2D truss, Method of joints, Method of section **Week 8.** Frame, Simple beam, types of loading and supports, Shear Force and bending. **Week 9.** Moment diagram in beams Relation among, load, shear force and bending moment. **Week 10.** Potential energy and equilibrium, stability, Center of Gravity and Moment of Inertia **Week 11.** First and second moment of area **Week 12.** Kinematics of Particles, Kinetics of Particles **Week 13.** Dynamics of Rigid Bodies, **Week 14.** Plane kinetics of rigid bodies, **Week 15.** Introduction to 3D Dynamics **Week 16.** Applications of engineering mechanics
Resources:	Textbook: • Engineering Mechanics Statics And Dynamics, *J.L. Mariam & L.G. Kraige*, 6th Edition Reference Book: • Engineering Mechanics – Statics And Dynamics, *R.C Hibbeler*,10th Edition • Vector Mechanics For Engineers, *Ferdinand P. Beer And E. Russel Johnston Jr*, 7th Edition
Tools	• MATLAB/Python

Mapping of CLO to PLOs

CLOs	MAPPED PLO	LEVEL
CLO 1. **Illustrate** the skills to use scalar and vector analytical techniques for analyzing forces in statically determinate structures.	PLO 1	C2

CLO 2. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple practical problems.	PLO 1	C3
CLO 3. Analyze and develop free-body diagrams for any system of forces in two and three dimensions.	PLO 2	C3

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	5	20	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	27	33	40

Robotic Modeling & Control	
Course Code:	RIS 362
Credit Hours:	3+1
Prerequisite:	Linear Control Systems
Objectives:	This course introduces the fundamentals of robot modeling and control. The course will cover forward and inverse kinematics, Jacobians, Lagrangian dynamics, motion planning, robust and adaptive motion and force control. The course will provide relevant applications from industrial robotics, mobile robotics, and human robotics and interaction. The course will be mathematically rigorous and requires knowledge of linear algebra, dynamic systems, and automatic control
Course Learning Outcomes (CLOs):	**CLO 1: (C2): Explain** the basic concepts of modeling and control of robotic systems and manipulators **CLO 2: (C3): Apply** concepts of modeling and control to construct the robotic systems and manipulators. **CLO 3:** (C5): **Design** the mathematical models and control paradigm for industrial robots, remotely operated manipulators for space and under water operations, service robots in unstructured environment **CLO 4: Follows** trajectory planning algorithms (e.g., polynomial interpolation), generation and visualization of robot trajectories (Covered in Lab)

Course Outline:	**Week 1.** Mathematical Modeling of Robots **Week 2.** Symbolic Representation of Robot Manipulators **Week 3.** The Configuration Space, The State Space **Week 4.** The Workspace **Week 5. T**he Geometry of Robots 33Rigid Motions **Week 6.** Parameterizations of Rotations **Week 7.** Euler Angles, Roll, Pitch, Yaw Angles **Week 8.** Axis-Angle Representation **Week 9.** Homogeneous Transformations **Week 10.** Forward Kinematics **Week 11.** Velocity Kinematics **Week 12.** Dynamics: dynamics of rigid bodies, reference frames in relative motion, equations of motion for manipulators and vehicles in closed and recursive form, elasticity. **Week 13.** Motion Planning: point-to-point motions, interpolation and path primitives **Week 14.** Localization of robots, mapping a robot environment. **Week 15.** Control: feedback linearization, passivity-based controller **Week 16.** Position and force control
Resources:	Textbook: • Robot Modeling and Control, 2nd Edition Mark W. Spong, Seth Hutchinson, M. Vidyasagar ISBN: 978-1-119-52404-5 Reference Book: • Modern Robotics: Mechanics, Planning, and Control 1st Edition by Kevin M. Lynch (Author), Frank C. Park (Author)
Tools	• MATLAB/Simulink

Mapping of CLO to PLOs

CLOs	MAPPED PLO	LEVEL
CLO 1: Explain the basic concepts of modeling and control of robotic systems and manipulators	PLO 1	C2
CLO 2: Apply concepts of modeling and control to construct the robotic systems and manipulators.	PLO 2	C3
CLO 3: Design mathematical models and control paradigm for industrial robots, remotely operated manipulators for space and under water operations, service robots in unstructured environment.	PLO 3	C5

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	5	20	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10

Quizzes (10)	2	3	5
Total (100)	27	33	40

Robotic System & Programing	
Course Code:	RIS 361
Credit Hours:	3+1
Prerequisite:	Object Oriented Programming
Objectives:	This course will prepare students to design, build, and program a robot. The student will apply programming in Python to perform various robotic movements involving transformations, tracking, steering, and kinematics. It is designed to prepare students to implement the concepts of robotic programming using small robots.
Course Learning Outcomes (CLOs):	**CLO 1:** (C2): **Comprehend** basics of programming that will be used to understand algorithms. **CLO 2:** **(C2): Describe** the usages of artificial intelligence in robotics. **CLO 3:** (C3) Write programming algorithms to **implement** various aspects of control of robot mechanics and algorithms.
Course Outline:	**Week 1.** Memory concepts, **Week 2.** Debugging, recursion, search **Week 3.** abstractions, threading, and message passing. **Week 4.** MATLAB programs Programming in C/C++/Python. **Week 5.** Familiarity with Linux the environment and its administration. **Week 6.** Familiarity with software version control systems (e.g. Subversion, Mercurial, CMake, Git) **Week 7.** ROS, linear algebra. **Week 8.** Installing and Configuring Your ROS Environment. **Week 9.** Navigating the ROS Filesystem **Week 10.** Creating a ROS Package **Week 11.** Building a ROS Package **Week 12.** Understanding ROS Nodes **Week 13.** Gazebo physical simulation **Week 14.** Turtlebot-2 Simulation in Gazebo, SLAM Navigation, Adaptive Monte-Carlo Localization **Week 15.** Simultaneous Localization and Mapping (SLAM) algorithms to construct a 2D map **Week 16.** Map to do 2D adaptive monte-carlo navigation of this robot using existing available ROS packages.
Resources:	Textbook: • Programming Robots with ROS: A Practical Introduction to the Robot Operating System 1st Edition Reference Book: • Practical Robotics in C++: Build and Program Real Autonomous Robots Using Raspberry Pi.
Tools	• MATLAB, C/C++/Python

Mapping of CLO to PLOs

CLOs	MAPPED PLO	LEVEL
CLO 1: Comprehend basics of programming that will be used to understand algorithms.	PLO 2	C2
CLO 2: Describe the usages of artificial intelligence in robotics.	PLO 2	C2
CLO 3: Write programming algorithms to **implement** various aspects of control of robot mechanics and algorithms.	PLO 3	C3

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	20	30
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	33	45

Sensors and Actuators	
Course Code:	RIS 241
Credit Hours:	3+1
Prerequisite:	
Objectives:	This course discusses understanding basic laws and phenomena on which operation of sensors and actuators-transformation of energy is based. It equips students with fundamental knowledge and skills on sensors and actuator circuits and systems
Course Learning Outcomes (CLOs):	**CLO 1:**(C2): **Comprehend** the basics of sensors, actuators and their operating principle. **CLO 2:**(C4): **Analyze the** characteristic parameters to evaluate sensor performance.

Course Outline:	**Week 1.** Introduction of applicable sensors and actuators in robotics. **Week 2.** Sensor and actuator criteria for a robotic system. **Week 3.** Sensor performance criteria and selection: thermocouples, resistive sensors, inductive sensors **Week 4.** Capacitive sensors, piezoelectric sensors **Week 5.** Encoders and tachometers **Week 6.** Impact of sensor characteristics such as range, accuracy, precision, sensitivity, linearity, resolution, in robotic system. **Week 7.** Sensor types and selection (Hall effect, capacitive sensors) **Week 8.** Actuator performance criteria and selection: fluidic actuators, solenoids and voice coil motors, **Week 9.** stepper motors, DC motors, piezoelectric actuators **Week 10.** Shape memory alloy, actuators. **Week 11.** MEMS sensors and actuators. **Week 12.** Transfer function models for commonly employed actuators analyze their impact on the robotic system. **Week 13.** Actuator types and selection **Week 14.** Understanding of Sensor Interfacing with Microprocessor to build electronic system **Week 15.** Static and Dynamic Characteristic Parameters for Sensors and Actuators, **Week 16.** Calibration of Sensor based electronics systems.
Resources:	Textbook: • Clarence W. de Silva (2015) Sensors and Actuators: Engineering System Instrumentation, Second Edition • N. Nise, "Control Systems Engineering", 7th Ed., Wiley, ISBN: 978-1-118-80063-8 Reference Book: Robert H. Bishop, "Mechatronic Systems, Sensors, and Actuators: Fundamentals and Modeling," CRC Press, ISBN: 978-0-8493-9258-0
Tools	MATLAB/Simulink, Onshape.

Mapping of CLO to PLOs

CLOs	MAPPED PLO	LEVEL
CLO 1: Comprehend the basics of sensors, actuators and their operating principle.	PLO 1	C2
CLO 2: Analyze the characteristic parameters to evaluate sensor performance	PLO 3	C4

Grading Rubric

Assessment Method	CLO 1	CLO 2
Final Exam (50)	15	35
Midterm Exam (20)	15	5
Assignments (20)	10	10
Quizzes (10)	5	5
Total (100)	45	55

Advanced Modelling of Robotics	
Course Code:	RIS 484
Credit Hours:	3+1
Prerequisite:	Robot Modelling and Control
Objectives:	Advanced Modelling of Robotics is an intensive course that focuses on the advanced mathematical and computational techniques used in the modelling and simulation of robotic systems. The course covers topics such as kinematics, dynamics, control, and optimization, providing students with the necessary tools to develop accurate and efficient models for robotic systems. Students will gain a deeper understanding of the complexities involved in robotic modelling and enhance their skills in designing and analyzing robotic systems.
Course Learning Outcomes (CLOs):	**CLO 1: (C2): Understand** of advanced mathematical and computational techniques for robotic modelling. **CLO 2: (C4) Analyze** the motion planning and trajectory generation for robotic systems. **CLO 3: Reproduce** robotic systems using simulation tools, optimization of robot models for performance and efficiency, analysis of simulation and optimization results (Covered in Lab Course).

Course Outline:	**Week 1.** Overview of advanced modelling techniques in robotics **Week 2.** Importance and applications of advanced robotic modelling **Week 3.** Kinematics of Robotic Systems, Geometric and analytical methods for solving kinematics problems **Week 4.** Dynamics of Robotic Systems **Week 5.** Lagrange's equations and the principle of virtual work **Week 6.** Newton-Euler and Lagrange-Euler formulations **Week 7.** Sampling-based motion planning algorithms **Week 8.** Smooth trajectory generation techniques **Week 9.** Dynamic modelling of rigid parallel robots without and with actuation redundancy **Week 10.** Geometric and kinematic modelling **Week 11.** Constraint equations, **Week 12.** Fundamentals of screw theory and its application to modelling **Week 13.** Feedback control and PID control **Week 14.** Adaptive and robust control strategies **Week 15.** Modelling and control of robot manipulators **Week 16.** Forward and inverse dynamics of manipulators
Resources:	Textbook: • Robot Manipulators: Modeling, Performance Analysis and Control (Control Systems, Robotics, And Manufacturing) by Etienne Dombre (Editor), Wisama Khalil (Editor) Reference Book(s):
Tools	•

Mapping of CLO to PLOs

CLOs	MAPPED PLO	LEVEL
CLO 1: Understand of advanced mathematical and computational techniques for robotic modelling.	PLO 1	C2
CLO 2: Analyze the motion planning and trajectory generation for robotic systems.	PLO 2	C4

Grading Rubric

Assessment Method	CLO 1	CLO 2
Final Exam (50)	25	25
Midterm Exam (20)	15	5
Assignments (20)	5	15
Quizzes (10)	5	5
Total (100)	50	50

Swarm Robotics	
Course Code:	RIS 486
Credit Hours:	3+1
Prerequisite:	Introduction to Robotics
Objectives:	Swarm Robotics is an interdisciplinary field that focuses on the study of large groups of simple robots working together to achieve complex tasks. This course provides an in-depth understanding of the principles, algorithms, and applications of distributive robotics. Students will explore topics such as swarm intelligence, collective behavior, communication, coordination, and task allocation. Through lectures, practical exercises, and projects, students will develop the necessary skills to design,
Course Learning Outcomes (CLOs):	**CLO 1:** (C2): **Explain** the fundamental concepts and principles of swarm robotics. **CLO 2:** (C2): **Understand** the communication and coordination mechanisms in swarm robotics. **CLO 3:** **(C4): Analyze** the algorithms for task allocation and decision-making in swarm systems.
Course Outline:	**Week 1.** Introduction to Distributive Robotics, Historical background and development of swarm robotics, Importance and applications of distributive robotic systems **Week 2.** Swarm Intelligence and Collective Behavior, Concepts of swarm intelligence and emergent behavior **Week 3.** Models for collective decision-making **Week 4.** Communication and Coordination in Swarm Robotics **Week 5.** Communication mechanisms in swarm systems **Week 6.** Local and global coordination strategies **Week 7.** Swarm aggregation and dispersal behaviors **Week 8.** Task Allocation in Swarm Systems **Week 9.** Task assignment algorithms in distributive robotics **Week 10.** Multi-robot task allocation methods **Week 11.** Role-based and self-organized task allocation approaches **Week 12.** Motion Control in Swarm Robotics **Week 13.** Sensing and Perception in Swarm Robotics **Week 14.** Decision-Making in Swarm Systems
Resources:	Textbook: • Swarm Robotics: A Formal Approach Heiko Hamann Reference Book(s): • Evolutionary Swarm Robotics — Vito Trianni
Tools	• MATLAB/Simulink

Mapping of CLO to PLOs

CLOs	MAPPED PLO	LEVEL
CLO 1: Explain the fundamental concepts and principles of swarm robotics	PLO 1	C2
CLO 2: Understand the communication and coordination mechanisms in swarm robotics.	PLO 2	C2
CLO 3: Analyze the algorithms for task allocation and decision-making in swarm systems	PLO 2	C6

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	5	20	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	27	33	40

AI for Computer Games	
Course Code:	RIS 487
Credit Hours:	3+1
Prerequisite:	Introduction to AI
Objectives:	This course equips students for a career in the rapidly growing game industry. Students will gain knowledge and skills in AI techniques that also apply to other domains, such as business planningand engineering. The primary focus of this course is on the use of AI techniques for generating efficient, intelligent behavior in games. Additional attention is given to AI algorithms for improving game play experience. The programming language used in the course is Java.
Course Learning Outcomes (CLOs):	**CLO 1:** (C2): **Describe** the performance of artificial intelligence techniques used in traditional and modern computer games. **CLO 2:** (C3) **Apply** artificial intelligence techniques that can be used to solve computer game design problems. **CLO 3:** **(C4): Examine** state-of-the-art artificial intelligence techniques from the industry and academia to solve computer game design problems.

