CURRICULUM FOR

INFORMATION SECURITY ENGINEERING

Bachelor of Engineering Program

2023

Pakistan Engineering Council
&
Higher Education Commission
Islamabad

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Contents

PREFACE

The curriculum, with varying definitions, is considered as a roadmap or plan of teaching-learning process that students of an academic programme are required to undergo. It includes objectives and learning outcomes, course contents, scheme of studies, teaching approaches, and assessment methodologies. Since knowledge in all fields and sectors is expanding at a faster pace and new disciplines are also emerging; it is imperative that curricula should be dynamic having regular review and updation.

University Grants Commission (UGC) was the authorised authority to develop, review and revise curricula beyond Class-XII vides Section 3, Sub-Section 2 (ii), Act of Parliament No. X of 1976 titled "Supervision of Curricula and Textbooks and Maintenance of Standard of Education". With the repeal of the UGC Act, the same function was assigned to the Higher Education Commission (HEC) under its Ordinance of 2002, Section 10, Sub-Section 1 (v). In compliance with this provision, the HEC has been undertaking the development of curricula for new/ emerging fields and revision of curricula after regular intervals through respective National Curriculum Revision Committees (NCRCs) until 2018.

As a policy change and expanding higher education base under HEC, the curriculum review and development task has been shifted to the respective regulators and HEIs. PEC also having a mandate under its Act of Parliament and especially after attaining Washington Accord full signatory status and IPEA licensing authority, took up the challenge to review and develop the curricula for engineering programs based on the Outcome-Based Education (OBE) System. PEC has therefore constituted an Engineering Curriculum Review and Development Committee (ECRDC) comprising of eminent engineers and professionals from academia and industry to take up the task of curricula review and updation. Nevertheless, the basic templates developed by HEC NCRC have been followed as guidelines.

Under OBE based curriculum review and development framework, PEC held national and regional levels stakeholders and industrial consultation workshops by engaging HEIs, industry, technical and consulting organizations. The experts' feedback and suggestions were translated into the curriculum review process while taking into consideration the dynamics of technological advancement, industrial needs and management-cum-soft skills for engineering graduates.

This curriculum document would serve as a guideline whereas allowing HEIs to tame/ change within the framework by introducing courses in support of local/ required industrial demand as well as satisfying the revised 11 GAs (Graduate Attributes) and 13 PCs (Professional Competency) covering core and elective courses, considered as beauty of the OBE system in the international arena. At the same time, this curriculum framework would fulfill the purpose of meeting our national, social and economic needs leading towards attainment of Sustainable Development Goals (SDGs-2030).

It would also provide the level of competency specified in Pakistan Qualification Framework to make it compatible with international educational standards.

While approving this curriculum in the 10th meeting of ECRDC-Main, Engr. Lt. Gen (Retd.) Javed Mahmood Bukhari (Convener) appreciated and complemented the role of PEC by doing a great job in many endeavors. He lauded the PEC initiatives and accomplishments being made by the current Governing Body & Management Committee under the Leadership of Engr. Muhammad Najeeb Haroon (Chairman PEC) and Engineering Accreditation Board (EAB) under the Convener-ship of Engr. Dr. Niaz Ahmad Akhtar (Convener EAB/ Vice-Chairman Punjab) for promoting standards of engineering education as well as practice of engineering for ultimate achievement to promote rapid growth in the socio-economic field of Pakistan.

He acknowledged the contribution and tangible input rendered by members/ experts of ECRDC-Main and respective discipline-wise Committees/ Sub-Groups and the continued support of Engr. Dr. Nasir Mahmood Khan (Secretary/ Registrar- PEC) for developing these undergraduate engineering programs curricula and producing quality work output.

The Convener also expressed gratitude to PEC and HEC for collaborative efforts and synergy for uplifting the standards of education particularly in engineering field in the country. He praised the working of HEC on issuing an Undergraduate Education Policy (UEP) to be implemented from Fall-2023 for all HEIs and Councils. In this regard, he appreciated PEC EAB's working and notification of engineering education guidelines/ framework document, which is developed in the light of HEC-UEP. He anticipated that these combined efforts will continue to achieve the Sustainable Development Goals (SDGs) of enhancing the quality of engineering education towards economic growth at national level.

1. Engineering Curriculum Review & Development Committee (ECRDC)

PEC in its efforts towards quality engineering education, took up the challenge of curriculum review and development for engineering programs after due consent of HEC. A high-level Engineering Curriculum Review and Development Committee (ECRDC), led by Engr. Lt. Gen (Retd.) Javed Mahmood Bukhari, Member Governing Body/ Rector, NUST was constituted (for the term 2021-2024), whereas other eminent members from industry and academia were involved in the task of curricula review and updation, besides developing curriculum for new/ emerging fields. The main responsibility of ECRDC is to oversee the entire curriculum review and development process while setting policies and guidelines for the subject ECRDCs working in their respective domains. The 9th meeting of the main ECRDC and first of this term, was held on 31st May 2022 at PEC Head Office Islamabad, wherein the Convener briefed the scope, objective and ToRs of the Committee and also endorsed the subject ECRDCs comprising of eminent engineers and professionals from academia and industry.

1.	Engr. Lt. Gen (Retd.) Javed Mahmood Bukhari Convener (ECRDC-Main)/ Member PEC Governing Body/ Rector NUST, Islamabad	Convener
2.	Engr. Prof. Dr. Altaf Mukati Vice President (Academics) SZABIST University, Karachi	Dy. Convener
3.	Engr. Prof. Dr. Bhawani Shankar Chowdhry Member, PEC Governing Body / Prof. Emeritus /Advisor MUET, Jamshoro	Member
4.	Engr. Prof. Dr. Shahid Khattak Convener, Elect Engg & Allied Disciplines	Member
5.	Engr. Prof. Dr. Ehsan Ullah Khan Kakar Convener, Civil Engg & Allied Disciplines	Member

6.	Engr. Prof. Dr. Syed Mushtaq Shah Convener, Mechanical Engg & Allied Disciplines	Member
7.	Engr. Prof. Dr. Amanat Ali Bhatti Convener, Materials, Metallurgical, Mining and Petrogas & Allied Disciplines	Member
8.	Engr. Prof. Dr. Naveed Ramzan Convener, Chemical Engg & Allied Disciplines	Member
9.	Engr. Dr. Muhammad Ashraf Convener, Agricultural Engg. & Allied Disciplines	Member
10.	Engr. Muhammad Raza Chohan Convener, Common to All (Non-Engg Component)	Member
11.	Mr. Hidayatullah Kasi HEC Representative	Member
12.	Engr. Dr. Nasir Mahmood Khan	Secretary / Registrar, PEC
13.	Engr. Niaz Ahmed Khaskheli Sr. Additional Registrar, EAD	Secretary ECRDC

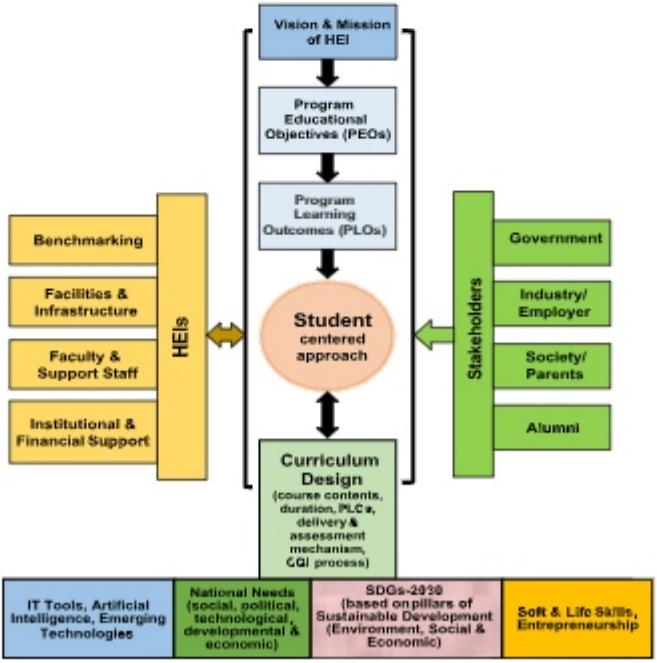
2. ECRDC Agenda

- The ECRDC is responsible to oversee the overall working of curriculum review and development for all engineering programs in terms of strategy, guidance & progress, and thereby submission to the relevant forum for adoption/ notification.
- Each Member of ECRDC will also work in the capacity of Convener for respective disciplines as mentioned against their names and as per their ToRs.

3. OBE-Based Curriculum Development Framework

Outcome Based Education (OBE) is an approach of teaching and learning that focuses on what students should be able to attain at the end of the educational program. OBE is a student centered system that concerns what the students will know and be able to do as learning outcomes. The curriculum development under OBE is therefore an integration of graduates' attributes and stakeholders' feedback in cognizance with the institution's Vision and Mission.

Outcome Based Education (OBE) Curriculum Development Framework



4. PDCA Approach to Curriculum Design and Development

The process of curriculum design and development constitutes various interconnected elements with the objective of achieving the intended purpose of the program. The Plan-Do-Check-Act approach (PDCA) as explained below has been followed in the curriculum development and review process.

Plan. This stage begins with an analysis of the stakeholders' needs of faculty, current and past students, employers and society in general. The stakeholders' needs are translated into human resource terminology i.e. graduate competencies which in turn translated into educational taxonomy and learning outcomes. Based on the learning outcomes, the curriculum is designed backward to meet PLOs.

Do. The Do plan stage is implemented where the curriculum is delivered and learning outcomes are assessed to gauge the achievement of PLOs.

Check. This stage involves the analysis of assessment results and feedback from students and faculty. Areas for improvement are also identified during this stage.

Act. When the learning outcomes are achieved, the curriculum, learning and teaching strategies and assessment methods are standardized. Best practices are shared and improvement is made for the next cycle of PDCA.

5. ECRDC for Electrical and Allied Engineering Disciplines

The PEC Engineering Curriculum Review and Development Committee (ECRDC) of Electrical and Allied Engineering disciplines took up the task to review and update the curriculum for the Information Security Engineering degree program. The subject Committee had several meetings besides multiple sessions of Sub-Groups and the concluding meeting of ECRDC Electrical & Allied Disciplines (Information Security Engineering) was conducted on 18-1-2024 at PEC Head Office, Islamabad. The Committee consisted of the following members:

1.	Engr. Prof. Dr. Shahid Khattak Ex-VC UET, Mardan	Convener
2.	Engr. Dr. Noor Muhammad Sheikh Professor, GCU, Lahore	Member
3.	Engr. Mian Sultan Mehmood CEO, Creative Group of Companies	Member
4.	Engr. Nasir Ayaz Khan Gurmani Chief Engineer, Strategic Planning MEPCO	Member
5.	Engr. Prof. Dr. Zubair Ahmed Sheikh President, MAJU Karachi	Member
6.	Engr. Dr. Zahid Hussain Khand Professor & Registrar, IBA Sukkur	Member
7.	Engr. Dr. Faizullah Khan Kakar Professor, BUITEMS Quetta	Member
8.	Engr. Dr. Nasir Baig Director (Satellite), Axiohesheng Islamabad	Member