Course Outline:	**Week 1.** Introduction to AI for Computer Games **Week 2.** Importance and applications of AI in game development Path **Week 3.** Finding Algorithms in Games **Week 4.** AI search algorithm and variations **Week 5.** Navigation meshes and waypoint systems **Week 6.** Hierarchical pathfinding techniques **Week 7.** Decision-Making in Game AI **Week 8.** Finite state machines and behavior trees **Week 9.** Rule-based systems for game AI **Week 10.** Decision-making under uncertainty **Week 11.** Game AI with Machine Learning **Week 12.** Game AI for Real-Time Strategy (RTS) Games **Week 13.** Game AI for First-Person Shooter (FPS) Games **Week 14.** Game AI for Dynamic Game Worlds **Week 15.** Player Modeling and AI Player Experience
Resources:	Textbook: AI for games (3rd ed.). Taylor & Francis, Millington, I. Reference Book(s): Artificial Intelligence and Games, **Yannakakis,** Georgios N., **Togelius**, Julian, Springer
Tools	• Java

Mapping of CLO to PLOs

CLOs	MAPPED PLO	LEVEL
CLO 1: Describe the performance of artificial intelligence techniques used in traditional and modern computer games.	PLO 1	C2
CLO 2: Apply artificial intelligence techniques that can be used to solve computer game design problems.	PLO 2	C3
CLO 3: Examine state-of-the-art artificial intelligence techniques from the industry and academia to solve computer game design problems.	PLO 2	C4

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	5	20	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	27	33	40

Introduction to Haptics	
Course Code:	RIS 482
Credit Hours:	3+1
Prerequisite:	Sensors and Actuators

Objectives:	Introduction to Haptics is a comprehensive course that provides an in-depth understanding of the field of haptics, which involves the science and technology of touch and force feedback. The course covers various aspects of haptic perception, devices, applications, and challenges. The students will learn how humans perceive real objects to learn the salient properties that are necessary to be recreated in virtual environments.
Course Learning Outcomes (CLOs):	**CLO 1:** (C2): **Understand** the fundamental concepts and theories of haptics and different aspects of haptic perception. **CLO 2:** **(C3): Apply the concepts of haptics** in various fields, such as virtual reality, robotics, and healthcare. **CLO 3:** **(C4): Analyze** the challenges and limitations in haptic technology.
Course Outline:	**Week 1.** Introduction to Haptics **Week 2.** Haptic Perception **Week 3.** Haptic Devices and Interfaces **Week 4.** Haptic Sensors and Actuators **Week 5.** Hapkit assembly and mechanical design **Week 6.** Programming virtual surroundings **Week 7.** Human Haptics **Week 8.** Haptic technology **Week 9.** Hapkit mechatronics **Week 10.** Haptic Applications: Virtual Reality **Week 11.** Haptic Applications: Robotics **Week 12.** Haptic Design and Evaluation **Week 13.** Emerging Trends in Haptics **Week 14.** Haptic Perception in Gaming **Week 15.** Haptic Display Technologies **Week 16.** Tactile displays and vibrotactile feedback, Haptic gloves and exoskeletons
Resources:	Textbook: • Haptics for Virtual Reality and Teleoperation By Matjaž Mihelj, Janez Podobnik · 2012 Reference Book: • Pervasive Haptics Science, Design, and Application
Tools	• PHANToM 1.0A (Sensable Technology) • PHANToM Omni (Sensable Technology) • Omega (ForceDimension) • Two 4D4Ms (VnVNet)

Mapping of CLO to PLOs

CLOs	MAPPED PLO	LEVEL
CLO 1: Understand the fundamental concepts and theories of haptics and different aspects of haptic perception.	PLO 1	C2
CLO 2: Apply the concepts of haptics in various fields, such as virtual reality, robotics, and healthcare	PLO 1	C3
CLO 3: Analyze the challenges and limitations in haptic technology.	PLO 2	C4

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	5	20	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	27	33	40

Machine Vision & Robotics	
Course Code:	RIS 481
Credit Hours:	3+1
Prerequisite:	Introduction to Robotics
Objectives:	The aim of the course is to provide the students with the understanding of the basic principles underlying the design, analysis, and synthesis of robotic systems and machine vision technology in automation. This course will lay down the foundations of the engineering principles in such a way that the students can identify the appropriate concepts required in given engineering problems and apply them to formulate the suitable engineering solutions in automation and other applications
Course Learning Outcomes (CLOs):	**(C3): Use** kinematic models and homogeneous transformations to compute position and rotation in 3D space for robots. **CLO 1: (C4): Analyze** 3D computer vision problems such as pose estimation, object tracking, 3D reconstructions and combinations.

Course Outline:	**Week 1.** Applications of robotics and vision, **Week 2.** Robot control, Image formation **Week 3.** Transduction and simple processing **Week 4.** Thresholding, filtering, and classification methods for extracting object information from an image. **Week 5.** Active vision and attention. **Week 6.** Sensors for self-monitoring. **Week 7.** General approaches and architectures. **Week 8.** Classical vs. behaviour-based robotics. Wider issues and implications of robot research. **Week 9.** Object Tracking: **Week 10.** Track object using Optical Flow, CamShift and meanShift **Week 11.** Robot Vision **Week 12.** Line Following **Week 13.** Lane Detection and Tracking **Week 14.** Point to point robot planning algorithms. **Week 15.** 3D Reconstruction based on two or more cameras (sparse, dense) and uncertainty models. **Week 16.** Knowledge of pose estimation
Resources:	Textbook: • Robot Modeling and Control, 2nd Edition Mark W. Spong, Seth Hutchinson, M. Vidyasagar ISBN: 978-1-119-52404-5 Reference Book: • Modern Robotics: Mechanics, Planning, and Control 1st Edition by Kevin M. Lynch (Author), Frank C. Park (Author)
Tools	• Optical Flow, CamShift and meanShift

Mapping of CLO to PLOs

CLOs	MAPPED PLO	LEVEL
CLO 1: Use kinematic models and homogeneous transformations to compute position and rotation in 3D space for robots.	PLO 1	C3
CLO 2: (C4): Analyze 3D computer vision problems such as pose estimation, object tracking, 3D reconstructions and combinations	PLO 2	C4

Grading Rubric

Assessment Method	CLO 1	CLO 2
Final Exam (50)	20	30
Midterm Exam (20)	10	20
Assignments (20)	5	5
Quizzes (10)	5	5
Total (100)	40	60

Introduction to Humanoid Robots	
Course Code:	RIS 483
Credit Hours:	3+0
Prerequisite:	Robot Modelling and Control
Objectives:	This course provides an overview of the fundamentals and the recent research in the field of humanoid robotics. The course will cover kinematics and dynamics, postural stability, control, gait and trajectory generation and inertial parameter estimation. Additional advanced topics in learning, human-robot interaction and manipulation and grasping and human motion modeling will be covered as time permits.
Course Learning Outcomes (CLOs):	**CLO 1:** (**C2): Understand** the locomotion mechanisms and motion planning for humanoid robots. **CLO 2:** **(C4): Analyze** the applications of humanoid robots in various fields, such as healthcare, entertainment, and research. **CLO 3:** **(C6) Investigate** perception and sensing techniques used in humanoid robotics.
Course Outline:	**Week 1.** Develop kinematic and dynamic models for anthropomorphic body structures and simulate their forward and inverse kinematics and dynamics **Week 1.** Develop gaits and other trajectories for humanoidrobots **Week 2.** Implement controllers that ensure postural stability during trajectory execution for humanoid robots **Week 3.** Humanoid Robot Locomotion **Week 4.** Walking and running mechanisms in humanoid robots, Gait generation and optimization, **Week 5.** Terrain adaptation and obstacle avoidance **Week 6.** Humanoid Robot Perception **Week 7.** Sensor technologies for humanoid robots, Vision and object recognition, Speech and audio processing for humanoid robots, **Week 8.** Humanoid Robot Localization and Mapping **Week 9.** Localization techniques for humanoid robots **Week 10.** Simultaneous Localization and Mapping (SLAM) in humanoid robots **Week 11.** Navigation and path planning for humanoid robots **Week 12.** Humanoid Robot Manipulation, Grasping and manipulation in humanoid robots, Object recognition and manipulation planning **Week 13.** Humanoid Robot Interaction with Humans **Week 14.** Human-robot interaction and collaboration **Week 15.** Gesture and facial expression recognition, Social and emotional intelligence in humanoid robots.

Resources:	Textbook: • S. Kajita, H. Hirukawa, K. Harada and K. Yokoi, Introduction to Humanoid Robotics, Springer, 2014. Reference Book(s): • Dragomir Nenchev Atsushi Konno Teppei Tsujita, Humanoid Robotics Automation and Control
Tools	•

Mapping of CLO to PLOs

CLOs	MAPPED PLO	LEVEL
CLO 1: Understand the locomotion mechanisms and motion planning for humanoid robots.	PLO 1	C2
CLO 2: Analyze the applications of humanoid robots in various fields, such as healthcare, entertainment, and research.	PLO	C3
CLO 3: Investigate perception and sensing techniques used in humanoid robotics	PLO	C6

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	5	20	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	27	33	40

Introduction to Deep Learning	
Course Code:	RIS 474
Credit Hours:	3+1
Prerequisite:	Introduction to AI
Objectives:	Deep Learning is a hierarchical learning methodology based on artificial neural networks which are algorithms inspired by the structure and function of the brain. It has applications in wide-range of industries these days such as face-recognizers working at massive scales, robotics, speech translation, text analysis, improving customer experience, autonomous vehicles etc. In this course we will take a "hands-on approach" and start will implementation of basic building blocks such as training a simple perceptron and move to design and train a deep convolution neural network..

Course Learning Outcomes (CLOs):	**CLO 1: (C2): Discuss** knowledge of the building blocks of DL: Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), and Generative Models **CLO 2: (C3): Construct** mathematical models based on backpropagation in Artificial Neural Networks (ANNs) using modern tools
Course Outline:	**Week 1.** Brief introduction to Deep Learning (DL), Potential student projects, **Week 2.** Differences from Machine Learning (ML), Evolution of ML and DL, Importance of Artificial Neural Networks (ANNs) **Week 3.** Shallow ANNs, Single layer, Multi-layer, Perceptron Rule, Gradient Descent **Week 4.** Backpropagation, Loss Functions, Hyperparameter tuning [Hands-On] **Week 5.** Deep ANNs and Regularization, Optimization Algorithms **Week 6.** Batch Normalization, Practical Aspects, DL Pipeline and Strategy **Week 7.** Convolutional Neural Networks, ConvNets, Edge Detection **Week 8.** Padding, Convolution Operator, CNN architecture, Parameter Sharing **Week 9.** Object Localization and Detection, Le-Net, AlexNet, VGG, Residual Networks, Inception Net [Hands-On] **Week 10.** Recurrent Neural Networks (RNN), Sequence Modeling, Building the RNN **Week 11.** Backpropagation through time, LSTM, Attention Networks, Natural Language Processing, Word Embedding Applications **Week 12.** Generative Models – Restricted Boltzmann Machines and Deep Belief Networks [Hands-On] **Week 13.** Generative Models – Autoencoders, Variational, Stacked, Denoising, [Hands-On] **Week 14.** Generative Models – Generative Adversarial Networks **Week 15.** Miscellaneous Topics – Capsule Networks, Convolutional LSTM, One Shot Learning **Week 16.** Siamese Networks, Triplet Loss, Graph CNN
Resources:	Textbook: Neural Networks and Deep Learning by Charu C. Aggarwal Reference Book(s): Deep Learning (Adaptive Computation and Machine Learning series) Illustrated Edition by Ian Goodfellow
Tools	•

Mapping of CLO to PLOs

CLOs	MAPPED PLO	LEVEL
CLO 1: Discuss knowledge of the building blocks of DL: Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), and Generative Models	PLO 1	C2
CLO 2: Construct mathematical models based on backpropagation in Artificial Neural Networks (ANNs) using modern tools	PLO 5	C3

Grading Rubric

Assessment Method	CLO 1	CLO 2
Final Exam (50)	20	30
Midterm Exam (20)	15	5
Assignments (20)	5	15
Quizzes (10)	5	5
Total (100)	45	55

Appendage 4411

LAUNCH PROPOSAL FOR BS IN POWER AND RENEWABLE ENERGY

	A. Academic Details
1.	**Faculty/Institute/Department:** Faculty of Engineering and Sciences, Bahria University Islamabad & Karachi Campus, Electrical Engineering Department
2.	**Name of the Program:** BS (Power and Renewable Energy)
3.	**Mission of the Program:** To produce trained human resource in the discipline of Power and Renewable Energy Systems for exploiting energy resources to enhance economic growth of the country.
4.	**Program Educational Objectives (PEOs):** The graduates of the program will be able to: • Impart professional knowledge for developing efficient energy systems by integrating science and engineering principles adaptable to changing organizational and societal needs. • Engage in individual projects and multi-disciplinary teams to design, evaluate, and recommend methods and strategies for the efficient production, processing and utilization of energy and addressing the associated environmental challenges. • Effectively communicate with management, coworkers, customers, clients and others in diverse environments. • Get employment in the public and private sectors in the areas of energy science, energy project management, or pursuing an advanced degree and maintain professional competency through lifelong learning.
5.	**Program Learning outcomes:** • **Professional Knowledge:** An ability to apply knowledge of power and renewable energy fundamentals to the solution of energy requirements. • **Problem Analysis:** An ability to identify, formulate, review, and analyze the power and renewable energy related problems to reach substantiated conclusions using principles of natural sciences and energy engineering. • **Design/Development of Solutions:** An ability to design solutions for electrical energy sector that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. • **Investigation:** An ability to investigate 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. • **Modern Tool Usage:** An ability to create, select and apply appropriate techniques, resources, and modern tools, including prediction and modeling, with an understanding of the limitations. • **Environment, Society and Sustainability:** An ability to understand the impact of power and renewable energy solutions in societal and environmental contexts and demonstrate knowledge for sustainable development. • **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of professional practice. • **Individual and Teamwork:** An ability to work effectively, as an individual or in a

	team, on multifaceted and /or multidisciplinary settings. • **Communication:** An ability to communicate effectively 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. • **Project Management**: An ability to demonstrate effective management skills to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment. • **Lifelong Learning:** An ability to recognize importance of and pursue lifelong learning in the broader context of innovation and technological developments.
6.	**Rationale for the Program:** • In order to meet the ever-increasing energy needs, the globe is shifting towards renewable energy sources rather than producing energy using fossil fuels, which are quickly depleting and pose major environmental hazards. • Renewable sources are not only endless, but they are also environmentally friendly. • These sources offer the chance to encourage distributed power generation in order to prevent losses during electricity transmission and distribution and other related complications. Additionally, these sources are proving to be more cost-effective. Therefore, it is imperative to create aware and skilled human resources in order to meet the demands of power and energy development. • Following are the salient features of the proposed program: o Students lower than 60% marks in HSSC can be enrolled. o No involvement of PEC in the program: intake restriction, yearly re-accreditation process fees, continues investment on the infrastructure and lab equipment. o Program will be approved by HEC, and established HEI can start any BS program with ease. o No program specific funds required for infrastructure and lab development. o Lower fees compare to BEE with almost equal opportunity and job prospects will attract more students. Student will be able to work in the field of electrical and electronics domain. o No restriction of the intake for DAE Students and they will be able to purse higher studies. o Could be beneficial for on job student since offered in evening. o More technical/field-oriented subjects.
7.	**Brief Description of the Program:** Power and Renewable Energy System is an exciting and unique undergraduate program which is being offered to meet current energy crises. This BS degree is a first of its kind in the country with the curriculum addressing the call for the development of alternative sources of energy and conventional fossil fuels at the undergraduate level. More specifically, the program will incorporate elements of the conventional energy generation methods with the addition of courses focused on sustainable renewable energy as well as professional electives on business, finance, and management. Graduates of the program will be able to understand engineering fundamentals and apply that knowledge to solving problems in the production, processing, storage, distribution, and utilization of energy using multiple techniques such as synthesis, analysis, design, and case studies and to incorporate with the associated processes.
8.	**Duration:** 04 Years

<table>
<tr><td>9.</td><td>Venue (s):
H-11, Islamabad Campus.
NCMS Building, Bahria University, 13, National Stadium Road, Karachi.</td></tr>
<tr><td>10.</td><td>Program Scheduling Format (Morning/Evening/Weekend) (Bi-Semester/Trimester):
Bi-annual (Evening)</td></tr>
<tr><td>11.</td><td>Proposed Date of Commencement: Fall 2023</td></tr>
<tr><td>12.</td><td>Mode of Study/Examination:
Mode of study for BS (Power & Energy) is based on classroom teaching and labs. Assignments, quizzes, presentations, projects, mid-term exam and final term exams will be used to evaluate the students in each semester.</td></tr>
<tr><td>13.</td><td>Additional Faculty Member(s) Required: For intake of two batches per annum 6 faculty members (2 PhD and 4 MS) are required for the program.
Following faculty member are already available, whereas, rest of the HR will be inducted asper schedule mentioned in section B7.
Dr. Muhammad Raza
Dr. Anzar Alam
Research Interests: Power Systems, Power Electronics
Total 4 FMs (2 PhD and 4 MS) are required after program maturity may be required.
<table>
<tr><th>Year</th><th>No. of FMs</th><th>PhD</th><th>MS</th></tr>
<tr><td>First Year</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Second Year</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Third Year</td><td>2</td><td>-</td><td>2</td></tr>
<tr><td>Fourth Year</td><td>2</td><td>-</td><td>2</td></tr>
</table>
</td></tr>
<tr><td>14.</td><td>Additional Skilled-Worker(s) Required: None</td></tr>
<tr><td>15.</td><td>Availability/Requirement of Classrooms (Provide details, use extra sheet if required):
There is no mandatory requirement of classes for BS (Power & Energy) program. Classrooms available to the Electrical Department are sufficient to execute the program.</td></tr>
<tr><td>16.</td><td>Availability/Requirement of Laboratories, (provide details, use extra sheet if required):
Power Transmission and Distribution Lab
Power Generation and Protection/ High Voltage Lab
Electrical Machine Lab.
Applied Physics Lab
Workshop Lab
Analog Electronics and Devices Lab
Digital Logic Design Lab</td></tr>
<tr><td>17.</td><td>If existing labs suffice, requirement for any additional equipment? (Provide details, use extra sheet if required): Nil</td></tr>
<tr><td>18.</td><td>Additional Requirement for Books, Subscriptions, Memberships to Online Research Sites/ Repositories: At least 100 books, journals, and resources.</td></tr>
<tr><td>19.</td><td>Minimum Entry Level:
As per BU policy, i.e., the candidates seeking admission in BS (Power & Energy) should have qualified the Intermediate examination from any Board of Intermediate and Secondary Education in Pakistan ‘OR’ An examination equivalent to the Intermediate for which such candidates must submit Equivalence Certificate issued by the Inter-Board Chairman Committee, Islamabad. Applicants must have scored minimum 50% marks in Pre-Engineering field OR Pre-Medical with additional Mathematics OR ICS OR DAE in (Electrical, Electronics, Telecom; Biomedical; Computer)</td></tr>
</table>

19.	**Admission Criteria:** Matric/O-level : 10% Intermediate/A-level: 40% Entry Test Score: 50%
20.	**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). Nil
21.	**Number of Admissions Expected for First Intake:** 20 admissions for first intake
22.	**Number of Admissions Planned/ Expected for Subsequent Intake:** 20 admissions per intake
23.	**Complete Plan of Studies, inclusive of complete Roadmap:** Complete plan for BS (Power & Energy) Program is attached with this document for reference (**Annex – A**).
24.	**Course Outlines, Descriptions, Pre-Requisites & Readings (Compulsory &Recommended)** Course outlines for BS (Power & Energy) Program are attached with this document for reference (**Annex – B**).
25.	**Date of Approval by the Board of Study?**
	B. FINANCIAL ANALYSIS
1.	**Source of Funding:** • BU: Fully/Partially: Fully • **Public Sector (B1): Fully/Partially** *(provide complete details; attach MOU, agreement etc.)* • **NNGO (B1): Fully/Partially** *(provide complete details; attach MOU, agreement etc.)* • **INGO (B1): Fully/Partially** *(provide complete details; attach MOU, agreement etc.)* • **UN/IGO (B1): Fully/Partially** *(provide complete details; attach MOU, agreement etc.)*
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**
Fall 2023	20	0	20	138,250	0	2,765,000	0	**2,765,000**
Spring 2024	20	20	40	138,250	81,250	2,765,000	1625000	**4,390,000**
Fall 2024	20	40	60	138,250	81,250	2,765,000	3250000	**6,015,000**
Spring 2025	20	60	80	138,250	81,250	2,765,000	4875000	**7,640,000**
Fall 2025	20	80	100	138,250	81,250	2,765,000	6500000	**9,265,000**
Spring 2026	20	100	120	138,250	81,250	2,765,000	8125000	**10,890,000**
Fall 2026	20	120	140	138,250	81,250	2,765,000	9750000	**12,515,000**
Spring 2027	20	140	160	138,250	81,250	2,765,000	11375000	**14,140,000**

*5000 Rs per credit hour and 16.25 credit hours per semester (Total 130 credit hours)
**For first semester: 27K admission fee, 10K Misc. expenditures, and 20K refundable security fee shall be applicable

4.	**Expected Number of students for 1st & 2nd Intakes:** 40 students (20 students per intake)

5. **Expected Earning from first two Intakes (B5): Rs. 7,155,000/-**

	Students			Fee per student		Total Fee		
Semester	**Fresh**	**Existing**	**Total**	**Fresh**	**Existing**	**Fresh**	**Existing**	**Total**
Fall 2023	20	0	20	138,250	0	2,765,000	0	**2,765,000**
Spring 2024	20	20	40	138,250	81,250	2,765,000	1625000	**4,390,000**

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

	Students			Fee per student		Total Fee		
Semester	**Fresh**	**Existing**	**Total**	**Fresh**	**Existing**	**Fresh**	**Existing**	**Total**
Fall 2024	20	40	60	138,250	81,250	2,765,000	3250000	**6,015,000**
Spring 2025	20	60	80	138,250	81,250	2,765,000	4875000	**7,640,000**
Fall 2025	20	80	100	138,250	81,250	2,765,000	6500000	**9,265,000**
Spring 2026	20	100	120	138,250	81,250	2,765,000	8125000	**10,890,000**
Fall 2026	20	120	140	138,250	81,250	2,765,000	9750000	**12,515,000**
Spring 2027	20	140	160	138,250	81,250	2,765,000	11375000	**14,140,000**

Total 3 years earnings: Rs. 60, 465,000/-
Total earnings per annum: Rs. 16,905,000/-

7. **Total Estimated Salaries of all Extra Human Resources per Annum:**

Semester	Regular FM (MS*)	Visiting FM* (Credit)	Per Semester Salary
Fall 2023	0	15	600,000.00
Spring 2024	0	30	1,200,000.00
Fall 2024	0	46	1,840,000.00
Spring 2025	0	64	2,560,000.00
Fall 2025	1	73	3,520,000.00
Spring 2026	2	81	3,840,000.00
Fall 2026	3	87	4,080,000.00
Spring 2027	4	94	4,360,000.00

* MS 100K per month and 2500 VFM Per hour (average)
Total estimated salaries per annum of HR: Rs. 5,500,000/= (per annum)

8 **Cost of <u>Additional</u> Laboratory Equipment/Tools (B8):**
N/A

9 **Cost of Additional Classrooms (B9):**
N/A

10 **Cost of Additional Books, Subscription & Memberships to on-line Sites/Repositories (B10):**
Year 2: Rs. 100,000/-

11 **Off-Site rental Expenses and Cost of other Fixtures (B11):**
N/A

12 **Miscellaneous Expenses required for Starting the Program (B12):**
- Advertisement: Rs. 100,000.
- Printing & Stationary: Rs. 50,000.
- Admin Cost:
- Zero Visit:
- Total: Rs. 150,000

13 **Annual Recurring Expenditures in Subsequent Years (B13):**

	- Salaries: Rs. 5,500,000 (per annum) - Rentals: Nil - Subscriptions/Memberships: Nil - Advertisements: Rs. 100,000. - Printing & Stationary: Rs. 50,000. - Admin Cost: - Accreditation Fee: - Total: Rs. 5,650,000 (Per annum)
14	**Total Cost of the Program (B14):** [Add B(7) to B(12)] **Total cost per year: Rs. 5,650,000/=**
15	**Net Cost of the Program (B15): [Subtract B(1) from B(14)] Rs. 5,650,000.00/-**
16	**Net Earnings in First Year (B16): [Subtract B(15) from B(5)] Rs. 1,505,000.00/-**

BACHELOR OF SCIENCE (POWER & RENEWABLE ENERGY) ROADMAP

Curriculum

Campus:	**Karachi**
Department:	Department of Electrical Engineering
Program Title:	BS
Program Level:	Bachelors
Total Duration of Program:	4 years
Total Number of Semesters:	8 semesters
Total Number of Credit Hours:	130
Number of Credit Hours per Semester:	15-18

Areas	**Courses**	**Credit Hours**
Power & Renewable Energy Core Courses	22	72
Power & Renewable Energy Elective Courses	5	18
Computing Courses	1	3
Mathematics and Supporting courses	4	12
General Education Courses	5	13
Management Science Course	4	10
Social Science Course	1	3
Total	**42**	**131**

Semester-1

S.No.	**Pre-Req**	**Course Code**	**Course Title**	**Credit Hours**	**Theory**	**Lab**
1	None	GSC 113	Applied Physics	3	3	0
2	None	GSL 113	Applied Physics Lab	1	0	1
3	None	MAT 121	Applied Mathematics – I	3	3	0
4	None	ISL 101/HSS	Islamic Studies/Ethics	2	2	0

		116				
5	None	ENV 440	Energy and Environment	2	2	0
6	None	GSC 115	Circuit Analysis	3	3	0
7	None	GSL 115	Circuit Analysis Lab	1	0	1
Total Credit Hours in Semester-1				**15**	**13**	**2**

Semester-2

S.No	Pre-req	Course Code	Course Title	Credit Hours	Theory	Lab
1	None	ESC 111	Basic Mechanical Engineering	2	2	0
2	MAT 121	MAT 122	Applied Mathematics - II	3	3	0
3	None	EEL 112	Workshop Practice	1	0	1
4	None	CSC 112	Programming Fundamentals	2	2	0
5	None	CSL 112	Programming Fundamentals Lab	1	0	1
6	None	EEL 121	Engineering Drawing & CAD	1	0	1
7	None	CEN 120	Digital Logic Design	3	3	0
8	None	CEL 120	Digital Logic Design Lab	1	0	1
9	None	PAK 105	Pakistan Studies	2	2	0
Total Credit Hours in Semester-2				**16**	**12**	**4**

Semester-3

S.No	Pre-Req	Course Code	Course Title	Credit Hours	Theory	Lab
1	GSC 115	EEN 312	Electrical Machine	3	3	0
2	GSC 115	EEL 312	Electrical Machine Lab	1	0	1
3	GSC 115	EEN 224	Electronic Devices & Circuits	3	3	0
4	GSC 115	EEL 224	Electronic Devices & Circuits Lab	1	0	1
5	None	ENG 100	English-I	2	2	0
6	MAT 121	EEN 226	Probability Methods in Engineering	3	3	0
7	None	EEP 448	Renewable Energy Systems	3	3	0
Total Credit Hours in Semester-3				**16**	**14**	**2**

Semester-4

S.No.	Pre-Req	Course Code	Course Title	Credit Hours	Theory	Lab
1	EEN 224	EEP 468	Power Electronics	3	3	0
2	EEN 224	EEL 468	Power Electronics -Lab	1	0	1
3	GSC 115	EEN 433	Powe Distribution and Utilization	3	3	0
4	GSC 115	EEL 433	Powe Distribution and Utilization -Lab	1	0	1
5	MAT 122	GSC 320	Numerical Analysis	3	3	0
6	None	EPS 220	Energy Economics, Policy, and Management	2	2	0
7	CEN 120	CEN 440	Embedded Systems Design	3	3	0
8	CEN 120	CEL 440	Embedded Systems Design -Lab	1	0	1
Total Credit Hours in Semester-4				17	14	3

Semester-5

S.No.	Pre-Requisite	Course Code	Course Title	Credit Hours	Theory	Lab
1	None	MGT 425	Project Management in Engineering	3	3	0
2	GSC 115	EEP 331	Power System Analysis	3	3	0
3	GSC 115	EEL 331	Power System Analysis Lab	1	0	1
4	EEN 224	EEN 316	Instrumentation & Measurements	3	3	0
5	EEN 224	EEL 316	Instrumentation & Measurements Lab	1	0	1
6	None	ENG 320	Technical Report Writing and Presentation Skills	3	3	0
7	None	xxxx	Social Science Elective-1	3	3	0
Total Credit Hours in Semester-5				**17**	**15**	**2**

Semester-6

S.No	Pre-Req	Course Code	Course Title	Credit Hours	Theory	Lab
1	None	EPS-324	Energy Conservation and Auditing	3	3	0
2	None	EPS 345	Bio-Energy System	2	2	0
3	EEP 448	EPS 378	Integration of Distributed Power Generation	3	3	0
4	EEP 448	EPL 378	Integration of Distributed Power Generation Lab	1	0	1
5	CEN 120	CEN-354	Programming for DSP/FPGA	3	3	0
6	CEN 120	CEL-354	Programming for DSP/FPGA Lab	1	0	1
7	XXXX	XXXX	Elective – I	3	3	0
8	XXXX	XXXX	Elective – I Lab	1	0	1
Total Credit Hours in Semester-6				**17**	**14**	**3**

Semester-7

S.No.	Pre-Requisite	Course Code	Course Title	Credit Hours	Theory	Lab
1	--	FYP 400	Final Year Project	3	0	3
2	None	MGT 437	Total Quality Management	3	3	0
3	EEP 331	EEP 444	Power System Protection	3	3	0
4	EEP 331	EEL 444	Power System Protection Lab	1	0	1
5	XXXX	XXXX	Elective – II	3	3	0
6	XXXX	XXXX	Elective – II Lab	1	0	1
7	XXXX	XXXX	Elective - III	3	3	0
Total Credit Hours in Semester-7				**17**	**12**	**5**

Semester-8

S.No.	Pre-Requisite	Course Code	Course Title	Credit Hours	Theory	Lab
1	--	FYP 400	Final Year Project	3	0	3
2	None	MKT 422	Business Planning in Energy System	2	2	0
3	EEN 312	EEP 475	FACTs and HVDC Transmission	3	3	0
4	EEN 312	EEL 475	FACTs and HVDC Transmission Lab	1	0	1
5	XXXX	XXXX	Elective - IV	3	3	0
6	XXXX	XXXX	Elective - V	3	3	0
7	XXXX	XXXX	Elective – V Lab	1	0	1
Total Credit Hours in Semester-8				16	11	5

Total Credit Hours: 131

LIST OF COURSES

Computing Courses (3 credit hours)

Sr. No	Pre-req	Course Code	Course Title	Theory	Lab	CR
1	None	CSC 112	Programming Fundamentals	2	0	0
2	None	CSL 112	Programming Fundamentals - Lab	0	1	1

Mathematics and Supporting courses (12 credit hours)

Sr. No	Pre-req	Course Code	Course Title	Theory	Lab	CR
1	None	MAT 121	Applied Mathematics-I	3	0	3
2	MAT 121	MAT 122	Applied Mathematics - II	3	0	3
3	MAT 121	EEN 226	Probability Methods in Engineering	3	0	3
`4	MAT 122	GSC 320	Numerical Analysis	3	0	3

General Education Courses (13 credit hours)

Sr. No	Pre-req	Course Code	Course Title	Theory	Lab	CR
1	None	GSC 113	Applied Physics	3	0	3
2	None	GSL 113	Applied Physics	0	1	1
3	None	ISL 101/ HSS 116	Islamic Studies/Ethics	2	0	2
4	None	ENG 100	English-I	2	0	2
5	None	PAK 105	Pakistan Studies	2	0	2
6	None	ENG 320	Technical Report Writing and Presentation Skills	3	0	3

Power & Renewable Energy Core Courses (72 credit hours)