9.	Engr. Muhammad Imran Khan Cheema Head Business Development IP, Descon	Member
10.	Engr. Abdul Rehman Sheikh Senior Manager, PTCL Karachi	Member
11.	Engr. Prof. Dr. Muhammad Kamran Vice Chancellor, MNS-UET, Multan	Member
12.	Engr. Dr. Noor Muhammad Khan Professor, Capital University of Science & Technology, Islamabad	Co-opted Member
13.	Engr. Dr. Syed Madad Ali Shah Professor, IBA Sukkur	Co-opted Member
14.	Engr. Dr. Hafiz Ashiq Hussain Professor, Air University, Islamabad	Co-opted Member
15.	Engr. Dr. Kamran Liaquat Bhatti Associate Professor, NFC-IET, Multan	Co-opted Member
16.	Engr. Dr. Zahir Javed Paracha Professor, PIET Multan	Co-opted Member
17.	Engr. Dr. Naeem Iqbal Professor, PIEAS Islamabad	Co-opted Member
18.	Engr. Dr. Tariq ullah Jan Associate Professor, UET Peshawar	Co-opted Member
19.	Engr. Dr. Saad A. Qazi Professor, NED-UET Karachi	Co-opted Member
20.	Engr. Dr. Gulistan Raja Professor, UET Taxila	Co-opted Member
21.	Engr. Prof. Dr. Abdul Rehman Memon Former VC MUET, Jamshoro	Co-opted Member
22.	Engr. Zafar Mahmood CEO, Inter-SES Islamabad	Co-opted Member

23.	Engr. Abdul Khalique Sheikh Director, K-Electric	Co-opted Member
24.	Engr. Dr. Muhammad Saeed FAST NUCES, Islamabad	Co-opted Member
25.	Mr. Hidayatullah Kasi Representative HEC	Co-opted Member
26.	Engr. Niaz Ahmad Sr. Additional Registrar/ HoD-EAD	Secretary ECRDC
27.	Engr. Osaf Mahmood Malik Section Head (Curriculum & Development)	Additional Registrar-EAD
28.	Engr. Syed Haider Abbas Bokhari	Assistant Registrar-EAD
29.	Mr. Muhammad Irfan	Office Superintendent-EAD

The working on curriculum development of Information Security Engineering was initiated in 2022 by the previous EAD team comprising of Engr. Dr. Ashfaq Ahmed Sheikh (Sr. Additional Registrar), Engr. Ghulam Karim (Additional Registrar) and Engr. Daniyal Hameed (Assistant Registrar). The contribution of previous as well as current EAD team was highly acknowledged and appreciated by the Convener ECRDC Electrical and Allied Engineering Disciplines.

Sub Group Information Security Engineering

1.	Engr. Prof. Dr. Mohammad Younas Javed Vice Chancellor Mirpur University of Science and Technology, Mirpur	Lead Sub-Group
2.	Engr. Prof. Dr. Zubair Ahmed Sheikh President, MAJU Karachi	Member
3.	Engr. Dr. Nasir Baig Director (Satellite), Axiohesheng Islamabad	Member
4.	Engr. Prof. Dr. Syed Madad Ali Shah Pro-Vice Chancellor, IBA Sukkur	Member
5.	Engr. Dr. Asad Afreen Associate Professor & Director IT NED University of Engineering & Technology, Karachi	Member
6.	Engr. Ahrar Naqvi Founder & CEO Ebryx LLC	Member

The ECRDC Electrical and Allied Engineering Disciplines appreciated the extra-ordinary efforts and contribution of Engr. Prof. Dr. Shahid Khattak (Convener), Engr. Prof. Dr. Younus Javed (Lead Sub-Group), Engr. Dr. Asad Arfeen (Co-opted Member) & Engr. Osaf Mahmood Malik (Section Head Curriculum & Development) for compilation of course contents and proofreading of this curriculum booklet.

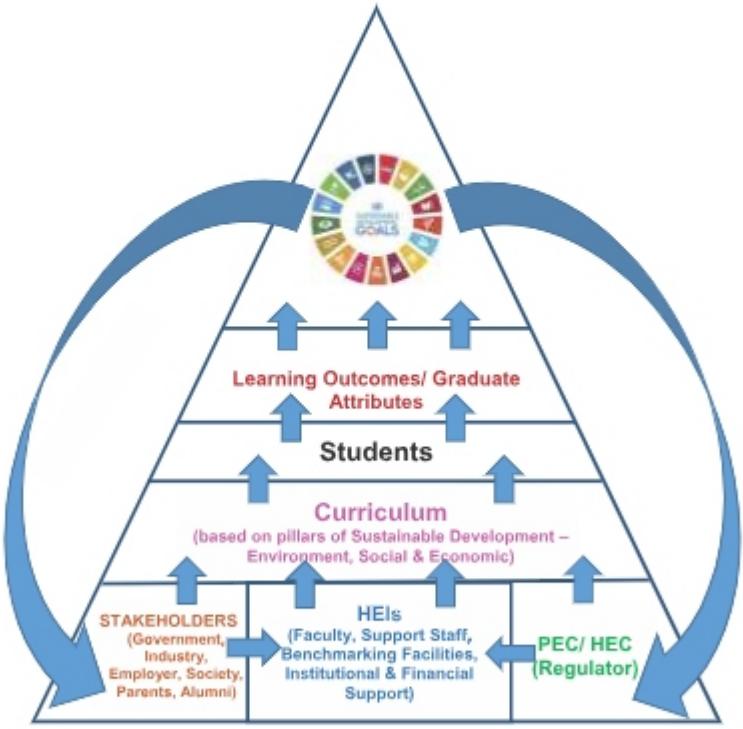
6. Agenda of ECRDC for Electrical and Allied Engineering Disciplines

- The Subject ECRDC will work under the overall directions and supervision of the main ECRDC comprising all Conveners.
- The key driving lines for the development of the engineering curriculum for each discipline will be the overall policy of Pakistan Engineering Council in conjunction with international commitments (Washington Accord, IPEA etc.) and Government policies/ HEC.
- Review of policies and stakeholders' feedback for the sector(s) relevant to the respective discipline.
- Comparative study of the curricula being offered at various engineering universities/institutions already following the OBE-based system.
- Development and finalization of complete scheme and curriculum for respective discipline including all aspects.

The Convener Engr. Prof. Dr. Shahid Khattak highlighted the important benchmarks and international best practices to be considered for the development/ revision of the curriculum while taking into account the Outcome Based Education (OBE) system. He also suggested that the Committee comprising professors and experts from academia, industry and R&D institutions have provided useful input and suggestions covering new developments to be incorporated in the curriculum. He also highlighted the importance of the field of Information Security Engineering for achieving sustainable developments while addressing socio-economic issues and challenges envisaged in Goal-4 of the Sustainable Development Goals-2030.

- Goal-1: No Poverty
- Goal-2: Zero Hunger
- Goal-3: Good Health and Well-being
- Goal-4: Quality Education
- Goal-5: Gender Equality
- Goal-6: Clean Water and Sanitation
- Goal-7: Affordable and Clean Energy
- Goal-8: Decent Work and Economic Growth
- Goal-9: Industrial Innovation and Infrastructure

- Goal-10: Reduced Inequalities
- Goal-11: Sustainable Cities and Communities
- Goal-12: Responsible Consumption and Production
- Goal-13: Climate Action
- Goal-14: Life Below Water
- Goal-15: Life on Land
- Goal-16: Peace, Justice and Strong Institution
- Goal-17: Partnerships for the Goals



The curriculum therefore has been designed based on the above SDGs alongside their mapping strategy with the program mission, objectives, learning attributes and the scheme of study.

7. Attainment of Graduate Attributes and Professional Competencies

The development of an engineering professional is an ongoing process with important identified stages. The first stage is the attainment of an accredited educational qualification i.e., the graduate stage. The fundamental purpose of engineering education is to build a knowledge base and attributes to enable the graduate to continue learning and to proceed to formative development that will develop the competence required for independent practice. The second stage, following a period of formative development, is professional registration. The fundamental purpose of formative development is to build on the educational base to develop the competencies required for independent practice in which the graduate works with engineering practitioners and progresses from an assisting role to taking more responsibility as an individual and as a team member until competence can be demonstrated at this level required for registration. Once registered, the practitioner must maintain and expand competence.

The baseline for developing the curriculum of the engineering program and setting the graduate attributes are the defined set of Knowledge and Attitude Profiles approved by International Engineering Alliance (IEA) in version 4.0.

7.1 Knowledge and Attitude Profile

In order to inculcate different dimensions of thinking mathematical, computational, design and creativeness among students in Cognitive, Psychomotor and Affective domains, the curriculum is designed to cover the following 9x knowledge and attitude profiles. These profiles reflect an indicated volume of learning and the work attitude against which graduates must be able to perform.

- **WK1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

- **WK2:** Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

- **WK3:** A systematic, theory-based formulation of engineering fundamentals required in the relevant engineering discipline.

- **WK4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

- **WK5:** Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

- **WK6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

- **WK7:** Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development (Represented by the 17 UN Sustainable Development Goals (UN-SDG).

- **WK8:** Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

- **WK9:** Ethics, inclusive behavior and conduct; Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability, etc. with mutual understanding and respect, and of inclusive attitudes.

7.2 Graduate Attribute Profiles (GAs)/ Program Learning Outcomes (PLOs)

Graduate attributes (GAs) form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. The graduate attributes are exemplars of the attributes expected from a graduate of an accredited program. Graduate attributes are clear, succinct statements of the expected capability, qualified if necessary, by a range indication appropriate to the type of program. The GAs have been revised in version 4.0 of IEA with distinctive change being the merger of GA-6 Engineer

and Society; and GA-7 Environment and Sustainability as the single GA of 'The Engineer and the World'. There are also minor changes in the statements of revised GAs approved as version 4.0 of IEA.

The engineering curriculum is the most important instrument for grooming the students based on 11x Graduate Attributes (GAs) encompassed under the Program Learning Outcomes (PLOs). Program outcomes are the narrower statements that describe what students are expected to know and be able to do at the time of graduation. These PLOs mainly relate to the knowledge, skills and attitudes that students acquire while progressing through the program. Specifically, it is to be demonstrated that the students have acquired the defined GAs. The program must demonstrate that by the time of graduation, the students have attained a certain set of knowledge, skills and behavioral traits, at-least to some acceptable minimum level. This minimum threshold value (i.e., KPI for PLO attainment) should not be less than 50% even to begin with; however, as the program progresses through its evolution, it is expected that this minimum threshold value would subsequently be raised to higher values through program's CQI. Specifically, it is to be demonstrated that all students of a batch to be accredited have acquired the following graduate attributes (GAs) set according to the revised framework of International Engineering Alliance (IEA) version-4.0:

- **PLO-1 Engineering Knowledge:** Apply knowledge of mathematics, natural science, engineering fundamentals and Engineering specialization to the solution of complex engineering problems (WK-1-WK-4).

- **PLO-2 Problem Analysis:** Identify, formulate, conduct research literature, and analyse complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences (WK-1-WK-4).

- **PLO-3 Design/Development of Solutions:** An ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations (WK-5).

- **PLO-4 Investigation:** Conduct investigation of complex Engineering problems using research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of

information to provide valid conclusions (WK-8).

- **PLO-5 Tool Usage**: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex Engineering problems, with an understanding of the limitations (WK-2 and WK-6).

- **PLO-6 The Engineer and the World:** Analyze and evaluate sustainable development impacts to society, the economy, sustainability, health and safety, legal frameworks, and the environment while solving complex engineering problems (WK-1, WK-5, and WK-7).

- **PLO-7 Ethics:** Apply ethical principles and commit to professional ethics and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion (WK-9).

- **PLO-8 Individual and Collaborative Team Work:** Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings (WK-9).

- **PLO-9 Communication:** Communicate effectively and inclusively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, and make effective presentations, taking into account cultural, language, and learning differences (WK-1 and WK-9).

- **PLO-10 Project Management and Finance:** Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments (WK-2 and WK-5).

- **PLO-11 Lifelong Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change (WK-8 and WK-9).

The graduate attributes are stated generically and are applicable to all engineering disciplines. In interpreting the statements within a disciplinary context, individual statements may be amplified and given particular emphasis but they must neither be altered in substance nor individual elements ignored. HEI is expected to prepare the PLO mapping with the whole curriculum as per their OBE design.

7.3 Professional Competence Profiles

A professionally or occupationally competent person has the attributes necessary to perform the activities within the profession or occupation to the standards expected in independent employment or practice. The professional competence profiles for each professional category record the elements of competence necessary for performance that the professional is expected to be able to demonstrate in a holistic way at the stage of attaining registration.

Professional competence can be described using a set of attributes corresponding largely to the graduate attributes, but with different emphases. For example, at the professional level, the ability to take responsibility in a real-life situation is essential. Unlike the graduate attributes, professional competence is more than a set of attributes that can be demonstrated individually. Rather, competence must be assessed holistically. Thirteen elements of professional competence as approved by the IEA for global benchmarking are mentioned as follows:

- **EC1 Comprehend and apply universal knowledge:** Comprehend and apply advanced Engineering knowledge of the widely-applied principles underpinning good practices.

- **EC2 Comprehend and apply local knowledge:** Comprehend and apply advanced Engineering knowledge of the widely-applied principles underpinning good practice specific to the jurisdiction of practices.

- **EC3 Problem analysis:** Define, investigate and analyze complex Engineering problems using data and information technologies where applicable.

- **EC4 Design and development of solutions:** Design or develop solutions to complex Engineering problems considering a variety of perspectives and taking account of stakeholder views.

- **EC5 Evaluation:** Evaluate the outcomes and impacts of complex Engineering activities.

- **EC6 Protection of society:** Recognize the foreseeable economic, social, and environmental effects of complex Engineering activities and seek to achieve sustainable outcomes.

- **EC7 Legal, regulatory, and cultural:** Meet all legal, regulatory, and cultural requirements and protect public health and safety in the course of all Engineering activities.

- **EC8 Ethics:** Conduct Engineering activities ethically.

- **EC9 Manage engineering activities:** Manage part or all of one or more complex Engineering activities.

- **EC10 Communication and Collaboration:** Communicate and collaborate using multiple media clearly and inclusively with a broad range of stakeholders in the course of all Engineering activities.

- **EC11 Continuing Professional Development (CPD) and Lifelong learning:** Undertake CPD activities to maintain and extend competences and enhance the ability to adapt to emerging technologies and the ever-changing nature of work.

- **EC12 Judgement:** Recognize complexity and assess alternatives in light of competing requirements and incomplete knowledge. Exercise sound judgement in the course of all complex Engineering activities.

- **EC13 Responsibility for decisions:** Be responsible for making decisions on part or all of the complex Engineering activities.

The professional competence profiles are stated generically and are applicable to all engineering disciplines. The application of a competence profile may require amplification in different regulatory, disciplinary, occupational or environmental contexts. In interpreting the statements within a particular context, individual statements may be amplified and given particular emphasis but must not be altered in substance or ignored.

8. Mapping of Bachelors of Engineering Program with UN SDGs

The Engineering Programs are vital for achieving sustainable development while addressing socio-economic issues and challenges envisaged in United Nation's Sustainable Development Goals i.e. UN SDGs (Figure 1) as under;

Figure 1: United Nation's Sustainable Development Goals (UN SDGs)

9. Concept Note on the Incorporation of UN SDGs in Curriculum

The United Nations' Sustainable Development Goals (SDGs) provide a global framework for addressing pressing societal and environmental challenges. In the context of engineering education and curriculum, integrating sustainable solutions is essential to contribute towards achieving these SDGs. This note explores how complex engineering problem (CEP) solving and complex engineering activities (CEAs) can align with specific SDGs and emphasizes the role of engineering in promoting sustainable development.

The CEP solving and CEAs play a pivotal role in developing innovative solutions that address societal challenges, fostering sustainable development. Thus, the analysis of a complex engineering problem needs to include consideration for sustainable development in the light of UN SDGs. Prospective sustainable solution resulting from a CEP-solving activity or CEA can be related to specific SDG(s).

It is pertinent to mention that it is not mandatory for an HEI to map all 17 SDGs with its engineering program. Only those SDGs may be mapped which are covered in CEP-solving activities, CEAs, semester projects, open-ended labs, capstone projects or co- and extra-curricular activities with holistic consideration for sustainable development.

The documentation or any deliverable of the activity will stand as evidence of the addressal of the respective SDG. For example, embedding renewable energy concepts, such as solar and wind power, into class/lab CEPs/ CEAs and final-year/ capstone projects can align them with the targets set for SDG-7. Similarly, focusing on cutting-edge technologies like the Internet of Things (IoT) and smart grids in class/ lab projects and final-year projects can work for SDG-9. By addressing CEPs/ CEAs aligned with specific SDGs, engineers can contribute significantly to global efforts to build a more sustainable and equitable world.

The effectiveness of the incorporation of SDG targets in class/ lab projects or CEPs/ CEAs can be further enhanced by encouraging the students to:

- Include Life Cycle Assessment (LCA) methodologies in class/ lab projects or CEPs/ CEAs to evaluate the environmental impact of products and systems.
- Collaborate with the students of other disciplines to address interconnected challenges.
- Emphasize the use of sustainable materials and manufacturing processes in the design and production of components.
- Assess the social implications of their projects, considering factors like community well-being, accessibility, and inclusivity.

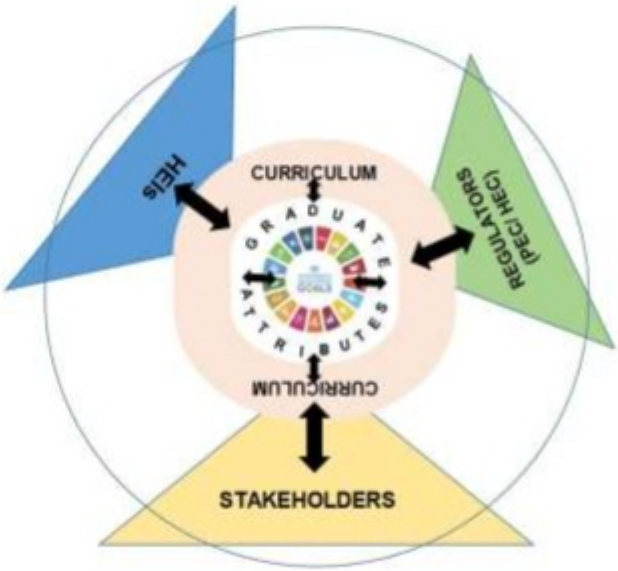


Figure : Consideration of UN SDGs in curriculum design

10. Correlation Matrix PLOs-ECs-WKs-SDGs

A correlation matrix has been established to link Program Learning Outcomes (PLOs) with the corresponding engineering competencies, knowledge and attitude profiles, as well as the targeted UN Sustainable Development Goals (SDGs) by 2030. This mapping has been developed in accordance with the revised definitions of Graduate Attributes and Professional Competences (GAPCs) approved in version 4.0 of the International Engineering Alliance (IEA).

PLOs	ECs **	WKs	SDGs (Proposed)
PLO-1 **Engineering Knowledge:** Breadth, depth and type of knowledge, both theoretical and practical	**EC-1** **Comprehend and apply universal knowledge** **& EC-2** **Comprehend and apply local knowledge**	(WK-1, WK-2, WK-3 & WK-4) **WK-1** **Natural sciences** and awareness of relevant **social sciences** **WK-2** **Mathematics & computing** **WK-3** **Engineering fundamentals** **WK-4** **Engineering specialist knowledge**	SDG-9
PLO-2 **Problem Analysis**: Complexity of analysis	**EC-3** **Problem analysis**	(WK-1, WK-2, WK-3 &WK-4) **WK-1** **Natural sciences** and awareness of relevant **social sciences** **WK-2** **Mathematics & computing** **WK-3** **Engineering fundamentals** **WK-4** **Engineering specialist knowledge**	Selected SDGs from SDG - 1 to 17 (relevance as per curriculum)
PLO-3 **Design/Development of Solutions:** Breadth and uniqueness of engineering problems i.e., the extent to which problems are original and to which solutions have not previously been identified or codified	**EC-4** **Design and development of solutions**	**WK-5** **Engineeringdesign and operations**	SDG-1, 2, 3, 6, 10, 11, 12, 13, 14 (relevance as per curriculum)

PLO-4 **Investigation:** Breadth and depth of investigation and experimentation	**EC-5** **Evaluation**	**WK-8** **Research literature**	SDG-9
PLO-5 **Tool Usage:** Level of understanding of the appropriatenessof technologies andtools	**EC-3** **Problem analysis** **& EC-5** **Evaluation**	(WK-2 & WK-6) **WK-2** **Mathematics & computing** **& WK-6** **Engineering practice**	SDG-9
PLO-6 **The Engineer and the World:** Level ofknowledge and responsibility for sustainable development	**EC-6** **Protection of society** **& EC-7** **Legal, regulatory, and cultural**	(WK-1, WK-5 & WK-7) **WK1** **Natural sciences** and awareness of relevant **social sciences** **WK-5** **Engineeringdesign and operations** **& WK7** **Engineering in Society**	Selected SDGs from SDG - 1 to 17 (relevance as per curriculum)
PLO-7 **Ethics:** Understanding andlevel of practice	**EC-8** **Ethics:** No differentiation in this characteristic	**WK-9** **Ethics, inclusive behavior and conduct**	SDG- 5, 10, 16
PLO-8 **Individual and Collaborative Team work:** Role inand diversity of team	**EC-10** **Communication and Collaboration**	**WK-9** **Ethics, inclusive behavior and conduct**	SDG- 5, 10, 16
PLO-9 **Communication:** Level of communication according to type of activities performed	**EC-10** **Communication and Collaboration**	(WK-1 & WK-9) **WK-1** **Natural sciences and awareness of relevant social sciences** **& WK-9** **Ethics, inclusive behavior and conduct**	SDG- 5, 10, 16

PLO-10 **Project Management and Finance:** Level of management required for differing types of activity	**EC-9** **Manage engineering activities**	(WK-2 & WK-5) **WK-2** **Mathematics & computing** **& WK-5** **Engineering** **design and operations**	SDG-9
PLO-11 **Lifelong Learning:** Duration and manner	**EC-11** **Continuing Professional Development (CPD) and lifelong learning** **EC-12** **Judgement** **EC-13** **Responsibility for decisions**	**WK-8** **Research literature**	SDG-9, 13

** ECs are expected to be demonstrated by graduates during their practical experiences, which have been mapped with PLOs to reflect integration in the designed curriculum.

The relationship matrix has been generically designed as a guiding framework for HEIs and is applicable to all engineering disciplines. When interpreting the matrix within a specific context, revisions or amplifications may be incorporated to highlight particular emphasis or compliance with rationalized program requirements.