Sr. No	Pre-req	Course Code	Course Title	Theory	Lab	CR
1	None	ENV 440	Energy and Environment	2	0	2
2	None	GSC 115	Circuit Analysis	3	0	3
3	None	GSL 115	Circuit Analysis Lab	0	1	1
4	None	ESC 111	Basic Mechanical Engineering	2	0	2
5	None	EEL 112	Workshop Practice	0	1	1
6	None	EEL 121	Engineering Drawing & CAD	0	1	1
7	None	CEN 120	Digital Logic Design	3	0	3
8	None	CEL 120	Digital Logic Design Lab	0	1	1
9	GSC 115	EEN 312	Electrical Machine	3	0	3
10	GSC 115	EEL 312	Electrical Machine Lab	0	1	1
11	GSC 115	EEN 224	Electronic Devices & Circuits	3	0	3
12	GSC 115	EEL 224	Electronic Devices & Circuits Lab	0	1	1
13	None	EEP 448	Renewable Energy Systems	3	0	3
14	EEN 224	EEP 468	Power Electronics	3	0	3
15	EEN 224	EEL 468	Power Electronics Lab	0	1	1
16	GSC 115	EEN 433	Powe Distribution and Utilization	3	0	3
17	GSC 115	EEL 433	Powe Distribution and Utilization Lab	0	1	1
18	CEN 120	CEN 440	Embedded Systems Design	3	0	3
19	CEN 120	CEL 440	Embedded Systems Design lab	0	1	1
20	GSC 115	EEP 331	Power System Analysis	3	0	3
21	GSC 115	EEL 331	Power System Analysis Lab	0	1	1
22	EEN 224	EEN 316	Instrumentation & Measurements	3	0	3
23	EEN 224	EEL 316	Instrumentation & Measurements Lab	0	1	1
24	None	EPS-324	Energy Conservation and Auditing	3	0	3
25	None	EPS 345	Bio-Energy System	2	0	2
26	EEP 448	EPS 378	Integration of Distributed Power Generation	3	0	3
27	EEP 448	EPL 378	Integration of Distributed Power Generation Lab	0	1	1
28	CEN 120	CEN-354	Programming for DSP/FPGA	3	0	3
29	CEN 120	CEL-354	Programming for DSP/FPGA Lab	0	1	1
30	EEP 331	EEP 444	Power System Protection	3	0	3
31	EEP 331	EEL 444	Power System Protection Lab	0	1	1
32	EEN 312	EEP 475	FACTs and HVDC Transmission	3	0	3
33	EEN 312	EEL 475	FACTs and HVDC Transmission Lab	0	1	1
34	None	EPS-220	Energy Economics, Policy, and Management	2	0	2
35	None	XXXX	Project -I	0	3	3
36	None	XXXX	Project -II	0	3	3

Social Science Course (3 credit hours)

Sr. No	Pre-req	Course Code	Course Title	Theory	Lab	CR
1	None	HSS 422	Engineering Ethics	3	0	3
2	None	HSS 202	Introduction to Sociology	3	0	3
3	None	BES 103	Critical Thinking	3	0	3
4	None	HSS 456	Organizational Behavior	3	0	3
5	None	HSS 111	Introduction to International Relations	3	0	3

Management Science Course (8 credit hours)

Sr. No	Pre-req	Course Code	Course Title	Theory	Lab	CR
1	None	MGT 425	Project Management in Engineering	3	0	3
2	None	MGT 437	Total Quality Management	3	0	3
3	None	MKT 422	Business Planning in Energy System	2	0	2

Power & Renewable Energy Electives Courses:

S. No.	Pre-req course code	Course Code	Course Title	Credit Hours	Theory	Practical
1	None	EEP 446	High Voltage Engineering	3	3	0
2	None	EEL 446	High Voltage Engineering Lab	1	0	1
3	EEP 468	EPS 455	Control of Power Electronics System	3	3	0
4	EEP 468	EPL 455	Control of Power Electronics System Lab	1	0	1
5	None	EPS 422	Hydropower and Energy Storage Technologies	3	3	0
6	None	EPL 422	Hydropower and Energy Storage Technologies Lab	1	0	1
7	EEP 448	EPS 434	RS & GIS for Renewable Energy Resources	3	3	0
8	EEP 448	EPL 434	RS & GIS for Renewable Energy Resources Lab	1	0	1
9	MAT 122	EEN 412	Linear Control System	3	3	0
10	MAT 122	EEL 412	Linear Control System Lab	1	0	1
11	EPS 378	EPS 421	Smart Grid System	3	3	0
12	EPS 378	EPL 421	Smart Grid System Lab	1	0	1
13	None	EPS 456	Modelling and Optimization of Energy Systems	3	3	0
14	None	EPL 456	Modelling and Optimization of Energy Systems Lab	1	0	1
15	EEN 433	EEP 443	Electrical Power Transmission	3	3	0
16	EEN 433	EEL 443	Electrical Power Transmission Lab	1	0	1
17	GSC 113	EPS 411	Heating, Ventilation, and Air Conditioning Systems	3	3	0

18	None	EPS 424	Production Planning and Control	3	3	0
19	None	EPS 444	Energy in Transportation	3	3	0
20	None	EPS 454	Manufacturing Engineering	3	3	0
21	GSC 113	EPS 431	Hydrogen and Fuel Cell	3	3	0
22	GSC 113	EPS 432	Combine Heat and Power Energy System	3	3	0
23	EEP 448	EPS 433	Geothermal and Tidal Energy	3	3	0
24	GSC 113	EPS 435	Nuclear Energy Engineering	3	3	0
25	None	EPS 436	Conventional Power Generation Systems	3	3	0
26	EEN 412	EEP 445	Power System Stability & Control	3	3	0

COURSE OUTLINES

1. Electrical Power Transmission

Course Code: EEP 443
Credit Hrs.: 3+1
Pre-Requisite: Power Distribution and Utilization

Objectives: The course presents basics of electrical power transmission along with electrical and mechanical design impacts on power transmission in detail and HVDC transmission is introduced.

S.No	CLOs	PLO
1.	To be able to understand the basic knowledge of electrical power transmission (AC & DC), and analysis of loss in transmission line due to transmission line parameter. (C1)	1
2.	Differentiate the performance of short, medium and long transmission line models and distributors radial, ring main and interconnected. (C2)	1
3.	Analysis of mechanical parameters i.e. Towers, lines and also analyzing the efficiency of insulators for transmission lines. (C4)	2

Course Outline:

Week 1: Percent and per-unit quantities, selection of base and change in base of per unit quantities, node equations,

Week 2: one-line diagram, choice of voltage and choice of AC/DC systems,

Week 3: economic comparison of various transmission systems, standard voltages in Pakistan and abroad for transmission and sub-transmission.

Week 4: Introduction to HV, EHV and UHV system.

Week 5: Conductor types; resistance, skin 48 effect, line inductance based and flux considerations. Inductance of single phase and three phase lines,
Week 6: inductance of composite conductor line, inductance of bundled conductors, capacitance of single phase and three-phase lines,

Week 7: effect of earth on capacitance, capacitance of bundled conductors, parallel circuit lines,

Week 8: Ferranti effect. Short, medium and long transmission lines, solution of equations. Traveling waves,

Week 9: surge impedance loading, equivalent circuit, and power flow through the line, voltage regulation and line surges.

Week 10: Line supports, sag and tension calculation, total length of conductor supports at various levels,

Week 11: mechanical degree of safety, effect of wind pressure and ice loading,

Week 12: conductor vibration and use of dampers. Insulator material, types of insulators, voltage distribution over insulator string, string efficiency,

Week 13: methods of improving the string efficiency, testing of insulators, corona effect, corona loss, radio interference due to corona.

Week 14: Underground cables: types, calculation of inductance and capacitance, insulation resistance, insulation breakdown of cables,

Week 15: thermal characteristics of cables, calculation of current rating of the cables, fault locating techniques, cable jointing techniques.

Week 16: Introduction and classification of HVDC transmission.

Recommended Book(s):

1. Stevenson, "Elements of Power System", Latest Edition.
2. Grainger and Stevenson, "Power System Analysis", Latest Edition.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

2. Electrical Machines

Course Code: EEN 312
Credit Hrs.: 3+1
Pre-Requisite: Circuit Analysis

Objectives: Covers detailed and in-depth aspects of Electrical Machines.

S.No	CLOs	PLO
1.	Define the concepts of power electric circuits, magnetic circuits, and the principles of linear and rotating electromagnetic machines. (C1)	1
2.	Analyze the operating principles of transformer & electrical machines to investigate their performance characteristics. (C4)	2
3.	Propose the design parameters of transformers and electrical machines (C3)	3

Course Outline:

Week 1: Transformers: Equivalent Circuit, per unit system of measurement,

Week 2: voltage regulation and efficiency, three phase transformers,

Week 3: types of connections, testing, and parallel operation. Synchronous Generators: Equivalent circuit and operations,

Week4: Characteristics of Salient and Non-Salient poles, model parameters, Single and parallel operation, ratings.

Week 5: Synchronous Motors: Basic Principle,

Week 6: Equivalent Circuit, steady state operation:

Week 7: Torque speed characteristics, power factor correction,

Week 8: starting of synchronous motors, ratings, speed control.

Week 9: Induction Motors: Production of rotating field and torque,

Week 10: Construction, Synchronous speed,

Week 11: Slip and its effect on rotor frequency and voltage.

Week 12: Equivalent circuit. Power and torque.

Week 13: Losses, efficiency and power factor.

Week 14: Torque-speed characteristic.

Week 15: Starting and speed control.

Week 16: Induction generator.

Recommended Book(s):

1. Stephen J. Chapman, "Electric Machinery Fundamentals", McGraw-Hill. (Latest Edition)
2. Hubert, "Electric Machines Theory, Operation, Applications, Adjustment and Control", (Latest Edition).

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

3. Conventional Power Generation Systems
Course Code: EPS 436
Credit Hrs.: 3+0
Pre-Requisite: None

Objectives: The students learn different power plant and modes of energy conversion to generate electrical energy in this course and the concepts of fuel cells are introduced.

S.No	CLOs	PLO
1.	Get knowledge about the energy resources and energy conversion methods available for the production of electric power and determine the efficiency and output of a modern Rankine cycle steam power plant from given data. (C1)	1
2.	Explain the performance of gas turbines with reheat and regeneration, and discuss the performance of combined cycle power plants.(C2)	1
3.	Analyze the environmental impact of electric power production on air quality, climate change, water, and land. (C3)	7
4.	Perform the preliminary design of the major components or systems of a conventional or alternate power plant. (C5)	3

Course Outline:

Week 1: Thermal Power Plants: Sources of conventional energy and method of harnessing, specific features and cycles used in steam,

Week 2: gas and diesel power plants, combine cycle systems and cogeneration. Location of the above plants and selection of units,

Week 3: prime movers and associated equipment. Hydroelectric Power Plants:

Week 4: The plants and their equipment, layouts, run of the river and accumulation type station, types of hydroelectric turbines and their stations.

Week 5: Nuclear Power Plants: Nuclear reaction, fission and fusion reaction, critical mass chain reaction, moderators, reactor control and cooling,

Week 6: classification of reactors, different types of reactors, radiation damages, shielding of grays neutrons, materials for construction.

Week 7: Thermoelectric Generators: Thermoelectric effect, solid state description of thermoelectric effect,
Week 8: analysis and design of thermoelectric generators, figure of merit, device configuration, solar and radioisotope powered generators, applications.

Week 9: MHD Generators: Gaseous conductors,

Week 10: analysis and design of MHD generator,

Week 11: problems associated with MHD generation, possible configuration.

Week 12: Fuel Cells: Thermodynamic principles,

Week 13: efficiency of fuel cell factors limiting the performance,

Week 14: design, new development in fuel cells,

Week 15: possibility of future use in electric vehicles.

Week 16: Wind power generation.

Recommended Book(s):

1. Arche W. Culp, "Principles of Energy Conversion", Latest Edition.
2. M.M. Wakel, "Power Plant Technology", McGraw-Hill, Latest Edition.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

4. Energy in Transportation
Course Code: EPS 444
Credit Hrs.: 3+0
Pre-Requisite: None

Objectives: Students are introduced to the basics of electrical distribution systems for transportation.

S.No	CLOs	PLO
1.	Describe the current state of the transportation sector from the point of view of energy and environment. (C1)	1
2.	Analyze the key propulsion technologies and urban mobility problems and identify solutions for sustainable mobility in terms of energy and environment, in different modes. (C4)	2
3.	Use tools for modeling pollutant emissions / fuel consumption. (C3)	5

Course Outline:

Week 1: Introduction to distribution system.

Week 2: Urban, suburban and rural distribution systems. Primary, secondary and tertiary voltages.

Week 3: Radial and ring main systems, application of distribution transformers, estimation of load,

Week 4: load characteristics, substation switch gears and bus bar arrangements.

Week 5: calculation of voltage drop and regulation in distribution feeders.

Week 6: Grounding and earthing, distribution transformer neutral, earthing resistance, earthing practice in L.V. networks.

Week 7: Power Factor: Disadvantages and causes of low power factor, methods for improvement, application of shunt capacitors in distribution network.

Week 8: Batteries & Electrochemical Processes:

Week 9: Main types of batteries and their working, battery charging,

Week 10: electroplating, electrolysis and electro-metallurgical process.

Week 11: Cathodic protection of poles, gas pipes, oil pipes and water structures. Heating and Welding:

Week 12: Electric heating, resistance, induction and dielectric heating,

Week 13: electric furnaces, microwave heating, electric welding,

Week 14: resistance welding and its types. Fundamentals of Illumination Engineering:

Week 15: Laws, units and terms used, requirements for good lighting,

Week 16: illumination schemes for various situations (street lighting, commercial/industrial lighting, stadium/flood/stage/spot lighting etc.), types of lamps, their working and relative merit.

Recommended Book(s):

1. M. L. Anand, "A Text Book of Electrical Power", Latest Edition.
2. Turan Gonen, "Electrical Power Distribution System", Latest Edition.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

5. Power System Analysis
Course Code: EEP 331
Credit Hrs.: 3+1
Pre-Requisite: Circuit Analysis

Objectives: This course has been designed to introduce the importance of analyzing various aspects of power system. It covers power flow studies and fault analysis of both symmetrical and unsymmetrical faults in power networks. This forms the basis for power system operation, control and protection.

S.No	CLOs	PLO
1.	Explain the principles and methods for power system analysis (C2)	1
2.	Examine the principles of modelling and analysis of power systems subject to steady state, symmetrical and unsymmetrical faults with reference to stability analysis of power system (C4)	2
3.	Apply the short circuit, load flow, and stability analysis on the transmission and distribution network to propose the solutions complying the network standards. (C6)	3

Course Outline:

Week 1: The Admittance Model and Network Calculations: Branch and Node admittances; Mutually coupled Branches in Y-bus;

Week 2: Equivalent Admittance Network; Modification of Y-bus; Impedance matrix and Y-bus; the method of successive elimination;

Week 3: Node Elimination (Kron Reduction); Triangular Factorization.

Week 4: The Impedance Model and Network Calculations:

Week 5: The bus, admittance and impedance Matrices;

Week 6: Thevenin's Theorem and Z-bus; Modification of an existing Z-bus;

Week 7: Direct determination of Z-bus;

Week 8: Calculation of Z-bus elements from Y-bus; Power Invariant Transformations; Mutually coupled branches in Z-bus. Symmetrical Faults:

Week 9: Transients in RL circuits; internal voltages of loaded machines. Under fault conditions; fault calculations using Zbus;

Week 10: Equivalent circuits; Selection of circuit breakers. 45 Symmetrical Components and Sequence Networks:

Week 11: Synthesis of unsymmetrical phasors; symmetrical components of unsymmetrical phasors; Networks of a symmetrical Transmission line; sequence Networks of the synchronous Machines;

Week 12: Sequence Networks of Y-impedances; sequence networks; positive, negative and zero sequence networks;

Week 13: Unsymmetrical Faults: Unsymmetrical faults on power systems;

Week 14: single line-to-ground faults; line-to-line faults.