11. Program Salient Features

The undergraduate engineering program has been based on the following salient features:

- **Duration:** 4 years
- **Number of Semesters:** 8
- **Total Number of Credit Hours:** 130 - 136
    - o General Education for Engineering Discipline: Minimum 38 Credit Hours
    - o Engineering Domain (including computer courses, foundation, breadth, depth/major courses): Minimum 72 Credit Hours
    - o FYDP/ Capstone Project: 06 Credit Hours
    - o Multidisciplinary Engineering/Specialty Courses: Minimum 06 Credit Hours
    - o HEIs have the flexibility of 8-14 Credit Hours to add courses either in Engineering, Non-Engineering or both Domains to fulfill the program objectives in line with the overall Vision/ Mission of the Institute concerned.
- **Number of Weeks per Semester:** 15 - 18
- **Number of Credit Hours per Semester:** 15 - 18

The curriculum matrix covering the defined knowledge and attitude profiles should therefore be composed of General Education/ Non-Engineering domain (humanities, math, management and natural sciences), and engineering domain with Information Security Engineering, foundation, breadth, depth and multidisciplinary courses (including safety) so that different streams could be encouraged within each discipline, enabling students to undertake a range of Complex Problem Solving and Complex Engineering Activities. The students may select electives from any of the streams with guidelines from their respective advisors. The knowledge areas of Non-Engineering and Engineering domains have been broadly mapped with 11x PLOs and 9x WKs using the guiding framework of IEA version 4.0 in the following table:

Knowledge Profile (WK-1 to WK-9)	Knowledge Area	Sub-Area	Courses	Credit Hours
General Education/ Non-Engineering Domain				
WK-1/ WK-2	**Natural Sciences**	Math	As per program requirements	12-15
		Physics	***Applied Physics	3-9
		Chemistry	***Applied Chemistry	
		Natural Science/ Math Elective	*** Math Elective	
WK-1/ WK-5/ WK-7/ WK-9	**Humanities**	English	**Functional English	3
			** Expository Writing	3
		Culture	** Islamic Studies or Ethics	2
			**Ideology & constitution of Pakistan	2
			*Arts & Humanities Elective (Languages or study of religion)	2
		Social Science	***Social Science Elective	2
			** Civics and Community Engagement	2
	Management Sciences	Professional Practice	***Project Management	2
			**Entrepreneurship	2
	Computer Sciences	Basic Computing	**Applications of ICT	3

Engineering Domain				
Knowledge Profile (WK-1 to WK-9)	**Knowledge Area**	**Sub-Area**	**Courses**	**Credit Hours**
WK-2/ WK-4/ WK-5/	Advanced Computer and Information Sciences	ICT/AI/ Data Science/ Cyber Security		6-9
WK-2/ WK-3	Foundation Engg Courses		Specific to Program Objectives and outcome	22-24
WK-1/ WK-2/ WK-4	Core Breadth of Engg Disciplines		Specific to Program Objectives and outcome	22-24
WK-5/ WK-6	Core Depth of Engg Disciplines		Specific to Program Objectives and outcome	22-24
				Min 72
WK-1/ WK-2/ WK-3/ WK-4/ WK-7/ WK-9	Multi disciplinary Engg Courses		Specific to Program Objectives and outcome Occupational Health and Safety (Mandatory 01 credit hours)	6
WK-4/ WK-5/ WK-6/ WK-7/ WK-8/ WK-9	Final Year Design Project (FYDP)/ Capstone	Integration of innovative, creative, technical, management and presentation skills of a graduate towards final year.		6
WK-6/ WK-7/ WK-9	Industrial Training	Internship (06-08 Weeks)		Mandatory & Qualifying

WK-2/ WK-4/ WK-5/ WK-6/ WK-7/ WK-8	**Innovative and Critical Thinking (under relevant courses):** - Complex Problem Solving - Complex Engineering Activities - Semester Project - Case Studies - Open Ended Labs - Problem-Based Learning (PBL)	
	(Flexible Engineering/ Non-Engineering) Courses may be adjusted as per the requirements	8-14
	Total (Credit Hours)	**130-136**

Note: * University may offer any course within the specific broader subject domain/ cluster to meet the given credits.

** HEC designed model courses may be used by the university.

*** PEC ECRDC designed courses.

- **Industrial Training:** Internship of at least 6 - 8 weeks is a mandatory part of degree requirements to be carried out during 3rd to 4th year of program; must be supervised, monitored, evaluated, and reflected in the transcripts under a prescribed mechanism and with defined and mapped rubrics with program outcomes. The assessment phase should focus about;

    - Selection of internship in line with elective subjects/ specific streams
    - Qualifying weightage: 70%
        - At least 75% attendance is mandatory 10%
        - Assessment report from the employer 50%
        - Evaluation at relevant HEIs/ Deptt – presentation 40%

- **Final Year Design Project (FYDP)/ Capstone**: FYDP aims to challenge innovative, creative, technical, management and presentation skills of a graduate to bring together the learning over the degree program.
- A final year design project (FYDP) is the confluence of an engineering program. Undertaking a final year design project is a compulsory requirement. It should mainly comprise literature search, individual analysis, modeling and simulation, AI (Artificial Intelligence) and computational data analytics, design of infrastructure, software, firmware and Algorithm Engineering / Informatics related to the program to demonstrate a functional concept including rapid prototyping, where applicable.
- The FYDP shall include complex engineering problems and design systems, components or processes integrating core areas and meeting specific needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
- A project of this nature should invariably lead to an integration of the knowledge and practical skills as mandated in the program outcomes. In this context, projects of multidisciplinary nature should be encouraged.
- The FYDP should span over two consecutive semesters, i.e. semester 7 & 8, totaling 6-credit hours and should be fully supervised, assessed and reflected in the transcripts under a prescribed mechanism to prepare for joining the industry after graduation.
- **Faculty:** The faculty must be trained for the Outcome-Based Education (OBE) system. Their familiarity with the program objectives and outcomes, understanding of the Outcome-Based Assessment (OBA) cycle, enthusiasm for developing an effective program, and the ability to become an active player towards its overall implementation are the key factors for ensuring

the attainment of program objectives. The faculty is expected to have the ability to ensure proper implementation of the program, and develop processes for evaluation, assessment and CQI. A formal training program to groom the faculty should be instituted so that they become effective instructors in applying pedagogical skills in all aspects of Teaching, Learning and Assessment covering all domains of Knowledge, Skills and Attitude.

- **Personal Grooming:** Personal Grooming of young faculty members and students is very important in order to develop and support their professional skills. Therefore, it is required that HEIs should conduct/arrange sessions or counseling hours on a regular basis to provide guidance for personal grooming as it is important for positive self-image and increasing the confidence level of the individuals. It would help in enhancing students' self- esteem and would go a long way in developing an attractive personality by adopting habits like personal hygiene, clothing, appearance, interaction and expressive skills, etc. The students should be motivated and equipped to be entrepreneurs in their relevant field.

- **Presentation and Communication Skills:** Special focus should be given to inculcate communication and presentation skills amongst the graduates through individual and group presentations, technical writing and discussions, throughout the program as a regular feature.

This Curriculum has been designed to guide and facilitate the universities and departments to formulate their own programs according to the industrial needs, emerging trends and recent developments in the field of Information Security Engineering. The HEIs have the flexibility to incorporate changes in the proposed curriculum within given range of credit hours for engineering and non-engineering domain.

12. Framework for Bachelor of Information Security Engineering Curriculum

Knowledge Profile (WK-1 to WK-9)	Knowledge Area	Sub Area	Course Title	Theory	Lab	Total
				Credit Hours		
General Education/ Non-Engineering Domain						
WK-1/ WK-5/ WK-7/ WK-9	**Humanities**	English	Functional English **	3	0	3
			Expository Writing **	3	0	3
		Culture	Ideology and Constitution of Pakistan **	2	0	2
			Islamic Studies/ Ethics **	2	0	2
			Arts and Humanity Elective*	2	0	2
		Social Sciences	Civic and Community Engagements **	2	0	2
			Social Science Elective ***	2	0	2
	Management Sciences	Professional Practice	Project Management ***	2	0	2
			Entrepreneurship **	2	0	2
	Computer Sciences	Basic Computing	Applications of ICT **	2	1	3
WK-1/ WK-2	**Natural Sciences**	Math	Calculus and Analytical Geometry	3	0	3
			Linear Algebra	2	0	2
			Differential Equations	2	0	2
			Complex Variable and Transforms	3	0	3
			Numerical Methods	2	1	3
			Discrete Mathematics	2	0	2
		Physics	Applied Physics ***	2	1	3
Total (General Education Domain)				**38**	**3**	**41**

Note: * University may offer any course within the specific broader subject domain/ cluster to meet the given credits.

** HEC designed model courses may be used by the university.

*** PEC ECRDC designed courses.

Knowledge Profile (WK-1 to WK-9)	Knowledge Area	Sub Area	Course Title	Theory	Lab	Total
				Credit Hours		
Engineering Domain						
WK-2 WK-4 WK-5 WK-6	**Advanced Computer and Information Science**	ICT/AI/ Data Science/Cyber Security	Fundamentals of Computing	2	1	3
			Data Structures and Algorithms	3	1	4
			Object Oriented Programming	3	1	4
			Artificial Intelligence	3	1	4
WK-3/ WK-2	**Engineering Foundation**		Operating systems & Systems Programming	3	1	4
			Workshop Practice	0	1	1
			Computer and Communication Networks	3	1	4
			Digital Logic Design	3	1	4
			Computer Architecture and Organization	3	1	4
			Database Management and Design	3	1	4
			Probability and Statistics for Engineers	3	0	3
WK-1/ WK-2 WK-4	**Major Based Core (Breadth)**		Information Security	3	0	3
			Cryptography and Network Security	3	1	4
			Computer Forensics	3	1	4
			Software and Systems Security	2	1	3
			Mobile Security / End Point Security	3	1	4
WK-5 WK-6	**Major Based core (Depth)**		Depth Elective-I*	3	1	4
			Depth Elective-II*	3	1	4
			Depth Elective-III*	3	1	4
			Depth Elective-IV*	3	0	3
			Depth Elective-V*	3	0	3
WK-1/ WK-2/ WK-3/ WK-4	**Multi-disciplinary Engg Courses**		MDE Elective-I **	3	0	3
			Occupational Health and Safety	1	0	1

WK-6 WK-7 WK-8	**Final Year Design Project (FYDP)/ Capstone**	Industrial/ Innovative/ Creative Projects	FYDP Part - I	0	2	2
			FYDP Part - II	0	4	4
WK-6 WK-7	**Industrial Training**	(6 – 8 Weeks Internship)		**Mandatory & Qualifying**		
	Community Service	Community service (Non-Credit)				
WK-2 WK-4 WK-5 WK-6 WK-7 WK-8	**Innovative and Critical thinking (under Relevant Courses)** - Complex Problem Solving - Complex Engineering Activities - Semester Project - Case Studies - Open Ended labs - Problem Based Learning					
Total (Engineering Domain)				58	27	85
WK-1 To WK-9	**Flexible Engg/ Non-Engg Courses**	Flexible Elective - I ***		3	0/1	3/4
		Flexible Elective - II ***		3	0	3
		Flexible Elective - III ***		3	0	3
				9	1	10
Total Credit Hours				135-136		

Note: Quran Translation (QT) Credits will be allowed as over and above 136 Cr. Hrs.

* Elective subjects may be offered from the pool of subjects given below.

** Multi-Disciplinary Engineering Electives may be offered from the pool of subjects given below.

*** Flexible Engg / Non-Engg elective is any subject of interest from the Engg / Non-Engg domain for which the pre-requisite requirements are satisfied.

13. Scheme of Studies for Bachelor of Information Security Engineering Curriculum

1st Year				
First Semester				
S. No.	**Course Title**	**(Credit Hours)**		**Total**
		Theory	**Lab**	**Cr. Hrs.**
1	Discrete Mathematics	2	0	2
2	Fundamentals of Computing	2	1	3
3	Ideology and Constitution of Pakistan	2	0	2
4	Functional English	3	0	3
5	Applied Physics	2	1	3
6	Applications of ICT	2	1	3
7	Workshop Practice	0	1	1
	Total	**13**	**4**	**17**
Second Semester				
S. No.	**Course Title**	**(Credit Hours)**		**Total**
		Theory	**Lab**	**Cr. Hrs.**
1	Object Oriented Programming	3	1	4
2	Arts and Humanities Elective*	2	0	2
3	Islamic Studies/Ethics	2	0	2
4	Calculus and Analytical Geometry	3	0	3
5	MDE Elective****	3	0	3
6	Digital Logic Design	3	1	4
	Total	**16**	**2**	**18**

2nd Year				
Third Semester				
S. No.	**Course Title**	**(Credit Hours)**		**Total**
		Theory	**Lab**	**Cr. Hrs.**
1	Differential Equations	2	0	2
2	Data Structures and Algorithms	3	1	4
3	Complex Variables and Transforms	3	0	3
4	Information Security	3	0	3
5	Computer Architecture and Organization	3	1	4
6	Occupational Health and Safety	1	0	1
	Total	**15**	**2**	**17**
Fourth Semester				
S. No.	**Course Title**	**(Credit Hours)**		**Total**
		Theory	**Lab**	**Cr. Hrs.**
1	Cryptography and Network Security	3	1	4
2	Database Management and Design	3	1	4
3	Computer and Communication Networks	3	1	4
4	Linear Algebra	2	0	2
5	Operating Systems and Systems Programming	3	1	4
	Total	**14**	**4**	**18**

3rd Year				
Fifth Semester				
S. No.	**Course Title**	**(Credit Hours)**		**Total Cr. Hrs.**
		Theory	**Lab**	
1	Mobile Security/End Point Security	3	1	4
2	Computer Forensics	3	1	4
3	Probability and Statistics for Engineers	3	0	3
4	Depth Elective-I***	3	1	4
5	Numerical Methods	2	1	3
	Total	**14**	**4**	**18**
Sixth Semester				
S. No.	**Course Title**	**(Credit Hours)**		**Total Cr. Hrs.**
		Theory	**Lab**	
1	Software and Systems Security	2	1	3
2	Expository Writing	3	0	3
3	Social Science Elective**	2	0	2
4	Depth Elective-II***	3	1	4
5	Depth Elective-III***	3	1	4
6	Project Management	2	0	2
	Total	**15**	**3**	**18**

Final Year				
Seventh Semester				
S. No.	**Course Title**	**(Credit Hours)**		**Total**
		Theory	**Lab**	**Cr. Hrs.**
1	Flexible Elective-I	3	1	4
2	Depth Elective-IV***	3	0	3
3	Artificial Intelligence	3	1	4
4	Depth Elective-V***	3	0	3
5	FYDP Part-I	0	2	2
	Total	**12**	**4**	**16**
Eighth Semester				
S. No.	**Course Title**	**(Credit Hours)**		**Total**
		Theory	**Lab**	**Cr. Hrs.**
1	Flexible Elective-II	3	0	3
2	Flexible Elective-III	3	0	3
3	FYDP Part-II	0	4	4
4	Entrepreneurship	2	0	2
5	Civics and Community Engagement	2	0	2
	Total	**10**	**4**	**14**

* List of Arts and Humanities Electives (2+0)	** List of Social Science Electives (2+0)
• Communication and Presentation Skills • Beginners Spanish • Elementary Arabic • Elementary French • Elementary Chinese • History • Philosophy • Professional Ethics • Any other Relevant Course / Language opted by HEI	• Professional Ethics • Sociology for Engineers • Critical Thinking • Organizational Behavior • Applied Psychology • Engineering Management • Marketing Management • Engineering Economics • Financial Management • Leadership and Personal Grooming • Any other Relevant Course opted by HEI

*** Major Based Core (MBC) Depth Electives	**** Multi-Disciplinary Electives (3+0)
• Security Management and Risk Assessment • Vulnerability Assessment and Penetration testing • Cloud Architecture & Security • Malware reverse engineering • Web Application Security • IoT Security • Ethical Hacking • Cyber Crime and Law • Secure Software Engineering • Data Protection and Disaster Recovery • Information Security Compliance • Cyber Threat Intelligence • Incident Response • Network Forensics • Database Security • Secure Intelligent Systems • Any other Relevant Course opted by HEI	• Linear Control Systems • Microprocessor Systems • Analog Communication Systems • Electronic Devices and Circuits • Digital Signal Processing • Digital Communication Systems • Signals & System • Electrical Network Analysis • Any other Relevant Course opted by HEI

14. Program Specific Laboratories

The following labs specific to engineering discipline be ensured to cover relevant knowledge domains but not limited to;

- Network Security Lab
- Cryptographic Design Lab
- Information System Security Lab
- Computer Lab
- Electronics Lab
- Digital Logics Design Lab

- ***"Labs/ Practical: The course practical/ labs should be defined and synchronized with the course outline (Theory part)."***

- ***"All safety protocols, manuals and log books etc. should be maintained and complied by each lab."***

15. Courses Details and Teaching-Assessment Approaches

In the following sections, Course Outlines and teaching-assessment approaches are given for guidance based on a typical semester system. The instructors may adopt or adapt accordingly defining CLOs, course delivery plan, innovative teaching approaches and assessment techniques.

Suggested Teaching & Assessment Methods include Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Project/Field Visits Group discussion, Community Service, Report Writing Social Impact Review and Social Audit of Engg Project.

Further, assessment may be carried out through Mid Term, Report writing/ Presentation, Assignments, Term Project, Quizzes and Final Term Exam etc.

15.1 Non-Engineering Domain

FUNCTIONAL ENGLISH

UGE Policy V1.1: General Education Course

Credits: 03
Pre-Requisite: Nil

DESCRIPTION

This course is designed to equip students with essential language skills for effective communication in diverse real-world scenarios. It focuses on developing proficiency in English language usage: word choices, grammar and sentence structure. In addition, the course will enable students to grasp nuanced messages and tailor their communication effectively through application of comprehension and analytical skills in listening and reading. Moreover, the course encompasses a range of practical communication aspects including professional writing, public speaking, and everyday conversation, ensuring that students are equipped for both academic and professional spheres. An integral part of the course is fostering a deeper understanding of the impact of language on diverse audiences. Students will learn to communicate inclusively and display a strong commitment to cultural awareness in their language use. Additionally, the course will enable them to navigate the globalized world with ease and efficacy, making a positive impact in their functional interactions.

COURSE LEARNING OUTCOMES

By the end of this course, students will be able to:

1. Apply enhanced English communication skills through effective use of word choices, grammar and sentence structure.
2. Comprehend a variety of literary / non-literary written and spoken texts in English.
3. Effectively express information, ideas and opinions in written and spoken English.
4. Recognize inter-cultural variations in the use of English language and to effectively adapt their communication style and content based on diverse cultural and social contexts.

COURSE OUTLINE

1. **Foundations of Functional English:**
   - Vocabulary building (contextual usage, synonyms, antonyms and idiomatic expressions)
   - Communicative grammar (subject-verb-agreement, verb tenses, fragments, run-ons, modifiers, articles, word classes, etc.)
   - Word formation (affixation, compounding, clipping, back formation, etc.)

- Sentence structure (simple, compound, complex and compound-complex)
- Sound production and pronunciation.

2. **Comprehension and Analysis:**
   - Understanding purpose, audience and context.
   - Contextual interpretation (tones, biases, stereotypes, assumptions, inferences, etc.).
   - Reading strategies (skimming, scanning, SQ4R, critical reading, etc.).
   - Active listening (overcoming listening barriers, focused listening, etc.).
3. **Effective Communication:**
   - Principles of communication (clarity, coherence, conciseness, courteousness, correctness, etc.).
   - Structuring documents (introduction, body, conclusion and formatting).
   - Inclusivity in communication (gender-neutral language, stereotypes, cross-cultural communication, etc.).
   - Public speaking (overcoming stage fright, voice modulation and body language).
   - Presentation skills (organization content, visual aids and engaging the audience).
   - Informal communication (small talk, networking and conversational skills).
   - Professional writing (business e-mails, memos, reports, formal letters, etc.).

PRACTICAL REQUIREMENT

As part of the overall learning requirements, students will also be exposed to relevant simulations, role-plays and real-life scenarios and will be required to apply skills acquired throughout the course in the form of a final project.

SUGGESTED INSTRUCTIONAL/READING MATERIALS

1. "Understanding and Using English Grammar" by Betty Schrampfer Azar.
2. "English Grammar in Use" by Raymond Murphy.
3. "The Blue Book of Grammar and Punctuation" by Jane Straus.
4. "English for Specific Purposes: A Learning-Centered Approach" by Tom Hutchinson and Alan Waters.
5. "Cambridge English for Job-hunting" by Colm Downes.
6. "Practical English Usage" by Michael Swan.
7. "Reading Literature and Writing Argument" by Missy James and Alan P. Merickel.

8. "Improving Reading: Strategies, Resources, and Common Core Connections" by Jerry Johns and Susan Lenski.
9. "Comprehension: A Paradigm for Cognition" by Walter Kintsch.
10. “Communication Skills for Business Professionals” by J.P Verma and Meenakshi Raman.

EXPOSITORY WRITING

UGE Policy V1.1: General Education Course

Credits: 03
Pre-Requisite: Functional English

DESCRIPTION

Expository Writing is a sequential undergraduate course aimed at refining writing skills in various contexts. Building upon the foundation of the pre-requisite course, Functional English, this course will enhance students' abilities of producing clear, concise and coherent written texts in English. The course will also enable students to dissect intricate ideas, to amalgamate information and to express their views and opinions through well-organized essays. The students will further be able to refine their analytical skills to substantiate their viewpoints using credible sources while adhering to established ethical writing norms. Additionally, the course will highlight the significance of critical thinking enabling students to produce original and engaging written texts.

COURSE LEARNING OUTCOMES

By the end of this course, students will be able to:

1. Understand the essentials of the writing process integrating pre-writing, drafting, editing and proof reading to produce well-structured essays.
2. Demonstrate mastery of diverse expository types to address different purposes and audiences.
3. Uphold ethical practices to maintain originality in expository writing.

COURSE OUTLINE

1. **Introduction to Expository Writing:**
   - Understanding expository writing (definition, types, purpose and applications)
   - Characteristics of effective expository writing (clarity, coherence and organization)
   - Introduction to paragraph writing
2. **The Writing Process:**
   - Pre-writing techniques (brainstorming, free-writing, mind-mapping, listing, questioning and outlining etc.)
   - Drafting (three stage process of drafting techniques)
   - Revising and editing (ensuring correct grammar, clarity, coherence, conciseness etc.)
   - Proof reading (fine-tuning of the draft)
   - Peer review and feedback (providing and receiving critique)
3. **Essay Organization and Structure:**

- Introduction and hook (engaging readers and introducing the topic)
- Thesis statement (crafting a clear and focused central idea)
- Body Paragraphs (topic sentences, supporting evidence and transitional devices)
- Conclusion (types of concluding paragraphs and leaving an impact)
- Ensuring cohesion and coherence (creating seamless connections between paragraphs)

4. **Different Types of Expository Writing:**
   - Description
   - Illustration
   - Classification
   - Cause and effect (exploring causal relationships and outcomes)
   - Process analysis (explaining step-by-step procedures)
   - Comparative analysis (analyzing similarities and differences)
5. **Writing for Specific Purposes and Audiences:**
   - Different types of purposes (to inform, to analyze, to persuade, to entertain etc.)
   - Writing for academic audiences (formality, objectivity, and academic conventions)
   - Writing for public audiences (engaging, informative and persuasive language)
   - Different tones and styles for specific purposes and audiences
6. **Ethical Considerations:**
   - Ensuring original writing (finding credible sources, evaluating information etc.)
   - Proper citation and referencing (APA, MLA, or other citation styles)
   - Integrating quotes and evidences (quoting, paraphrasing, and summarizing)
   - Avoiding plagiarism (ethical considerations and best practices)

PRACTICAL APLICATIONS AND CAPSTONE PROJECT

As part of the overall learning requirements, students will be required to build a writing portfolio having a variety of expository texts and present the same at the end of the course showcasing proficiency in expository writing.

SUGGESTED INSTRUCTIONAL/ READING MATERIALS

1. "The St. Martin's Guide to Writing" by Rise B. Axelrod and Charles R. Cooper.
2. "They Say / I Say: The Moves That Matter in Academic Writing" by Gerald Graff and Cathy Birkenstein.
3. "Writing Analytically" by David Rosenwasser and Jill Stephen.