Week 15: Double line-to-ground faults;

Week 16: Demonstration problems; open conductor faults.

Recommended Book(s):

1. B. S. William, "Elements of Power System Analysis", McGraw Hill, Latest Ed.
2. B. M. Weedy, "Electrical Power Systems", Pergamon Press, Latest Ed.
3. Hadi Saadat, "Power System Analysis", Latest Ed.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

6. Power System Protection

Course Code: EEP 444
Credit Hrs.: 3+1
Pre-Requisite: Power System Analysis

Objectives: The course presents diverse types of relays, relaying schemes, circuit breakers and fuses. Topics like discrimination and coordination are also introduced.

S.No	CLOs	PLO
1.	Acquire the basic knowledge of protection system attributes and understand the fundamentals of electromechanical and digital relays for (Transformer, Bus, Generator, Motor, Line). (C2)	2

2.	Design the protection schemes for different power equipment's using software. (C3)	3
3.	Evaluate the protection schemes for a power system and investigate the behavior of various electrical components. (C5)	4

Course Outline:

Week 1: Introduction to protection system,

Week 2: types of faults, effect of faults, fuse as protective device,

Week 3: types of fuses, characteristics of fuses, selection and application of fuses, discrimination and coordination,

Week 4: current transformer and its operation, relay construction,

Week 5: basic relay terminology, electromagnetic relays,

Week 6: thermal relays, static relays and introduction to microprocessor based protective relays,

Week 7: over current protection,

Week 8: distance protection, impedance relay,

Week 9: R-X 47 diagram of impedance relay,

Week 10: operation of impedance relay in different zones, reactance relay, differential protection of transformers,

Week 11: generator protection, bus bar protection,

Week 12: arc voltage, arc interruption, re-striking voltage and recovery voltage, resistance switching,

Week 13: current chopping circuit breaker,

Week 14: classification of circuit breakers, oil circuit breakers,

Week 15: air blast circuit breakers, air break circuit breakers,

Week 16: SFB6B circuit breakers, vacuum circuit breakers, operational mechanism and rating of circuit breakers.

Recommended Book(s):

1. S. Rao, "Switchgear and Protection", Khanna Publisher, Latest Edition.
2. Paithanker & Bhide, "Fundamentals of Power System Protection", Prentice Hall, Latest Edition.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

7. High Voltage Engineering
Course Code: EEP 446
Credit Hrs.: 3+1
Pre-Requisite: None

Objectives: The demand for the generation and transmission of copious amounts of electric power today, necessitates in transmission at extra-high voltages. At this juncture, a practicing electrical engineer or a student of electrical engineering is expected to possess knowledge of high voltage techniques and should have sufficient background in high voltage engineering. Upon completion of this course, the participant shall be able to understand high voltage basics and its application appreciate the design principles and critical elements of a high voltage system.

S.No	CLOs	PLO
1.	Recognize various types of insulating materials and their applications in high-voltage equipment. (C3)	1
2.	Explain the breakdown mechanisms in solid, liquid and gaseous dielectrics. (C4)	2
3.	Ability to identify the performance of high-voltage generation and measurement devices. (C5)	2

Course Outline:

Week 1: Introduction,

Week 2: testing voltages,

Week 3: Generation of High Voltages,

Week 4: Measurements of High Voltages,

Week 5: Electrostatic Field

Week 6: field stress control,

Week 7: Breakdown Mechanism of Gases,

Week 8: Breakdown in Solids,

Week 9: Breakdown in Liquids,

Week 10: Non-destructive testing technique,

Week 11: Over voltages,

Week 12: Testing procedure and insulation coordination,

Week 13: Transients in Power Systems

Week 14: Transients in Power Systems (Continued)

Week 15: Transients in Power Systems (Continued)

Week 16: Transients in Power Systems (Continued)

Recommended Book(s):

1. High Voltage Engineering by C.L Wadwa

Recommended Text(s)/Reference Books:

2. High Voltage Engineering by M S Naidu
3. High Voltage Engineering Fundamentals by E. Kuffel

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

8. Renewable Energy Systems
Course Code: EEP 448
Credit Hrs.: 3+0
Pre-Requisite: None

Objectives: Students are introduced to different types of renewable energy resources by engaging in various activities to help them understand the transformation of energy (solar, water, nuclear, biomass and wind) into electricity. Students explore the different roles engineers who work in renewable energy fields have in creating a sustainable environment – an environment that contributes to greater health, happiness and safety.

S.No	CLOs	PLO
1.	Explain the renewable energy resources and conversion systems with their impacts on the environment and community. (C2)	7
2.	Analyze the potential of renewable energy resources and solve problems associated with them. (C4)	2
3.	Evaluate performance and design considerations for utilization of renewable energy resources. (C5)	4

Course Outline:

Week 1: Promising renewable energy sources,

Week 2: potential availability and present status,

Week 3: existing technologies and availability, solar energy:

Week 4: Sun-Earth relationship, solar geometry, sun path and solar irradiance, solar spectrum. Solar constant,

Week 5: atmospheric effects, global distribution, effects of tilt angle, daily and seasonal variations, resource estimation.

Week 6: Extraterrestrial, global, direct, diffused radiation,

Week 7: Flat plate collectors, their designs, heat transfer, transmission through glass, absorption transmission of sun energy, selective surfaces,

Week 8: performance, and efficiency, Photovoltaic: PV effect, materials, solar cell working, efficiencies,

Week 9: different types of solar cells, characteristics, (dark, under illumination), efficiency limiting factors,

Week 10: power spectral response, fill factor, temperature effect; PV systems, components, modules, arrays, controllers, inverters, storage, PV system sizing, performance and applications,

Week 11: Wind: Global distribution, resource assessment, wind speed, height and topographic effects, power extraction for wind energy conversion, wind mills, their types, capacity, properties, wind mills for water lifting and power generation, environmental effect.,

Week 12: Hydropower: Global resources, and their assessment, classification, micro, mini, small and large sources principles of energy conversion; turbines, their working and efficiency for micro to small power systems, environmental impact, Biogas: Biomass sources; residue, farms, forest.

Week 13: Solid wastes; agricultural, industrial and municipal wastes etc.; applications, traditional and nontraditional uses: utilization, process, gasification, digester, types, energy forming,

Week 14: Environment issues, Geothermal: Temperature variation in the earth, sites, potentials, availability, extraction techniques, applications; water and space heating, power generations, problems, environmental effects,

Week 15: nuclear: Global generations of reserves through reprocessing and breeder reactors,

Week 16: growth rate prospect of nuclear fusion, safety and hazards issue.

Recommended Book(s):

1. Manfred Grathwhol. World Energy Supply: Resources, Technologies and Prospective, Walter de Gruyter-Berlin, Latest edition
2. J.W Twidell and A.D. Weir. Resources, E & F.N. Spon Ltd, London, Latest edition
3. M Iqbal. An Introduction to Solar Radiation, Academic Press, Canada, Latest edition
4. Simon Roberts. A Practical Guide to Solar Electricity, Prentice Hall, Latest edition
5. Martin A G. Solar cells: Operating Principles, Technology, & System Application, Prentice Hall, Latest edition
6. T.J. Jansen. Solar Engineering Technology, Prentice Hall, Latest edition
7. Daniel H' Wind Power. A Book on Wind Energy Conversion System, Litton Educational Press, Latest edition

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

9. Energy and Environment
Course Code: ENV 440
Credit Hrs.: 2+0
Pre-Requisite: None

Objectives: This course examines the scientific and engineering aspects of energy production, transformation, and consumption, investigates the energy flows in the Earth's systems, and provides students with necessary engineering approaches and techniques for understanding, assessing, and remediating environmental problems associated with energy production, transformation, and consumption.

S.No	CLOs	PLO
1.	Define key components of energy systems, including opportunities and limitations from resource, technology, environmental perspectives. (C1)	1
2.	Understand conventional, non-conventional sources of energy and new technologies used for minimizing environmental hazards. (C2)	6
3.	Analyze energy production, consumption and its effect on environment with particular emphasis on climate change. (C3)	7

Course Outline:
Week 1: Introduction: Getting Power to the People (Energy and Environment);

Week 2: Sources of energy, Renewable and non-renewable energy resources,

Week 3: Economics of energy production and consumption Global Politics and Strategies,

Week 4: Making global and local decisions on the structure of utilized energy sources, Energy and Society;

Week 5: Thermodynamic Principles of Energy Conversion;

Week 6: Flue gases, NOx formation and reduction,

Week 7: Combustion emission control, Thermodynamic fundamentals,

Week 10: Natural gas combustion, Coal combustion,

Week 11: Estimating steam power; Global Energy Use and Supply,

Week 12: Renewable resources and fossil fuels, Hydraulic, geothermal, wind, tidal, solar, biomass energies,

Week 13: Oil, gas, coal, and oil shale energy production,

Week 14: Environmental consequences of the fossil fuels production and utilization; Nuclear Energy; Fundamentals of nuclear power,

Week 15: Nuclear power systems, Comparing fission and fusion energies, Nuclear power health effects,

Week 16: Safety requirements for nuclear power plants, Radioactive waste management and disposal; Alternative Fuels and Advanced Technologies (Renewable Energy).

Recommended Book(s):
1. James A. Fay and Dan S. Golomb, 2002, Energy and the Environment, OXFORD University Press, 198 Madison Avenue, New York, NY, 10016.

2. On Global Forces of Nature Driving the Earth's Climate. Are Humans Involved, by L.F. Khilyuk and G.V. Chilingar, 2006, Environmental Geology, 50: 899-910

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

10. Integration of Distributed Power Generation

Course Code: EPS 378
Credit Hrs.: 3+1
Pre-Requisite: Renewable Energy Systems

Objectives: The course has been designed to help students understand the concept of distributed generation. The course will also enhance the skill of students to analyses the impact on grid integration & to study concept of microgrid and its configuration.

S.No	CLOs	PLO
1.	Explain the structure and configuration of modern electrical network for integrating conventional and nonconventional energy generation. (C2)	1
2.	Apply the standard criteria for the selection of electrical transmission network and industrial equipment. (C3)	2
3.	Analyze the characteristics of micro/hybrid grid using power system software. (C4)	5

Course Outline:

Week 1: Introduction to distribution generation system,

Week 2: renewables application as distribution sources,

Week 3: concept of distributed generations, topologies, selection of sources, regulatory standards/ framework,

Week 4: Standards for interconnecting Distributed resources to electric power systems: IEEE 1547.

Week 5: DG installation classes, security issues in DG implementations. Energy storage elements.

Week 6: Requirements for grid interconnection, limits on operational parameters, voltage, frequency,

Week 7: THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system:

Week 8: reliability, stability and power quality issues.

Week 9: Concept and definition of microgrid, microgrid drivers and benefits,

Week 10: review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids,

Week 11: Power Electronics interfaces in DC and AC microgrids,

Week 12: Modes of operation and control of microgrid: grid connected and islanded mode,

Week 13: Active and reactive power control, protection issues, anti-islanding schemes:

Week 14: passive, active and communication based techniques,

Week 15: microgrid communication infrastructure,

Week 16: Power quality issues in microgrids, regulatory standards, Microgrid economics.

Recommended Book(s):

1. Integration of Distributed Generation in the Power System by Math Bollen And Fainan Hassan
2. Voltage Source Converters in Power Systems: Modeling, Control and Applications", Amir naserYezdani, and Reza Iravani, IEEE John Wiley Publications.
3. "Power Switching Converters: Medium and High Power", Dorin Neacsu, CRC Press, Taylor & Francis, 2006.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

11. Energy Conservation and Auditing

Course Code: EPS 324
Credit Hrs.: 3+0
Pre-Requisite: None

Objectives: This course provides students with a good theoretical knowledge and understanding of power system economics. The basic principles of power system economics (main regulatory regimes and pricing principles) will be analysed in order to combine power system analysis and economic appraisal, providing an insight and ability to estimate future developments. Technical and economic implications of transition to a low-carbon energy systems will be discussed.

S.No	CLOs	PLO
1.	CONSTRUCT the energy flow diagram of an industry and identify the energy wasted. (C3)	2
2.	SELECT an appropriate energy conservation method to reduce the wastage of energy. (C4)	1
3.	CARRY OUT energy audit of an industry/organization. (C6)	3

Course Outline:

Week 1: Power market fundamentals;

Week : 2pricing power, energy, and capacity;

Week 3: power supply and demand;

Week 4: Marginal cost in a power market;

Week 5: Market structure;

Week 6: Reliability and investment policy;

Week 7: reliability and generation;

Week 8: operating reserve pricing;

Week 9: requirement of installed capacity;

Week 10: Market architecture;

Week 11: day ahead market design;

Week 12: ancillary services;

Week 13: Market for operating reserves;

Week 14: defining Market power,

Week 15: modelling market power.

Week 16: modelling market power (Continued)

Recommended Book(s):

1. Power System Economics: Designing Market for Electricity by Steven Stoft
2. Fundamentals of Power System Economics by Daniel S. Kirschen, Goran Strbac

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

12. Modelling and Optimization of Energy Systems
Course Code: EPS 456
Credit Hrs.: 3+1
Pre-Requisite: None

Objectives: Students will understand the operation of power networks from a control and optimization perspective. They will learn how mathematical tools and computational methods are used for the design, modelling, planning, and real-time operation of power grids.

S.No	CLOs	PLO
1.	Explain the thermodynamic efficiency, energy & exergy efficiency of industrial processes using flow diagram. (C1)	1
2.	Analyze the industrial processes to determine the corresponding energy and exergy efficiencies and mass balance. (C3)	2
3.	Model, design and optimize energy conversion systems and industrial processes. (C4)	5

Course Outline:

Week 1: Introduction to optimization,

Week 2: Meaning of optimization,

Week 3: Types of problems, Linear programming,

Week 4: Basic solution,

Week 5: Simplex method and LU decomposition,

Week 6: Unconstrained optimization,

Week 7: Minimization and maximization of convex functions, Gradient descent method,

Week 8: Method of steepest descent, Newton's method, Multi objective optimization problems,

Week 9: Evolutionary optimization algorithms,

Week 10: Economic Dispatch,

Week 11: DC Optimal Power Flow, AC Optimal Power

Week 12: Flow, Power optimization problems such as state estimation, unit commitment,

Week 13: optimal power flow, and transmission planning,

Week 14: Efficient optimization and numerical algorithms for mixed-integer nonlinear problems,

Week 15: Control and optimization for renewable energy,

Week 16: Unit commitment.

Recommended Book(s):

1. An Introduction to Optimization by E.K. Chong and S.H. Zak, Wiley-Interscience.
2. Convex optimization Stephen Boyd, and Lieven Vandenberghe, Cambridge university press, 2004.
3. Allen J. Wood, Bruce F. Wollenberg, and Gerald B. Sheble, Power Generation, Operation, and Control (3rd edition), Wiley, 2013.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10

Quizzes (10)	2	3	5
Total (100)	22	38	40

13. Power System Stability & Control

Course Code: EEP 445

Credit Hrs.: 3+0

Pre-Requisite: None

Objectives: This course helps a student to analyses the stability issues in a power system and focuses on small signal stability, transient stability and voltage stability. It highlights the significance of dynamic modelling of generators, loads, excitation systems and prime movers in analyzing the stability issues.