4. "Style: Lessons in Clarity and Grace" by Joseph M. Williams and Joseph Bizup.
5. "The Elements of Style" by William Strunk Jr. and E.B. White.
6. "Good Reasons with Contemporary Arguments" by Lester Faigley and Jack Selzer.
7. "Writing to Learn: How to Write - and Think - Clearly About Any Subject at All" by William Zinsser.
8. "The Norton Field Guide to Writing" by Richard Bullock, Maureen Daly Goggin, and Francine Weinberg.
9. "The Art of Styling Sentences" by Ann Longknife and K.D. Sullivan.
10. "Writing Today" by Richard Johnson-Sheehan and Charles Paine

IDEOLOGY AND CONSTITUTION OF PAKISTAN

UGE Policy V1.1: General Education Course

Credits: 02
Pre-Requisite: Nil

DESCRIPTION

This course is designed to provide students with a fundamental exploration of the ideology and the constitution of Pakistan. The course focuses on the underlying principles, beliefs, and aspirations that have been instrumental in shaping the creation and development of Pakistan as a sovereign state. Moreover, the course will enable students to understand the core provisions of the Constitution of the Islamic Republic of Pakistan concerning the fundamental rights and responsibilities of Pakistani citizens to enable them function in a socially responsible manner.

COURSE LEARNING OUTCOMES

By the end of this course, students will be able to:

1. Demonstrate enhanced knowledge of the basis of the ideology of Pakistan with special reference to the contributions of the founding fathers of Pakistan.
2. Demonstrate fundamental knowledge about the Constitution of Pakistan 1973 and its evolution with special reference to state structure.
3. Explain about the guiding principles on rights and responsibilities of Pakistani citizens as enshrined in the Constitution of Pakistan 1973.

COURSE OUTLINE

1. **Introduction to the Ideology of Pakistan:**
   - Definition and significance of ideology.
   - Historical context of the creation of Pakistan (with emphasis on socio-political, religious, and cultural dynamics of British India between 1857 till 1947).
   - Contributions of founding fathers of Pakistan in the freedom movement including but not limited to Allama Muhammad Iqbal, Muhammad Ali Jinnah., etc.
   - Contributions of women and students in the freedom movement for separate homeland for Muslims of British India.
2. **Two-Nation Theory:**
   - Evolution of the Two-Nation Theory (Urdu-Hindi controversy, Partition of Bengal, Simla Deputation 1906, Allama Iqbal's Presidential Address 1930, Congress Ministries 1937, Lahore Resolution 1940).
   - Role of communalism and religious differences.

3. **Introduction to the Constitution of Pakistan:**
   - Definition and importance of a constitution.
   - Ideological factors that shaped the Constitution(s) of Pakistan (Objectives Resolution 1949).
   - Overview of constitutional developments in Pakistan.
4. **Constitution and State Structure:**
   - Structure of Government (executive, legislature, and judiciary).
   - Distribution of powers between federal and provincial governments.
   - 18th Amendment and its impact on federalism.
5. **Fundamental Rights, Principles of Policy and Responsibilities:**
   - Overview of fundamental rights guaranteed to citizens by the Constitution of Pakistan 1973 (Articles 8-28).
   - Overview of Principles of Policy (Articles 29-40).
   - Responsibilities of the Pakistani citizens (Article 5).
6. **Constitutional Amendments:**
   - Procedures for amending the Constitution.
   - Notable constitutional amendments and their implications.

SUGGESTED INSTRUCTIONAL/ READING MATERIALS

1. "The Idea of Pakistan" by Stephen P. Cohen.
2. "Ideology of Pakistan" by Javed Iqbal.
3. "The Struggle for Pakistan" by I.H. Qureshi.
4. "Pakistan the Formative Phase" by Khalid Bin Sayeed.
5. "Pakistan: Political Roots and Development" by Safdar Mahmood.
6. "Ideology of Pakistan" by Sharif-ul-Mujahid.
7. "The Struggle for Pakistan: A Muslim Homeland and Global Politics" by Ayesha Jalal.
8. "Jinnah, Pakistan and Islamic Identity: The Search for Saladin" by Akbar S. Ahmed.
9. "The Making of Pakistan: A Study in Nationalism" by K.K. Aziz.
10. "Pakistan: A New History" by Ian Talbot.
11. "Pakistan in the Twentieth Century: A Political History" by Lawrence Ziring.
12. "The Constitution of Pakistan 1973". Original.
13. "Constitutional and Political Development of Pakistan" by Hamid Khan.
14. "The Parliament of Pakistan" by Mahboob Hussain.
15. "Constitutional Development in Pakistan " by G.W. Choudhury.
16. "Constitution-Making in Pakistan: The Dynamics of Political Order" by G.W. Choudhury.

ISLAMIC STUDIES

UGE Policy V1.1: General Education Course

Credits: 02
Pre-Requisite: Nil

DESCRIPTION

This course is designed to provide students with a comprehensive overview of the fundamental aspects of Islam, its beliefs, practices, history and influence on society. It will further familiarize students with a solid foundation in understanding the religion of Islam from an academic and cultural perspective. Through this course, students will have an enhanced understanding of Islam's multifaceted dimensions which will enable them to navigate complex discussions about Islam's historical and contemporary role, fostering empathy, respect, and informed dialogue.

COURSE LEARNING OUTCOMES

By the end of this course, students will be able to:

1. Demonstrate enhanced knowledge of Islamic foundational beliefs, practices, historical development, spiritual values and ethical principles.
2. Describe basic sources of Islamic law and their application in daily life.
3. Identify and discuss contemporary issues within the Muslim world including social challenges, gender roles and interfaith interactions.

COURSE OUTLINE

1. **Introduction to Islam:**
   - Definition of Islam and its core beliefs.
   - The Holy Quran (introduction, revelation and compilation).
   - Hadith and Sunnah (compilation, classification, and significance).
   - Key theological concepts and themes (Tawhid, Prophethood, Akhirah etc.).
2. **Sirah of the Holy Prophet (Peace Be Upon Him) as Uswa-i-Hasana:**
   - Life and legacy of the Holy Prophet PBUH
   - Diverse roles of the Holy Prophet PBUH (as an individual, educator, peace maker, leader etc.)
3. **Islamic History and Civilization:**
   - World before Islam.
   - The Rashidun Caliphate and expansion of Islamic rule.
   - Muslims contributions to philosophy, science, medicine, mathematics, and culture.
4. **Islamic Jurisprudence (Fiqh):**
   - Fundamental sources of Islamic jurisprudence.
   - Pillars of Islam and their significance.

- Major schools of Islamic jurisprudence.
- Significance and principles of Ijtihad.

5. **Family and Society in Islam:**
   - Status and rights of women in Islamic teachings.
   - Marriage, family, and gender roles in Muslim society.
   - Family structure and values in Muslim society.
6. **Islam in the Modern World:**
   - Relevance of Islam in the modern world (globalization, challenges and prospects).
   - Islamophobia, interfaith dialogue, and multiculturalism
   - Islamic responses to social, ethical, and technological changes
7. **Introduction to Islamic Trade and Finance:**
   - Islamic Financing Structures
   - The Stability of Islamic Financial System
   - Financial Engineering
   - Regulation of Islamic Financial Institutions

SUGGESTED INSTRUCTIONAL/READING MATERIALS

1. "The Five Pillars of Islam: A Journey Through the Divine Acts of Worship" by Muhammad Mustafa Al-Azami.
2. "The Five Pillars of Islam: A Framework for Islamic Values and Character Building" by Musharraf Hussain.
3. "Towards Understanding Islam" by Abul A' la Mawdudi.
4. "Islami Nazria e Hayat" by Khurshid Ahmad.
5. "An Introduction to Islamic Theology" by John Renard.
6. "Islamic Civilization Foundations Belief & Principles" by Abul A' la Mawdudi.
7. "Women and Social Justice: An Islamic Paradigm" by Dr. Anis Ahmad.
8. "Islam: Its Meaning and Message" by Khurshid Ahmad.

Note: This course is compulsory for Muslim and optional for non-Muslim undergraduate students. Non-Muslim students can opt for nay course of at least the same or more credits in subjects such as religious studies, ethics, theology, comparative religion, Christian ethics, etc.

*** List of Arts and Humanities Electives (2+0)**

- Communication and Presentation Skills
- Beginners Spanish
- Elementary Arabic
- Elementary French
- Elementary Chinese
- History
- Philosophy
- Professional Ethics

COMMUNICATION AND PRESENTATION SKILLS

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

By the end of the course, students will be able to:

1. Write clearly, concisely, and grammatically correctly in various forms, avoiding errors.
2. Read critically to understand information better and improve vocabulary.
3. Deliver engaging presentations with effective communication and visuals.
4. Adapt communication style to audience and context, demonstrating active listening.

COURSE OUTLINE

Writing Skills

- Vocabulary Building
- Writing Skills: Essays and Letters
- Common Writing Errors
- Purposeful Writing

Reading Skills

- Skimming and Scanning
- Critical Reading
- Reading for Understanding
- Techniques and strategies to develop sound vocabulary.

Listening Skills

- Introduction to Communication Process
- Seven Cs of Communication
- Types of Listening
- Listening for Comprehension

Speaking Skills

- Verbal and Non-Verbal Communication
- Basics of Presentation Skills
- Presentation Strategies and public speaking skills.
- Use of Audio-Visual Aids
- Basics of Group Communication
- Listening Skills

- Communicate effectively in job interviews.

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio,/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Project / Field Visits, Group discussion, Community Service, Report Writing, Social Impact Review and Social Audit of Engineering Project

ASSESSMENT:

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

SUGGESTED INSTRUCTIONAL/ READING MATERIALS

1. Anchor in English-II (Lessons 1-5), A SPELT Publication
2. Christopher Fry, "Summary Writing (Book-I)", Oxford University Press
3. College Essays by John Langlan
4. Barron's TOFFL iBT Edition
5. Communication Skills for Engineers by Sunita Marshal and C.Muralikrishna
6. Writing for Computer science by Justin Zobel Research Methodologies – A step by step guide for beginners, Ranjit Kumar.

BEGINNERS SPANISH

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

By the end of the course, students will be able to:

1. Greet and introduce yourself and others in basic Spanish, stating your profession, nationality, activities, and family members.
2. Comprehend the Spanish alphabet, numbers, telling the time, days of the week, months, and weather descriptions.
3. Describe people, places, your likes and dislikes, using basic vocabulary and simple sentence structures.
4. Communicate in basic Spanish for everyday situations like eating out, shopping, daily activities, and work, in both formal and informal settings.

COURSE OUTLINE:

- Greeting and introducing yourself and others: profession, nationality, activities and family
- the alphabet numbers, telling the time, days of the week, the months, the weather
- describing people and places, likes and dislikes
- Spanish in context: eating out, shopping, daily activities, work formal and informal situations
- describing past events
- expressing opinions.
- Grammatical structures: pronunciation, present tense: regular, irregular and reflexive verbs, personal pronouns, definite and indefinite articles, adjectives and nouns: gender and number, asking a question, demonstrative adjectives and pronoun, prepositions of place, verbs, adverbs of frequency, introduction to the past tense (pretérito indefinido).

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio,/video aids), Written Assignments/ Quizzes, Tutorials, Group discussion, Community Service, Report Writing, Social Impact Review

ASSESSMENT:

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

SUGGESTED INSTRUCTIONAL/ READING MATERIALS

1. Ele Actual A1 by Virgilio Boribio, Publisher: Editorial SM; ISBN: 978-84-675-4741-

ELEMENTARY ARABIC

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

By the end of the course, students will be able to:

1. **Greet** and introduce yourself and others in basic Arabic, utilizing both formal and informal forms of address.
2. **Formulate** basic questions in Arabic using proper structure to inquire about everyday topics.
3. **Describe** yourself and others using relevant vocabulary and adhering to singular and plural noun/adjective formation and gender agreements.
4. **Construct** grammatically correct sentences in the present tense, incorporating conjugated verbs, definite and indefinite articles, and possessive adjectives.

COURSE OUTLINE:

Vocabulary

- Greetings and introductions
- Formal and informal address
- Question formation for asking basic questions
- Speaking about yourself and others
- Arabic numbers
- Everyday life vocabulary

Grammar

- Conjugating verbs in the present tense
- Formation of singular and plural nouns and adjectives
- Feminine and Masculine Forms
- Definite and indefinite articles
- Possessive adjectives (feminine and masculine)
- Adjectives and adjective agreements
- Sentence structure

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio,/video aids), Written Assignments/ Quizzes, Tutorials, Group discussion, Community Service, Report Writing, Social Impact Review.

ASSESSMENT:

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

SUGGESTED INSTRUCTIONAL/ READING MATERIALS
1. Al-Kitaab fii TaCallum al-Arabyya: A Textbook for Beginning Arabic (Part 1), 3rd Edition, Brustad, Al-Batal, AlTonsi, Georgetown University Press, 2011. ISBN: 978-1-58901-736-8

ELEMENTARY FRENCH

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

By the end of the course, students will be able to:

1. **Engage** in basic social interactions using greetings, numbers, and calendar expressions.
2. **Express** likes and dislikes on various topics, including weekend and school activities.
3. **Describe** aspects of your family, home, shopping experiences, and food preferences through basic vocabulary.
4. **Formulate** grammatically correct sentences in the present tense using regular and irregular verbs, subject pronouns, possessive adjectives, and the verbs "aller" and "venir" to express the future and immediate past.

COURSE OUTLINE

- Social greetings, Number, Calendar and time, expressing likes and dislikes, Talking about weekend and school activities, Family and the home, Shopping, Food
- Grammatical structures:
  - Subject pronouns and the verb être
  - Present tense regular –er verbs
  - Agreement and placement of adjectives
  - The verb aller and its use in expressing the future
  - The verb venir and the immediate past
  - Possessive adjectives
  - Present tense irregular verbs
  - Interrogative pronouns qui and que
  - Partitive article

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio,/video aids), Written Assignments/ Quizzes, Tutorials, Group discussion, Community Service, Report Writing, Social Impact Review

ASSESSMENT:

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

SUGGESTED INSTRUCTIONAL/ READING MATERIALS

1. Débuts. Siskin, Williams-Gascon, Field. McGraw-Hill

ELEMENTARY CHINESE

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

By the end of the course, students will be able to:

1. **Utilize** Hanyu Pinyin to accurately sound and read Chinese characters, mastering standard pronunciation.
2. **Recognize** and write approximately 260 basic Chinese characters, applying them in simple communication.
3. **Construct** grammatically correct sentences by understanding fundamental word order and the usage of particles in Chinese.
4. **Formulate** different types of questions to effectively seek information in daily situations.

COURSE OUTLINE:

- Use Hànyǔ Pīnyīn to speak and read with standard Chinese pronunciation.
- Read and write about 260 Chinese characters.
- Understand the basic word order of Chinese sentences and the use of particles.
- Use different types of questions.
- Identify people and things
- Use time expressions and numbers.
- Use adjectives to describe people and things.
- Express possession and existence
- Express wishes, obligations, capabilities, possibilities and permissions.
- State likes and dislikes.
- Explain where something is located.
- Describe how an action is performed.

SUGGESTED TEACHING METHODS:

Lectures (audio,/video aids), Written Assignments/ Quizzes, Tutorials, Group discussion, Community Service, Report Writing, Social Impact Review

ASSESSMENT:

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

SUGGESTED INSTRUCTIONAL/ READING MATERIALS

1. Kung Fu (I): An Elementary Chinese Text. By John C. Jamieson and Lin Tao. Hong Kong:Chinese University Press, 2002

HISTORY

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

By the end of the course, students will be able to:

1. Define the concept of history, distinguishing its key characteristics and recognizing its evolving nature.
2. Describe the intricate relationship between memory, historical records, and the construction of history, critically examining their interconnected roles.
3. Evaluate the nature of historical inquiry, including its methods, limitations, and potential biases.
4. Explain the epistemological nature of history, including its methods of knowledge production and the challenges it faces.
5. Identify and categorize different forms of historical narratives based on their focus, methodology, and purpose.

COURSE OUTLINE:

- What is History?
- Memory, Record and History
- Nature of History:
- Utility, Benefits & importance of History:
- Epistemological nature of History:
- Forms and Classification of History

ASSESSMENT:

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

SUGGESTED INSTRUCTIONAL/ READING MATERIALS

1. Burke, Varieties of Cultural History, Cornell University Press, 1977
2. Carlo, Ginzburg. Clues. Myths, and the Historical Method, John Hopkins: University Press, 1992
3. Carr, E. H., What is History? Harmondsworth: Penguin, 1961
4. Cohn, Bernard. An Anthropologist among Historians and Other Essay, Oxford University Press, 1988
5. Collingwood, R. G. The Idea of History. Oxford: Oxford University Press, 1978.
6. Daniels, Studying History: How and Why, New Jersey, 1981.

7. Gertrude Himmalfarb. The New History and the Old, Cambridge: Harvard University Press, 1987
8. Govranski. History Meaning and Methods, USA, 1969
9. Hegel. Elements of the Philosophy of Right. Cambridge University Press, 1991

PHILOSOPHY

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

By the end of the course, students will be able to:

1. Examine the fundamental nature of philosophy, exploring its scope, purpose, and relevance to the engineering discipline.
2. Apply principles of arguments and logic in the context of philosophical analysis, developing the ability to construct and evaluate logical reasoning.
3. Examine different perspectives on knowledge within epistemology, relating these perspectives to engineering practices and the development of technological solutions.
4. Analyze the concept of induction, exploring its role in reasoning and its applications in the engineering field.
5. Compare and contrast the philosophical perspectives of rationalism and empiricism, considering their implications for the understanding of engineering phenomena.

COURSE OUTLINE

- Introduction: The Nature of Philosophy
- Arguments and Logic in Philosophy
- Epistemology – Skepticism and Certainty
- Epistemology: The Scope and Limits of Knowledge
- Epistemology: Knowledge
- Induction
- Rationalism and Empiricism
- Philosophy and Meaning

ASSESSMENT:

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

SUGGESTED INSTRUCTIONAL/ READING MATERIALS

1. Hales, S. D. (2021). This is philosophy: An introduction. John Wiley & Sons.

2. Hospers, J. (2013). An introduction to philosophical analysis. Routledge.
3. Hurley, P. J. (2014). A concise introduction to logic. Cengage Learning.
4. Rachels, J., & Rachels, S. (1986). The elements of moral philosophy (p. 9). Philadelphia: Temple University Press.
5. Solomon, R. C., & Higgins, K. M. (2013). The big questions: A short introduction to philosophy. Cengage Learning.
6. Stewart, D. (2010). Fundamentals of Philosophy. 6th. Boston: Pearson

PROFESSIONAL ETHICS

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

By the end of the course, students will be able to:

1. Define key terms: profession, ethics, and their relation to law/morality.
2. Analyze ethical frameworks and their application in engineering. Identify desirable personality traits for ethical behaviour.
3. Explain ethical livelihood in engineering, including halal earning.
4. Describe professional ethics in engineering societies and codes of conduct.
5. Apply critical thinking and problem-solving in ethical situations.

COURSE OUTLINE:

- Profession; What is a Profession? and Professional Ethics.
- Ethics; What is Ethics?, Why study Ethics?, Professional Ethics, Difference between Laws, morals, and Ethics: Character Ethics, Personality Ethics, Value &Virtue Ethics, and Characteristics of Code of Ethics
- Personality Traits, Desirable Personality Traits and Undesirable Personality Traits, Trust and Honesty, Sincerity, Truthfulness, Politeness, Respect & Etiquettes,
- Human values, values, morals and ethics, Moral Code of Islam, Struggle for Rizq e Halaal. To identify and adopt the legitimate, lawful and ethical sources of earning / livelihood.
- Moral development, moral dilemma, dealing with moral dilemma, moral autonomy, Fulfilment of Promise, Pride and Arrogance, Malpractice, Engineer's moral rights, right of professional conscience, professional rights and Ethical theories, intellectual property rights, patents, design, trademark etc.
- Professional ethics, role of professional bodies, Engineering code of ethics, Engineering ethics, training in preventive ethics, questionable engineering practices, Micro and Macro ethics, examples of moral problems in engineering. Time management, Cooperation

- Inter-Personal Relations (Employer-Employee relationship), employee rights, professionalism and loyalty, right to protest, obligation of confidentiality, effect of change of job on confidentiality, conflict of interest. Grievances, Welfare, health & safety of personnel, whistleblowing and its features, types, procedures to be followed and conditions to be satisfied before whistle blowing
- Problem-Solving, Decision-Making, Engineers responsibilities towards society welfare, environment degradation, bio-centric ethics, Ecocentric ethics, Human centered environmental ethics, Global examples of catastrophic engineering incidents. Safety, responsibilities and rights; safety and risks, responsible engineering, cost of unsafe designed product, Moral thinking, tests in moral problems solving, problem solving in engineering ethics, case studies.

ASSESSMENT:

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

SUGGESTED INSTRUCTIONAL/ READING MATERIALS

1. Engineering Ethics: Concepts and Cases by Charles E. Harris Jr, 2018, 6th Ed., Cengage Learning, ISBN:978-1337554503
2. Ethics in Engineering by Mike Martin, 2022, 5th Ed., McGraw Hill, ISBN: 9781260721744
3. Attributes of Muslim Professionals in the Light of Quran & Sunnah by Akram Muhammad Zeki, 2021, Ilum Press, ISBN: 9789674911201

CIVICS AND COMMUNITY ENGAGEMENT

UGE Policy V1.1: General Education Course

Credits: 02
Pre-Requisite: Nil

DESCRIPTION

This course is designed to provide students with fundamental knowledge about civics, citizenship, and community engagement. In this course, the students will learn about the essentials of civil society, government, civic responsibilities, inclusivity, and effective ways to participate in shaping the society which will help them apply theoretical knowledge to the real-world situations to make a positive impact on their communities.

COURSE LEARNING OUTCOMES

By the end of this course, students will be able to:

1. Demonstrate fundamental understanding of civics, government, citizenship and civil society.
2. Understand the concept of community and recognize the significance of community engagement for individuals and groups.
3. Recognize the importance of diversity and inclusivity for societal harmony and peaceful co-existence.

COURSE OUTLINE

1. **Introduction to Civics and Citizenship**
   - Definition of civics, citizenship, and civic engagement
   - Historical evolution of civic participation
   - Types of citizenship: active, participatory, digital etc.
   - The relationships between democracy and citizenship
2. **Civics and Citizenship**
   - Concepts of civics, citizenship, and civic engagement.
   - Foundations of modern society and citizenship.
   - Types of citizenship: active, participatory, digital, etc.
3. **State, Government and Civil Society**
   - Structure and functions of government in Pakistan.
   - The relationship between democracy and civil society.
   - Right to vote and importance of political participation and representation.

4. **Rights and Responsibilities**
   - Overview of fundamental rights and liberties of citizens under Constitution of Pakistan 1973.
   - Civic responsibilities and duties.
   - Ethical considerations in civic engagement (accountability, non-violence, peaceful dialogue, civility, etc.)
5. **Community Engagement**
   - Concept, nature and characteristics of community.
   - Community development and social cohesion.
   - Approaches to effective community engagement.
   - Case studies of successful community driven initiatives.
6. **Advocacy and Activism**
   - Public discourse and public opinion.
   - Role of advocacy in addressing social issues.
   - Social action movements.
7. **Digital Citizenship and Technology**
   - The use of digital platforms for civic engagement.
   - Cyber ethics and responsible use of social media.
   - Digital divides and disparities (access, usage, socioeconomic, geographic, etc.) and their impacts on citizenship.
8. **Diversity, Inclusion and Social Justice:**
   - Understanding diversity in society (ethnic, cultural, economic, political etc.).
   - Youth, women and minorities' engagement in social development.
   - Addressing social inequalities and injustices in Pakistan.
   - Promoting inclusive citizenship and equal rights for societal harmony and peaceful co-existence.