S.No	CLOs	PLO
1.	Interpret and devise schemes for adapting the stability techniques in the current distributed power systems. (C1)	1
2.	Analyze the small signal stability of the power systems with and without excitation systems. (C4)	2
3.	Model the power system components for stability considerations. (C6)	3
4.	Investigate transient stability issues of single and multiple synchronous machines in power systems. (C5)	4

Course Outline:

Week 1: Review of synchronous machine theory –

Week 2: Stability classification –

Week 3: Modelling aspects:

Week 4: Synchronous machine classical model, Eq' model, Park's model – Prime mover, Exciter models;

Week 5: Transient stability – step by step solution of swing equation –

Week 6: multi-machine systems;

Week 7: Transient stability –

Week 8: Numerical Integration Methods:

Week 9: Euler and Fourth Order Runge-Kutta methods;

Week 10: Small signal stability – Linearized model of synchronous machine –

Week 11: Eigen values – Eigen vector analysis;

Week 12: Power system stabilizers ;

Week 13: Voltage stability –

Week 14: phenomena and components –

Week15: steady state stability (PV and VQ curves)

Week15: steady state stability (PV and VQ curves) (Continued)

Recommended Books:

1. Woolen Barg, "Power Generation, Operation and Control", Latest Edition.
2. Trosten Cegral, "Power System Control Technology", Latest Edition.
3. P. Kundur, "Power System Stability and Control", Latest Edition.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

14. Smart Grid System
Course Code: EPS 421
Credit Hrs.: 3+1
Pre-Requisite: Integration of Distributed Power Generation

Objectives: The objective of the course is to develop a broader understanding of Smart Grid and familiarize the students regarding the existing smart grid technologies. The course will also focus on the applications of smart grid and give awareness of modern, affordable, and sustainable energy.

S.No	CLOs	PLO
1.	Explain the need for smart grid implementation, the current status of smart grid technology, and the future prospects of smart grid development. (C1)	1
2.	Apply load flow analysis techniques in a smart grid environment to study the impact of distributed generation on power flow. (C3)	2
3.	Analyze the challenges associated with load flow studies in the context of smart grid and distributed generation. (C4)	3

Course Outline:

Week 1: Smart grid basics: Overview of existing grid, why do we need smart grid, **Week 2:** Objectives and main features of Smart Grid,

Week 3: Current status of smart grid technology, Future of Smart Grid, advantages and Disadvantages,

Week 4: Implementation of smart grid and possible difficulties. Distributed Generation: Overview of Distributed Generation,

Week 5: New paradigm of power generation, future power grid, Impact of Distributed Generation on the main power grid,

Week 6: Smart Grid and Distributed Generation: Advantages and Disadvantages,

Week 7: Challenges for load flow studies,

Week 8: Load flow analysis in smart grid environment.

Week 9: Demand side management: Introduction, types and tools for demand side management,

Week 10: Demand response and its applications,

Week 11: Types of loads & their current signatures,

Week 12: Smart Meters. Micro networks. Converter control, Micro-network simulation,

Week 13: Communication Technology for Smart Grid:

Week 14: Basics of Data communication technology, Communication protocols.

Week 15: Power System Monitoring and Control,

Week 16: Architecture and application of SCADA (Supervisor Control and Data Acquisition).

Recommended Books:

1. Power System Analysis by Hadi Saadat McGraw-Hill International Editions
2. The Smart Grid: Enabling Energy Efficiency and Demand Response by Clark W. Gellings, P.E.
3. Synchronized Phasor Measurement Units and their applications by A.G Phadke, J.S Thorp

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

15. Nuclear Energy Engineering

Course Code: EPS 435
Credit Hrs.: 3+0
Pre-Requisite: Applied Physics

Objectives: This course will give the student basic understanding of nuclear process in fission and fusion reaction, analyze the advanced nuclear reactor systems and the sustainable development of innovative nuclear energy technologies, and be able to explain the concepts of radioactive waste management for nuclear energy application.

S.No	CLOs	PLO
1.	Get knowledge about the units and nomenclature used in nuclear engineering including radiation, radioactivity, particles and their interactions, radioactive decay. (C1)	1
2.	Understand and explain the effects of radiation on matter including alpha, beta, gamma and neutrons, material defects, the origin of swelling and material degradation mechanisms. (C2)	2
3.	Understand and describe basic reactor engineering concepts and designs. (C5)	3

Course Outline:

Week 1: Role and importance of nuclear energy,

Week 2: Particle wavelength, Excited states and radiation,

Week 3: Nuclear stability and radioactive decay,

Week 4: Nuclear reaction, Binding energy,

Week 5: Mass deficit Radioactive decay, Interaction of radiation with matter:

Week 6: Neutron interaction, Cross-sections, Neutron attenuation,

Week 7: Neutron flux, Neutron cross-section data, Energy loss in scattering collision,

Week 8: Fission, γ-ray interaction with matter,

Week 9: Nuclear reactor: Fission chain reaction,

Week 10: Nuclear reactor fuel, Nuclear power plants Nuclear Reactor Systems and components:

Week 11: Steam generator, Pressurizer, Steam supply system,

Week 12: Reactor Containment, Turbine, Cooling Tower;

Week 13: Nuclear Detectors: Neutron flux, Fick's law,

Week 14: Equation of continuity, Diffusion equation, heat Removal from reactor,

Week 15: Heat generation in reactors, Conduction,

Week 16: Convention, Two Phase Flow, Boiling Heat transfer, Nuclear reactor safety: Reliability, Risk, Safety

Recommended Books:

1. J. R. Lamarsh and A. J. Baratta 2001. Introduction to Nuclear
2. Engineering, 3rd Ed., Prentice Hall.
3. E. E. Lewis. 2009. Fundamentals of Nuclear Reactor Physics
4. R. L. Murray 2009. Nuclear Energy: An introduction to the concepts, systems, and applications of nuclear processes, 6th Edition, Elsevier Inc.
5. R. A. Knief 2008 . Nuclear Engineering Theory and Technology of Commercial Nuclear Power 2008

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

16. Geothermal and Tidal Energy

Course Code: EPS 433
Credit Hrs.: 3+0
Pre-Requisite: Renewable Energy Systems

Objectives: This course will give the student the knowledge of geothermal energy, tidal and wave energy conversion system. Issues and problems for successful exploration of geothermal and tidal will be analyzed.

S.No	CLOs	PLO
1.	Understand the principles of geothermal and tidal energy systems in relation to their use in electric power generation. (C2)	1
2.	Apply knowledge gained in geothermal and tidal energy systems to solve renewable energy engineering problems. (C3)	2
3.	Work with a team to apply geothermal and tidal systems knowledge to develop and conduct a project. (C5)	3

Course Outline:

Week 1: Geology of Geothermal Regions,

Week 2: Exploration Strategies and Techniques Principles,

Week 3: Heat source systems for ambient air utilization,

Week 4: Heat source systems for shallow geothermal utilization,

Week 5: Geothermal well drilling,

Week 6: Design of down hole part,

Week 7: Up hole part system, District heating system,

Week 8: Environmental analysis of geothermal energy,

Week 9: Case study related to geothermal energy,

Week 10 - 12: Steam Power Plants, Single and double flash steam power plants,

Week 13 - 14: Binary cycle power plants, Advanced geothermal energy conversion systems,

Week 15: Exergy analysis applied to geothermal power systems,

Week 16: Tidal and wave energy, Tidal and wave energy conversion systems.

Recommended Books:

1. Pimental, D. and R. DiPippo. 2008. Geothermal Power Plants, 2nd Ed. Elsevier. USA.
2. Charlier, R.H. and W.Finkl. 2009. Ocean Energy Tide and Tidal Power. 1st Ed. Springer.
3. Brooke, J. 2003. Wave Energy Conversion. 1st Ed. Vol- 6. Elsevier Ocean engineering.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

17. Hydrogen and Fuel Cells

Course Code: EPS 431
Credit Hrs.: 3+0
Pre-Requisite: None

Objectives: This course will give the student knowledge of hydrogen systems, storage, production and its application in fuel cells. Hydrogen energy system for use with fuel cells systems will be analyze.

S.No	CLOs	PLO
1.	Demonstrate a good knowledge about the role of hydrogen as an energy vector in the context of global and regional energy system as well as its connotations and impact economic, social and environmental. (C1)	1
2.	Understand the main sources of information, current projects and future challenges related to the processes of obtaining hydrogen and different types of fuel cells. (C2)	1
3.	Demonstrate a good understanding on the applications of hydrogen and fuel cells in stationary environments (buildings), mobile (transportation) and laptops (electronic devices). (C3)	3

Course Outline:

Week 1: Fuel-cell technologies, possible fuels, and their applications,

Week 2: Hydrogen as Future Energy Carrier.

Week 3: Hydrogen Fuel Cell Engines and Technologies,

Week 4: Hydrogen Properties, thermal, electrolytic,

Week 5: Photolytic processes of hydrogen decomposition.

Week 6: Hydrocarbon Decomposition water decomposition.

Week 7: Hydrogen Distribution, Hydrogen Storage.

Week 8: Hydrogen Use in Internal Combustion Engines;

Week 9: Hydrogen feeding system, air feeding system, thermal management system, Integrated Fuel Cell System.

Week 10: Hydrogen feedstock and basics of its reforming;

Week 11: Fuel Cell Principles; Introduction to fuel cell types, basic principles; Polarization curve,

Week 12: Fuel cell thermodynamics;

Week 13: Fuel cell reaction kinetics; Charge transfer in fuel cells;

Week 14: Mass transport in fuel cells; Fuel cell characterization,

Week 15: Fuel reforming technologies, types of fuel reformers,

Week 16: Overview of fuel cell types; Proton exchange membrane and solid oxide fuel cell materials

Recommended Books:

1. Corbo, P., • F. Migliardini, and O, Veneri, (2011) Hydrogen Fuel Cells for Road Vehicles, Springer-Verlag London Limited
2. Stolten, D. and B. Emonts, (2012) Fuel Cell Science and Engineering, Wiley-VCH Verlag & Co. KGaA
3. Bejan, A. Advanced Engineering Thermodynamics. Wiley Int. Ed. 1988
4. Heywood, J. B.: Internal Combustion Engine Fundamentals. Mc Graw Hill 1988. ISBN 0-07-028637-X

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

18. Hydropower and Energy Storage Technologies

Course Code: EPS 422
Credit Hrs.: 3+1
Pre-Requisite: None

Objectives: To develop in the students the capability to understand, design, develop and implement hydro-power plants. Course will also cover the technologies needed to energy storage.

S.No	CLOs	PLO
1.	Understand the fundamental concepts and principles of hydropower, including the potential and importance of hydroelectric power plant sites. (C1)	1
2.	Apply the constructional details, layout considerations, and safety measures involved in the development of modern hydroelectric power plants. (C3)	2
3.	Analyze hydrographs and different components in hydropower generation applying hydrology, flow duration curves, and storage considerations for effective design and operation of hydroelectric power plants. (C4)	3

Course Outline:

Week 1: General Introduction :- Hydropower potential, Concept of Modern Hydro Power Plant ,

Week 2: Location /Site Selection, Plant Layout, Power Plant Safety , Reservoir, Dams & Tunnels etc.

Week 3: Constructional details and basic principles of Hydro-mechanical equipment,

Week 4: Hydrology & Hydro – Electric Power Plants- Hydrographs –

Week 5: Flow duration curve – Mass curve & storage. Site selection for hydroelectric power plants.

Week 6: Design Construction & Operation of Hydro-Electric Power Plants- Components-

Week 7: Advantages & Disadvantage of under-ground power station Turbine and auxiliaries,

Week 8: Construction and working principles of various types of Valves and Pumps and Hydraulic System.

Week 9: Construction and working principles of Alternators and Excitation Systems,

Week 10: Transformers, Motors, Switchgears. Operation,

Week 11: Control and Supervision of Hydro Power Plant. Instrumentation & Control (including DAS & DDC) and Protection system.

Week 12: Erection, Commissioning and Testing Aspects of Hydro Power Plant.

Week 13: Micro-hydro power: Introduction, Present situation, Future potential and prospects,

Week 14: Constraints, Flow measurement, working principles of different types of turbines, details of the components of a micro-hydel power system,

Week 15: turbine selection criteria, site selection and feasibility study. Energy storage: pumped storage facilities.

Week 16: Economic analysis and environmental considerations,

Recommended Books:

1. Du, P. and N. Lu. Energy Storage for Smart Grids: Planning and Operation for Renewable and Variable Energy Resources (VERs). Academic Press, USA, Latest edition
2. Wagner, H.J. and M. Jyotirmay. Introduction to Hydro Energy Systems, Springer Verlag Berlin Heidelberg, Latest edition
3. Godfrey Boyle. Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., Latest edition

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

19. Bio Energy Systems
Course Code: EPS 345
Credit Hrs.: 2+0
Pre-Requisite: None

Objectives: To acquaint the students with the knowledge of biomass resources, combustion, and their power generation potential.

S.No	CLOs	PLO
1.	UNDERSTAND the concepts of biomass to energy conversion technologies along with region wise biomass resource availability. (C2)	1
2.	RELATE availability of biomass feedstock in different areas of Pakistan, weather conditions and their potential attributes to bioenergy	2

	production. (C3)	
3.	CREATE mass and energy balances for various biomass to energy conversion case studies for process design. (C6)	3

Course Outline:

Week 1: Sources and Classification.

Week 2: Chemical composition, properties of biomass. Energy plantations,

Week 3: Size reduction, Briquetting,

Week 4: Drying, Storage and Supply chain management of biomass,

Week 5: Energy reclamation from agricultural crops/wastes,

Week 6: Different sources of biomass for energy production,

Week 7: Different components and efficiency calculation of biomass fired boilers,

Week 8: Thermo chemical conversion of lignocelluloses biomass. Incineration, Processing for liquid fuel production.

Week 9: Pyrolysis -Effect of particle size, temperature, and products obtained. Thermo chemical Principles:

Week 10: Effect of pressure, temperature, steam and oxygen.

Week 11: Fixed and fluidized bed Gasifiers- Partial gasification of biomass by CFB, types, design, development and evaluation of gasifier for heat and power generation.

Week 12: Combustion of woody biomass-Design of equipment. Cogeneration using bagasse-Case studies:

Week 13: Combustion of rice husk. Feedstock for biogas, Microbial and biochemical aspects-operating parameters for biogas production,

Week 14: Anaerobic digestion for methane production- basic processes, anaerobic fermentation, fermentation kinetics, digester design parameters, various types of biogas plants.

Week 15: Design, installation, operation and management of biogas plants, purification of biogas. Power generation from biogas plants, Concept of CHP in energy production, gas and digester effluent utilization strategies,

Week 16: design of efficient bio-digesters; Kinetics and mechanism- High rate digesters for industrial waste water treatment.

Recommended Books:

1. Chakraverthy A, 1989, Biotechnology and Alternative Technologies for Utilization of Biomass or Agricultural Wastes", Oxford & IBH publishing Co.
2. D. Yogi Goswami, Frank Kreith, Jan. F .Kreider, 2000, Principles of Solar Engineering, 2nd Edition, Taylor & Francis.
3. Mital K.M, 1996, Biogas Systems: Principles and Applications. New Age International publishers Pvt. Ltd.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

20. Manufacturing Engineering

Course Code: EPS 454
Credit Hrs.: 3+0
Pre-Requisite: None

Objectives: To acquaint the students with the knowledge of manufacturing processes, computer aided manufacturing (CAM) and computerized numerical control (CNC) machines and understand the concepts of manufacturing techniques for industrial applications.

S.No	CLOs	PLO
1.	Understand the working knowledge of broad range of manufacturing processes that are used in the manufacturing engineering. (C2)	1
2.	Apply appropriate manufacturing processes for a product and determine its parameters. (C3)	3
3.	Analyze process dynamics and performance of different manufacturing processes used in the manufacturing engineering. (C4)	2

Course Outline:

Week 1: Introduction to lathe machines. Turning and related operations.

Week 2: Types and construction of lathe and its accessories.

Week 3: Lathe operations, Turret lathe and turret lathe tooling,

Week 4: Mechanism of chip formation. Type of cutting tools and their materials Tool failure, tool life and use of coolants.

Week 5: Drilling and Reaming. Type of drilling machines, drill bits and drill chucks.

Week 6: Counter boring and sinking, boring and reaming practices and tools. Estimating drilling time,

Week 7: Milling machines. Types and working principle of milling machines. Milling operations and mill cutters. Estimating milling time. Shaping and Planning.

Week 8: Types of shaper and planers and their applications. Shaper drive mechanism. Shaper speeds and machining times.

Week 9: Construction and types of planning machines.

Week 10: Planer tools and work set up methods. Metal bending and sheet rolling processes. CAD and CIM Systems.

Week 11: Computer aided manufacturing and computer integrated manufacturing systems.

Week 12: Type of CNC machines and their working principles.

Week 13: Programming for numerical control. Machine tool control.

Week 14: Welding processes. Classification and application of welding processes. Oxyacetylene gas welding (OAW).

Week 15: Shielded metal arc welding (SMAW). Designation system for arc welding electrode. Resistance spot welding (RSW).

Week 16: Resistance seam welding (RSW) Forge welding (FOW). Weldability and weld quality. Weld design and process selection

Recommended Books:

1. Kalpakjian, S. and S. Schmid. 2007. Manufacturing Processes for EngEd. Pearson Education, New Delhi. India.
2. Kalpakjin, S. and R.S. Schmid. 2004. Manufacturing engineering and tecMcGraw Hill Co. Ltd, New Delhi. India.
3. Ostwald, P.H. and J. Munoz. 2002. Manufacturing Processes and SWiley and Sons, New York. USA.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

21. RS & GIS for Renewable Energy Resources

Course Code: EPS 434

Credit Hrs.: 3+1

Pre-Requisite: Renewable Energy Systems

Objectives: The course will give the student the knowledge of coordinate system projections and geo-referencing, analyze and interpret satellite imaging for site selection and be able to demonstrate the use of RS and GIS software for identifying potential zones to harness energy.

S.No	CLOs	PLO
1.	Explain the principles and applications of RS and GIS, including their role in data analysis, spatial interpolation, geo-referencing and scale generalization. (C1)	1
2.	Utilize GPS and Differential GPS (DGPS) for data collection and mapping, import and export data in GIS software, create and manipulate tables, and draw objects on maps. (C3)	2
3.	Analyze spatial data using GIS tools, perform spatial interpolation, conduct spatial statistics, and perform terrain analysis and assessment. (C4)	3

Course Outline:

Week 1: Introduction to Global positioning system (GPS),

Week 2: Satellite imagery, Introduction to RS & GIS, Example applications of RS & GIS.

Week 3: Coordinate systems and projections,

Week 4: geo-referencing and scale generalization GIS,

Week 5: Raster and vector data set,

Week 6: Use of GPS and DGPS,

Week 7: Data import and export, Open existing tables, Creating new tables,

Week 8: Drawing objects on a map, Creating and using layouts.

Week 9: Spatial interpolation and geo-station

Week 10:. Spatial data analysis, spatial statistics,

Week 11: Terrain analysis and assessment.

Week 12: Vector to raster and vice versa, RS Satellite data acquisition.

Week 13: Image processing.

Week 14: Image interpretation.

Week 15: Site identification for solar system installation,

Week 16: wind energy set up and hydropower energy.

Recommended Books:

1. DeMers, M.N., 2005. Fundamentals of geographic information systems, Wiley, Hoboken, N.J. ISBN: 0471451495. Shelf Number: 910.285 DEM
2. Longley, P, Goodchild, MF, Maguire, DJ, Rhind, W, 2005. Geographical information systems and science, 2nd edition, John Wiley, Chichester. ISBN: 047087001X. Shelf Reference: 910.285 LON.
3. Bhatta, B. 2008. Remote Sensing and GIS. Oxford University Press; 1 st edition (March 27, 2008)
4. Wegmann, M., Leutner, B., Dech, S. 2016. Remote Sensing and GIS for Ecologists: Using Open Source Software (Data in the Wild). Pelagic Publishing.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

22. Energy Economics, Policy, and Management

Course Code: EPS 220
Credit Hrs.: 2+0
Pre-Requisite: None

Objectives: The course will give student the understanding of the Pakistan current energy and environmental situation and policies. The course will cover the basics of energy economic and project management and analyze the sustainability of energy projects.

S.No	CLOs	PLO
1.	Explain the fundamentals of supply, demand, and price creation in competitive energy markets. (C1)	11
2.	Understand the influence of energy on the economy, development, and the environment, taking into account elements like greenhouse gas emissions and energy-related regulations. (C2)	1
3.	Analyze energy demand and price in the energy industry using economic concepts and different methods. (C4)	2

Course Outline:

Week 1: Pakistan's Energy and Environmental Profile Pakistan's energy supply-demand situation.

Week 2: Pakistan's energy related greenhouse gas (GHG) emissions.

Week 3: Impact of energy on economy, development and environment.

Week 4: Energy for sustainable development and need for use of new and renewable energy sources.

Week 5: Energy sources and overall energy demand and availability.

Week 6: Energy consumption in various sectors and its changing pattern.

Week 7: Exponential increase in energy consumption and projected future demands. Energy Economics and Management.

Week 8: Basics of supply, demand and price formation in competitive markets.

Week 9: Energy demand: short run and long run price and income elasticities.

Week 10: Introduction to single variate and multi variate regression analysis, Cost of power plant, structure of power tariffs.

Week 11: Concept and theory of management, methods and processes of management,

Week 12: Introduction to smart grid (On- and Off- grid system), Introduction to project management, Energy contracts & preparation of PCs, Regulatory bodies, NEPRA, OGRA, PPIB.

Week 13: Net-metering, Feed-in-tariff policy. Financial management and introduction to accounting, auditing, cash flow terms,Estimation of economic and financial rates of return, prices, wages, profit and interest. Pakistan's Energy and Environmental policies.

Week 14: Overview of Pakistan's oil, gas and power policies. Sustainability analysis of energy policies and reasons for failure of energy policies. Sustainability analysis of energy projects. Energy diplomacy, Energy Security,

Week 15: Energy diversity. Depletion of energy sources and their impact on economies of countries and on international relations. International Energy and Environmental treaties (Rio, Montreal, Kyoto, Paris).

Week 16: Pakistan's Intended Nationally Determined Contributions (INDCs). Energy investments under China-Pakistan Economic Corridor. Impacts of coal related investments under CPEC on energy and environment profile of Pakistan

Recommended Books:

1. Ayres, R.U. and E.H. Edward. Crossing the Energy Divide: Moving from Fossil Fuel Dependence to a Clean-Energy Future.
2. Bern, G. Investing in Energy: A Primer on the Economics of the Energy Industry. Wiley and Sons. USA.
3. Energy Management Handbook by Wayne C. Turner
4. Energy Management by Paul O Callaghan, Mcgraw Hill, New Delhi

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

23. Total Quality Management

Course Code: MGT 437
Credit Hrs.: 3+0
Pre-Requisite: None

Objectives: To enable students to develop quality management skills.

S.No	CLOs	PLO
1.	To enable the students understand the principles of Quality Management. (C1)	1
2.	To provide students details of quality planning and TQM techniques. (C2)	6
3.	To provide in depth knowledge of reliability and maintainability. (C3)	12

Course Outline:

Week 1: Introduction to Quality: Quality concepts, types and aspects,

Week 2: Significance of quality. Commitment and Leadership:

Week 3: Commitment and Policy, Creating or changing the culture,

Week 4: effective leadership.

Week 5: Quality Planning:

Week 6: Flow charting, process charting,

Week 7: purchase planning, planning for JIT.

Week 8: Design for Quality: Innovation, Quality Function Deployment and the house of Quality.

Week 9: Quality Related Costs: Prevention, Appraisal and Failure Costs, Models for Quality Costing.

Week 10: Quality Measurement: Significance, Methods, Tools and Techniques for Quality Improvement:

Week 11: Basic Tools, Advanced Tools.- Quality Management System (ISO 9000 series):

Week 12: Significance, Documentations, Implementation and Certification, Audits,

Week 13: Expected Problems. Environmental Management System (ISO 14000 series):

Week 14: Significance, Documentations,

Week 15: Implementation and Certification,

Week 16: Audits, Expected Problems.

Recommended Books:

1. Oakland J. S. TOTAL QUALITY MANGEMENT, Bulterworth Heinemann Ltd. UK.
2. ISO 9000 series of standards
3. ISO 14000 series of standards
4. Feigenbaum, TOTAL QUALITY CONTROL. McGraw Hill Book

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

24. Programming for DSP/FPGA

Course Code: CEN 354
Credit Hrs.: 3+1
Pre-Requisite: Digital Logic Design

Objectives: After completion of this course students should be able to: Fully understand the fundamental of designing techniques. Gain knowledge to design digital system. Understand fully the Hardware Description Language (HDL). Use HDL to design hardware components and systems. Gain sufficient knowledge to simplify a complex logic design using software tools. Acquire sufficient knowledge and inner working of programmable logic devices. Implement the designs and verify the complete system.

S.No	CLOs	PLO
1.	Use Verilog codes to offer solution to digital design problems and its functional verification. (C3)	1
2.	Design and implement controllers using FSM and partition designs into control logic and data path. (C6)	3

3.	Evaluate design trade-offs in terms of area, speed and critical-path while implementing digital designs. (C5)	4

Course Outline:

Week 1: Course organization and requirements, Overview of digital systems design, testing and verification.

Week 2: Hardware Description Languages (HDL);

Week 3: Selection of HDL Language, Fundamentals of the Language,

Week 4: Design and Modeling Recommendations ,

Week 5: Design Simulation, Synthesis of Designs 3.

Week 6: Design Implementation Technologies;

Week 7: Programmable Array Logic, Programmable Logic Array,

Week 8: Complex Programmable Logic Devices (CPLD),

Week 9: Field Programmable Gate Array (FPGA)Technologies.

Week 10: System Arithmetic Algorithms and Hardware Designs. Electronic Design Automation;

Week 11: Usage of CAD Tool, Programmable Device Design Flows.

Week 12: Physical Design Automation -- Systems;

Week 13: Partitioning; Placement; Routing. Clock Design Considerations -- Timing Margins,

Week 14: Clock Skew, Clock Distribution.

Week 15: Logic Circuit Testing and Testable Design; Design of a test bench, Digital Logic Circuit Testing and Test Vector Generation,

Week 16: Combinational and Sequential Logic Circuit Testing.

Recommended Books:

1. Wayne Wolf, “FPGA-Based System Design,” with CD-ROM, 2004, Prentice Hall, ISBN: 0131424610.
2. Samir Palnitkar, “Verilog HDL”, Prentice Hall, ISBN: 0130449113.
3. Michael D. Ciletti, “Advanced Digital Design with the Verilog HDL”, Prentice Hall, ISBN: 0130891614.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

25. Applied Mathematics-I

Course Code: MA 121
Credit Hrs.: 3+0
Pre-Requisite: None

Objectives: This course will cover the basic of complex variables, and calculus.

S.No	CLOs	PLO
1.	Identify and recall the basic geometrical constructs upon which calculus techniques are based. (C1)	1
2.	Explain the ideas of rate of change and derivatives using the concept of limits and continuity. (C2)	1
3.	Ability to solve application problems involving higher order derivatives, multiple integrals and areas between curves. (C3)	2

Course Outline:

Week 1: Complex numbers, Argand diagram,

Week 2: De Moivre‟s theorem, hyperbolic and inverse hyperbolic functions.

Week 3 - 5: Algebra of vectors and matrices, systems of linear equations.

Week 6 - 8: Derivative as slope, as rate of change (graphical representation).

Week 9 - 10: Extreme values, tangents and normals, curvature and radius of curvature.

Week 11 - 12: Differentiation as approximation. Partial derivatives and their application to extreme values and approximation. Integration by substitution and by parts,

Week 13: integration and definite integration as area under curve (graphical representation).

Week 14: Reduction formulae. Double integration and its applications.

Week 15: Polar and Cartesian coordinates**:** polar curves, radius of curvature,

Week 16: cycloid, hypocycloid, epicycloids and involutes of a circle.

Recommended Books:

1. Calculus and analytical Geometry, 11th Edition By Thomas Finney John Wiley & Sons.
2. Advanced Engineering Mathematics 5th Edition By C. R. Wylie McGraw-Hill Education.
3. Advanced Engineering Mathematics, 8th Edition By HTErwin Kreyszig TH John Wiley & Sons.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

26. Applied Mathematics-II

Course Code: MAT 122
Credit Hrs.: 3+0
Pre-Requisite: 26. Applied Mathematics-I

Objectives: This course will cover the basic of differential equations, and Laplace transform.

S.No	CLOs	PLO
1.	Identify different methods of solving First order ordinary differential equations & 2nd order ordinary differential equations. (C1)	1
2.	Solve first and second order differential equations and partial differential equations using the concepts developed in the course. (C3)	1
3.	Analysis different Engineering systems using the concept of First order & Higher Order Differential Equations. (C4)	2

Course Outline:

Week 1: Differential equation; basic concepts and ideas;

Week 2: geometrical interpretation of first and second order differential equations;

Week 3: separable equations, equations reducible to separable form,

Week 4: exact differential equations, integrated factors.

Week 5: Linear first order differential equations,

Week 6: Bernoulli‟s differential equation. Families of curves,

Week 7: orthogonal trajectories and applications of differential equations of first order to relevant engineering systems.

Week 8: Homogeneous linear differential equations of second order,

Week 9: homogeneous equations with constant coefficients, the general solutions, initial and boundary value problems,

Week 10: D-operator, complementary functions and particular integrals.

Week 11: Real, complex and repeated roots of characteristics equations.

Week 12: Cauchy equation, non-homogeneous linear equations.

Week 13: Applications of higher order linear differential equations.

Week 14-16: Ordinary and regular points and corresponding series solutions; introduction to Laplace transformation.

Recommended Books:

1. Calculus and analytical Geometry, 11th Edition By Thomas Finney John Wiley & Sons.
2. Advanced Engineering Mathematics 5th Edition By C. R. Wylie McGraw-Hill Education.
3. Advanced Engineering Mathematics, 8th Edition By HTErwin Kreyszig TH John Wiley & Sons.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

27. Control of Power Electronics System

Course Code: EPS 455

Credit Hrs.: 3+1

Pre-Requisite: Power Electronics

Objectives: This course covers the emerging topics in the control of power electronics and converters, including the theory behind control, and the practical operation, modeling, and control of basic power system models. This course introduces the most important controller design methods. Discusses the dynamic characterization of terminal behavior for converters, as well as preserving the stability and power quality of modern power systems.

S.No	CLOs	PLO
1.	Explain the theory underlying power electronics control systems, including dynamic characterization of terminal behavior and stability analysis methodologies. (C1)	1
2.	Apply Control strategies and design methodologies for power electronics converters are being used to achieve the necessary performance and power quality in modern power systems. (C3)	2
3.	Analyze the operation and behavior of voltage source converters, multi-level VSC systems, and current source converters, taking into account aspects such as parallelism, low voltage ride through, and virtual inertia operation. (C4)	3

Course Outline:

Week 1: Power electronics converters and converter system,

Week 2: power electronic switches, classification of converters,

Week 3: voltage source converter, basic configuration,

Week 4: multimodule VSC system, multilevel VSC system,

Week 5: DC/AC half bridge converter switched and average model,

Week 6: control of half bridge converter,

Week 7: feed-forward compensation, space phasors and two dimensional frames,

Week 8: two-level, three phase VSC, Three level neutral point clamped VSC, grid imposed frequency VSC system,

Week 9: alpha-beta frame, dq0-frame. Variable and controlled frequency VSC system. Static compensator control system.

Week 10: Dynamic model for PCC voltage control.

Week 11: Three phase current source converter and their control,

Week 12: Parallel operation of the power converters, virtual inertia operation of renewables,

Week 13: low voltage ride through operation of the converters,

Week 14: Phase locked loops and their design,

Week 15: Modeling and control of voltage converter with LCL filters, cyber security in power electronics system,

Week 16: overview of stability analysis methods in power electronics,

Recommended Books:

1. Voltage sourced converter in power system by Reza Iravani and Amirnaser Yazdani.
2. Control of Power Electronic Converters and Systems by Frede Blaabjerg

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

28. Heating, Ventilation, and Air Conditioning Systems

Course Code: EPS 411
Credit Hrs.: 3+0
Pre-Requisite: Applied Physics

Objectives: This course covers give the knowledge of the vapor compression and vapor absorption refrigeration systems, various refrigerants and their application. The course will also provide the fundamental concepts of air conditioning, its scope and application to perform psychrometric analysis of air conditioning systems.

S.No	CLOs	PLO
1.	Demonstrate knowledge of the refrigeration cycle, heating, ventilation, and air conditioning and refrigeration controls, including wiring configurations and technical components for optimum performance. (C1)	1
2.	Analyze the heating and air conditioning systems based on load calculations, equipment selection, and balanced air duct flow. (C4)	2
3.	Investigate and troubleshoot the air conditioning and ventilation components, systems, and accessories, including the sequence of operation. (C5)	4

Course Outline:

Week 1: Introduction and types of cooling systems: Definition and basic terminology.

Week 2: Refrigeration cycle, vapor compression cycle. COP.

Week 3: Introduction to pressure-enthalpy chart, types of refrigerants, air cycle refrigeration,

Week 4: vapor absorption refrigeration and air conditioning, working principle of thermally driven cooling machines,

Week 5: single, double and triple effect absorption chiller, adsorption chiller d.

Week 6: Desiccant evaporative cooling, ejector cycle Air-conditioning:

Week 7: Indoor and outdoor air conditions. Comfort air conditions and comfort zoneindoors air quality,

Week 8: psychrometry, Psychometric chart and psychometric properties,

Week 9: Central air conditioning system ,essential components of central air conditioning plant.

Week 10: Water chiller and water heater, air handling unit, chilled water and hot water re-circulating system, return air supply system. fresh air supply system and air mixture chamber.

Week 11: Supply fan, air dust cleaning and bacteria removal, air supply and air return terminals. Diffusers, dampers, grillers and registers,

Week 12: Air-conditioning system design: CFM rating and tons of air conditioning of central air conditioning plant, cooling and heating loads.

Week 13: Calculation procedures, duct sizing and piping design, Pumps and fans selection, air ventilation. Calculation of fresh air supply of multi-story buildings, air handling units for treatment of fresh and return,

Week 14: forced convection based air ventilator design. Cooling towers: Types of cooling towers. Performance of cooling tower. Hydronic terminal units. Indoor air quality:

Week 15: Dust and bacteria removal methods. Alternative cooling techniques: Thermo-electric, magnetocaloric, electrocaloric,

Week 16: Thermo-accoustics, solar-assisted cooling systems

Recommended Books:

1. Circle, T. and N.E. Atlanta. 1997. ASHRAE, Handbook - Fundamentals, SI Edition, American Society of Heating, Refrigerating and Air-Conditioning Engineers. USA.
2. Duffie, J.A. and W.A. Beckman. 1991. Solar Engineering of Thermal Processes, 2nd Ed. John Wiley & Sons, USA.
3. Kreith, F. and J.F. Kreider. 1978. Principles of Solar Engineering, 2nd Ed. McGraw-Hill, New York.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

29. Business Planning in Energy System

Course Code: MKT 422
Credit Hrs.: 2+0
Pre-Requisite: None

Objectives: The aim is to develop business plans. Students propose projects, define needs and challenges addressed, make critical review of the literature and carry out the market research.

S.No	CLOs	PLO
1.	Explain the basics of planning and forecasting, decision making process, organizational theory and structures, research and development, human resource, management functions and all factors related to it. (C2)	6
2.	Apply engineering designs to produce solutions that meet specified needs with consideration to environmental, global, social, and economic factors. (C3)	7
3.	Analyze the dynamics of organizations, technical and intellectual property protection issues. (C4)	12

Course Outline:

Week 1: Investigates management and planning aspects of future energy supplies,

Week 2: Developing integrated policy inteventions to achieve a long-term energy transition:

Week 3: theoretical and empirical perspectives.

Week 4: Energy and climate planning: the role of analytical tools and soft measures.

Week 5: Energy innovation policy: fostering small energy service companies. Competitiveness of distributed generation of heat,

Week 6: power and cooling: System design and policy overview. Are Smart Grids the holy grail? –

Week 7 - 9: Economic, environmental and regulatory opportunities for Smart Grid development in North-Western Europe. Renewables optimization in an energy only market.

Week 10 - 12: Optimal scheduling of a microgrid under uncertainty condition.

Week 13: Cost Benefit Analysis for Energy Policies.

Week 14: Benchmarking energy efficiency transitions in MENA countries. Energy supply in Europe.

Week 15: Current trends and future perspectives for the natural gas sector.

Week 16: Roller coaster of the Spanish energy policy with the EU.

Recommended Books:

1. Analysis of Energy Systems Management, Planning and Policy by Vincenzo Bianco.
2. Operation, Planning, and Analysis of Energy Storage Systems in Smart Energy Hubs by Behnam Mohammadi-Ivatloo, and Farkhondeh Jabari

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

30. Production Planning and Control

Course Code: EPS 424
Credit Hrs.: 3+0
Pre-Requisite: None

Objectives: The course enables the students to use various forecasting methods & their applications, different production planning models & capacity requirement planning.

S.No	CLOs	PLO
1.	Recognize the objectives, functions, applications of PPC and forecasting techniques and explain different Inventory control techniques. (C1)	1
2.	Analyze the concepts of demand management, forecasting and the link between demand management and MPS and solve the route and scheduling problems. (C3)	2
3.	Demonstrate the design and controlling skills of production activities and integrate different departments to execute PPC functions. (C6)	3

Course Outline:

Week 1 - 2: Forecasting methods and their applications to various industrial and management problems,

Week 3 - 6: Analysis and design of production and scheduling control systems,

Week 7 - 9: machine sequencing, Flow shop, Job shop, Open shop,

Week 10 - 12: Algorithms for production planning and re-planning,

Week 13 - 14: Stochastic inventory models, Aggregate planning,

Week 15 - 16: Capacity requirements planning, Introduction to mixed production models.

Recommended Books:

1. Operations Management: Sustainability and Supply Chain Management by Heizer, Render and Munson, 12th Edition, 2017.
2. Principle of Production Control by J. L. Burbige, 2nd Edition,1978.
3. Manufacturing Planning & Control by Vollmann, William Berry & Whybark, 4th Edition, 1997.
4. Factory Physics by Hopp & Spearman, 3rd Edition, 2011.

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

31. Combine Heat and Power System

Course Code: EPS 432
Credit Hrs.: 3+0
Pre-Requisite: Applied Physics

Objectives: The course enables the students to use various forecasting methods & their applications, different production planning models & capacity requirement planning.

S.No	CLOs	PLO
1.	Evaluate the operational characteristics of the most common systems for thermal power generation to identify practical limitations of operational performance. (C2)	1
2.	Identify and quantify the way to improve the total energy efficiency of combine heat systems by means of system integration concepts. (C4)	2
3.	Design adapted energy systems for realistic applications and evaluate its technical-economic feasibility, environmental impact and the sustainability of the proposed concepts.	3

Course Outline:

Week 1: Introduction to conduction, convection and radiation heat transfer, Thermodynamics and heat transfer,

Week 2: Engineering techniques in heat transfer, Different forms of energy, Heat transfer mechanisms;

Week 3: Conduction Heat transfer, Principles of conductive heat transfer,

Week 4: Energy balances concerning heat transfer, Heat transfer coefficient correlations,

Week 5: Equations of change for isothermal systems, macroscopic balances for isothermal systems,

Week 6: Analytical, approximate solutions to equations of heat transfer, Empirical model for the evaluation of conductive heat transfer coefficients.

Week 7: Principles of convective heat transfer, Shell balances concerning heat transfer,

Week 8: Heat transfer coefficient correlations, Boiling and condensation, transient heat transfer.

Week 9: Equations of change for isothermal systems, macroscopic balances for isothermal systems, Analytical, approximate solutions to equations of heat, transfer,

Week 10: momentum, energy transport, interphase momentum, heat transfer. Empirical model of the evaluation of heat transfer coefficients. Radiation Heat Transfer,

Week 11: Radiation properties, black body radiation, absorptivity, reflectivity, transmissivity, Wien's law, Kirchoff's law, Grey body radiation, Radiation shape factor and relations between shape factors,

Week 12: Heat Exchangers Principles of working of heat exchangers, Thermal design of heat exchangers, Empirical model for the evaluation of heat transfer in heat exchangers

Week 13: An introduction to combined heat and power, the power resources, estimating the potential, principles and technologies, piston engine combined heat and power systems,

Week 14: steam turbine combined heat and power system, gas turbine, fuel cell, and nuclear combined heat and power,

Week 15: renewable energy combined heat and power system. The environmental implication of combined heat and power,

Week 16: the economics of combined heat and power.

Recommended Books:

1. Combined Heat and Power by Paul Breeze.
2. Heat Transfer by J. P. Holman, 10th Edition
3. Fundamentals of Heat and Mass Transfer by Incropera & Dewitt, 7th Edition

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	×	25	25
Midterm Exam (20)	15	5	×
Assignments (20)	5	5	10
Quizzes (10)	2	3	5
Total (100)	22	38	40

Appendage 4122

METHODOLOGY FOR IMPROVEMENT OF UNDERPERFORMING STUDENTS

Guidelines for Improvement of Underperforming Students

General Academically underperforming students will be separated in each semester in any of the following categories:

a. **Category-I.** Students identified by concerned Cluster Heads for extra teaching on the basis of Midterm exams results, or attaining less than 60% marks in any course in the Final exams but not on Probation List.

b. **Category-II.** Students placed on Probation List after the Final exams results.

2. All academically underperforming students will be provided extra teaching through the mechanism explained in ensuing clauses.

3.

Methodology for Category-I Students

4. Respective Cluster Head will identify the academically underperforming student(s) of respective Dept after each Midterm and Final exams results. Consent of such student(s) is to be taken on related proforma (separate for each course, as given at Appendage 4409-B) and suitable FM assigned to address the weak areas. The Cluster Head is to then sign the relevant section of the proforma and forward all such cases to concerned Advisor Students Affairs (ASA) for related planning and execution.

5. In parallel, the Cluster Head is to make a list of all the students identified for extra teaching and forward the same to concerned ASA, with copies to concerned FM, the HOD and the Principal.

6. The Cluster Head may recommend any student(s) for counselling at Well Being Centre. If said counselling is availed, remarks/ assessment of the OI/C Well Being Centre is to be taken by the Cluster Head in relevant section of said proforma.

7. The ASA is to organize the extra teaching sessions for the students identified by the Cluster Head, by assigning the classroom(s) for required teaching, formulating the suitable schedule, and informing the respective FMs and the student(s) of these details. The proforma is to be then signed and retained by the ASA for endorsement by the FM after completion of the extra teaching session.

8. Concerned HODs are to ensure that the extra teaching sessions planned in their respective Depts are held regularly as planned.

9. Extra teaching of concerned student(s) will then commence. Upon completion of the semester, concerned FM is to record the progress of the student(s) in the proforma held with the ASA. The progress thus attained will be routed for HOD comments followed by the Principal's endorsement.

10. The proforma is then to be submitted to the Cluster Head, who will record the Midterm and Final exams performance of the student(s), along with analyzing the effectiveness of the extra teaching, and place it in the Dept record.

Methodology for Category-II Students

11. Each Advisor Student Affairs (ASA) will initiate the process of counselling/ mentoring of Category-II academically underperforming students of respective School/ Dept falling by interviewing each student and proposing the course(s) to be registered based on the status of Probation and the CGPA after the last semester, in the proforma at Appendage 4409-C.

12. The ASA will further determine the required interventions (meeting the parents; counselling by WBC; advisor/ mentoring) and forward the recommendations to respective Cluster Head for further processing.

13. The Cluster Head will approach the student's parents to inform them of his/ her academic underperformance and its implications on studies at BU. If required, counselling by the Well Being Centre (WBC) would also to be arranged. The outcome is to be forwarded to concerned HOD for further action.

14. The HOD will review the assessment undertaken by the ASA, Cluster Head and WBC, and appoint a suitable FM as the student's Advisor/ Mentor for performance improvement during the semester.

15. Advisors/ Mentors so appointed would be required to provide regular guidance to their students and record the progress after monthly meeting, in the proforma for the process (Appendage 4409-C).

16. After the completion of each semester, the HODs will undertake a review of the effectiveness of the process adopted for Category-II academically underperforming students, record the findings and suggestions in the proforma and forward the same to concerned principal.

17. The Principals will review all such cases and record their comments on the above stated proforma, followed by returning to concerned ASA.

18. The ASA will complete the process by scrutinizing the completed information, indicate whether continuation of counselling/ extra teaching is required, and archive the record for the completed semester.

IMPROVEMENT OF CATEGORY-I ACADEMICALLY UNDERPERFORMING STUDENTS

Cluster Head/Senior FM Action

Course Title:_____ **Section(s):**_____ **Prog:**_____ **Semester:** _____

FM for Tutorial Session: _____ **Recommended for Well Being Centre:** Yes/NO

Student Name(s)	Course	Midterm Exam Result	Final Exam Result

Name: _____ **Signature:** _____ **Date:** _____

Well, Being Centre (if Recommended by Cluster Head)

Remarks:

Name: _____ **Signature:** _____ **Date:** _____

ASA Action (for Planning and Execution)

Classroom: _____ **Date/Time:** _____ **FM and Attendee(s) informed:** Yes/No

Name: _____ **Signature:** _____ **Date:** _____

Nominated FM Action

Classroom: _____ **Date/Time:** _____ **Tutorial Sessions Held:** Yes/No

Name: _____ **Signature:** _____ **Date:** _____

HOD Compliance Report

Tutorial Sessions Held: Yes/No **Date/Time:** _____

Effectiveness of the Tutorial Session (Remarks after Final Exams Results):

Name: _____ **Signature:** _____ Date: _____

Endorsement of Principal

Remarks:

Name: _____ **Signature:** _____ **Date:** _____

IMPROVEMENT OF CATEGORY-II ACADEMICALLY UNDERPERFORMING STUDENTS

ASA Action – Before Semester Commencement	
Enrl No:_____ Name**:**_____ Prog**:**_____ Semester**:** _____ **Status:** Probation / Chance	**CGPA:** _____
Recommended Course(s) to be Registered in New Semester	**Repeat Course(s)**
Proposed Intervention: Meeting with Parent ☐ Counselling at WBC ☐ Advisor/Mentor for Next Semester ☐ **Name:** _____ Signature**:** _____ **Date:** _____	
Parents-Cluster Meeting Outcome	
Remarks: **Name:** _____ **Signature:** _____ **Date:** _____	
Counselling at Well Being Centre (if recommended by ASA/ Cluster Head)	
Remarks: **Name:** _____ **Signature:** _____ **Date:** _____	
HOD Action – Before Semester Commencement	
Remarks: **Advisor/ Mentor Appointed:** **Name:** _____ **Signature:** _____ **Date:** _____	

Advisor/Mentor Counselling – Monthly Endorsement	
Remarks after Meeting:	**Action Taken:**
Remarks after Meeting:	**Action Taken:**
Remarks after Meeting:	**Action Taken:**
Remarks after Meeting:	**Action Taken:**
Name: _____ **Signature:** _____ **Date:** _____	
HOD Action – After Semester Commencement	
Regular Counselling/Mentoring Sessions Held: Yes/No	**No. of Sessions Held:** _____
Analysis of Results and Effectiveness of Counselling/Mentoring:	
Name: _____ **Signature:** _____ **Date:** _____	
Endorsement of Principal	
Remarks:	
Name: _____ **Signature:** _____ **Date:** _____	
Archiving by ASA	
Counselling to be Continued in Next Semester: Yes / No	
Name: _____ **Signature:** _____ **Date:** _____	