SUGGESTED PRACTICAL ACTIVITIES (OPTIONAL)

As part of the overall learning requirements, the course may have one or a combination of the following practical activities:

1. **Community Storytelling:** Students can collect and share stories from community members. This could be done through oral histories, interviews, or multimedia presentations that capture the lived experiences and perspectives of diverse individuals.
2. **Community Event Planning:** Students can organize a community event or workshop that addresses a specific issue or fosters community interaction. This could be a health fair, environmental cleanup, cultural festival, or educational workshop.
3. **Service-Learning:** Students can collaborate with a local nonprofit organization or community group. They can actively contribute by volunteering their time and skills to address a particular community

need, such as tutoring, mentoring, or supporting vulnerable populations.

4. **Cultural Exchange Activities:** Students can organize a cultural exchange event that celebrates the diversity within the community. This could include food tastings, performances, and presentations that promote cross-cultural understanding.

SUGGESTED INSTRUCTIONAL/ READING MATERIALS

1. "Civics Today: Citizenship, Economics, & You" by McGraw-Hill Education.
2. "Citizenship in Diverse Societies" by Will Kymlicka and Wayne Norman.
3. "Engaging Youth in Civic Life" by James Youniss and Peter Levine.
4. "Digital Citizenship in Action: Empowering Students to Engage in Online Communities" by Kristen Mattson.
5. "Globalization and Citizenship: In the Pursuit of a Cosmopolitan Education" by Graham Pike and David Selby.
6. "Community Engagement: Principles, Strategies, and Practices" by Becky J. Feldpausch and Susan M. Omilian.
7. "Creating Social Change: A Blueprint for a Better World" by Matthew Clarke and Marie-Monique Steckel

List of Social Science Electives (2+0)

- Sociology for Engineers
- Sociology
- Social phycology
- Critical Thinking
- Human Resource Management
- Organizational Behavior
- Engineering Law
- Engineering Economics
- Applied Psychology
- Engineering Management
- Financial Management
- Marketing Management
- Leadership and Personal Grooming
- Any other relevant course decided by the HEI as per requirement.

SOCIOLOGY FOR ENGINEERS

Credits: 02
Pre-Requisite: Nil

DESCRIPTION

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

COURSE LEARNING OUTCOMES

By the end of this course, students will be able to:

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

COURSE CONTENT

- **Fundamental Concepts and Importance of Sociology for Engineers**

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

- **Cultural Impacts of Engineering Projects on Society**

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

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

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

Community Development in Engineering Context.

- **Understanding of Societal & Ethical Norms and Values for Engineers**

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

- **Organizational Social Responsibility (OSR) of Engineers**
  - Extent to which development intends to sensitize societal and under privileged needs
  - Gender inclusiveness and balance
  - Special and Disadvantaged Community of the Area o Planning for community inclusiveness
  - Societal Obligation of Engineers
- **Engineers, Society and Sustainability**

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

- **Industrial & Organizational Psychology**

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

- **Climate Change and Ecological Friendliness from Engineering Perspective**

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

- **Social Approaches and Methodologies for Development Administration & Stakeholders Analysis:**

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

- **Case Studies of Different Development Projects in Social Context**
- **SIA (Social Impact Assessment):**

Base line and need-assessment, evaluation and impact assessment surveys of the development projects. Role of Engg & Technology for Creating

Social Cohesiveness & Societal Integration. Technology Based change in Collective Behavior, Social Audit of Engineering Projects.

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

SUGGESTED TEACHING METHODS:

Suggested Teaching Methods
Lectures (audio/video aids), Written Assignments/ Quizzes, ,Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Project/Field Visits, Group discussion, Community Service, Report Writing, Social Impact Review and Social Audit of Engg Project

ASSESSMENT

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

SUGGESTED INSTRUCTIONAL/READING MATERIALS

1. Godhade, J. B., and S.T. Hunderkari. 2018. Social Responsibility of Engineers. International Journal of Academic Research and Development. Vol. 03; Special Issue. March, 2018.
2. Nichols,S.P.andWeldon,W.F.2017. Professional Responsibility: The Role of Engineering in Society Center for Electro-mechanics, The University of Texas at Austin, USA.
3. Aslaksen,E.W.2016. The Relationship between Engineers and Society: is it currently fulfilling its potential? Journal and Proceedings of the Royal Society of New SouthWales,Vol.148.Nos.455-456. Gumbooya Pty Ltc, Allambie Heights, Australia.
4. Bell, S. Engineers, Society and Sustainability. Synthesis Lectures on Engineers, Technology, and Society. Edited by Caroline Baillie, University of Western Australia. Morgan and Claypool Publishers
5. Jamison,A.,Christensen,S.H.,andLars,B.2011.A Hybrid Imagination: Science and Technology in cultural perspective
6. Vermaas,P.,Kroes,P.,Poet,l.,andHoukes,W.2011.APhilosophyofTechnolog y:FromTechnical Artefacts to Socio technical systems.
7. Mitcham,C.,andMunoz,D.2010.HumanitarianEngineering.MorganandCla ypoolPublishers. Riley,D.2008.Engineering and Social Justice. Morgan and Claypool Publishers. •
8. Bugliarello,G.1991.TheSocial Functions of Engineering: A Current Assessment, A Chapter in" Engineering as A Social Enterprise. Sociology

SOCIOLOGY

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

1. To introduce the necessary subject knowledge and understanding required for the successful study of Sociology and related Social Science disciplines at undergraduate.
2. To develop skills of application, analysis and evaluation in the context of the study of Social Science.
3. To develop a knowledge and understanding of sociology both at a global and national level.
4. To introduce the planning and organization skills necessary to develop as independent, autonomous learners.
5. To develop the confidence and competence of the students as learners and to assist them in taking some responsibility for their own learning through directed study and reading.

COURSE CONTENT

- Introduction: Sociological Perspective,
- The Development of Sociology,
- The Role of Values in Sociology, Prejudice In Early Sociology,
- Theoretical Perspective in Sociology. Culture: Components of Symbolic Culture, Subcultures and Counter Cultures, Cultural Universals, Animals and Culture,
- Technology and Global Village, Sociology and New Technology.
- Socialization: Social Development of Self, Mind, and Emotions,
- Socialization into Gender Social Structure and Interaction,
- Social Institutions. Research in Sociology: Research Model, Research Methods. Experiments, Ethics,
- Bureaucracy and Formal Organizations, Rationalization of Society, Formal Organizations and Bureaucracy,
- Voluntary Associations Social Classes, Economy, Politics, Power and Authority, Family, Medicine, Health and Illness, Population and Urbanization, Social Movements
- Social Psychology with special reference to attitudes, attributions and behavior, Emotions, Cognition and Thinking, Reasoning, Problem-Solving and Creativity, Personality, Intelligence, and Abnormal Behavior, etc.
- Introduction to the Field of Organizational Behaviour
- Conflict and Negotiation in the Workplace

- Leadership in Organizational Settings and Organizational Culture
- Ethics: In General an introduction and the development of ethical theory.
- Ethics in Islam, a comprehensive view with different ethics approaches and Ethics Theories
- Research Methods for Society and Sociology

SUGGESTED TEACHING METHODS:

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

ASSESSMENT

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

SUGGESTED INSTRUCTIONAL/READING MATERIALS

1. Henslin, Sociology: A Down-to-Earth Approach, latest edition.
2. D. Kendall, Sociology in our Times. Wadsworth Pub Co, latest edition.

SOCIAL PSYCHOLOGY

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

To impart knowledge of social psychology of attraction; attitudes and prejudice; altruism and aggression; personal and social identities; conformity; group influence and their applications in the real world

COURSE CONTENT

- Principles of sociology and psychology with emphasis on the individual and his/her reciprocal interaction with groups,
- basic psychological factors, attribution and perception of others, attitudes and attitudinal change, social attitudes, altruism, helping others, aggression, hurting others, prejudice, disliking others, discrimination and stereotypes,
- language and communication, society and cultures, culture and personality, small groups and their relation to the individual, leadership and group dynamics. Attraction, attitudes and prejudice; altruism and aggression; personal and social identities, conformity, group influence, moral and ethical issues, harassment,
- corruption and its control, thinking processes and decision making.

SUGGESTED TEACHING METHODS:

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

ASSESSMENT

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

SUGGESTED INSTRUCTIONAL/READING MATERIALS

1. Edward Alsworth Ross, “Social Psychology”, Macmillan, latest edition.
2. Emory Stephen Bogardus, “Essentials of Social Psychology”, Univ. of Southern, California Press, latest edition.
3. Hewstone, M., & Stroebe, W. (Eds.), “Introduction to Social Psychology”, 3rd ed., Oxford: Blackwell Publishers, latest edition.
4. Lesko, W.A. “Readings in social psychology General, classic, and contemporary selections, latest edition,

CRITICAL THINKING

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

At the end of the course, the students will be able to:

1. Define critical thinking and identify its benefits in the workplace.
2. List the characteristics of a critical thinker and distinguish them from other types of thinking.
3. Explain the importance of asking questions, actively listening, and challenging assumptions.
4. Describe common creative thinking techniques like brainstorming, mind mapping, and De Bono's thinking hats. List and explain root cause analysis techniques like the 5 Whys and Ishikawa Diagram.
5. Describe strategies for effectively presenting recommendations to decision-makers and stakeholders.

COURSE CONTENT/COURSE OUTLINE

Course Overview

- Introduction
- Introduction to Critical Thinking
- Benefits of critical thinking in the workplace
- Critical thinking as a management skill
- What are the characteristics of a critical thinker?
- Other Types of Thinking
- 5 Different thinking styles
- Module Reflection
- A Critical Thinker's Mindset
- Can you develop a critical thinker's mindset?
- The Critical Thinking Process
- Step 1 - Identifying the problem
- Step 2 - Gather and evaluate your information
- Step 3 - Generate alternative solutions
- Step 4 - Select and implement a solution
- Step 5 - Evaluate your solution
- Developing Critical Thinking Skills
- Asking questions
- Active listening

- Challenging assumptions
- Creative Thinking Techniques
- Brainstorming
- Imagining the opposite
- Mind mapping
- De Bono's thinking hats
- Root Cause Analysis Techniques
- Identifying the cause of a problem
- Ishikawa Diagram (Fishbone Diagram)
- 5 Whys technique
- SWOT analysis
- Using Your REACH Profile to Support Critical Thinking
- Adapting your profile
- Presenting Your Recommendations
- Seeking approval from decision makers and Stakeholders

ASSESSMENT

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

SUGGESTED INSTRUCTIONAL/READING MATERIALS

1. Critical Thinking for Students Roy van den Brink-Budgen (4th Edition)
2. Thinking, Fast and Slow Daniel Kahneman (2011)

HUMAN RESOURCE MANAGEMENT

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

At the conclusion of the course, the students will be able to:

1. Understand key challenges and trends in Human Resource Management (HRM).Compare and contrast global and local HRM practices.
2. Explain basic principles of HRM from Islamic and indigenous perspectives.
3. Apply job analysis techniques, including HR planning, job description, and specification.
4. Differentiate between compensation and benefit packages and their management.
5. Explain staffing strategies, covering recruitment techniques, sources, and selection tests.

COURSE CONTENT/COURSE OUTLINE

- Emerging Human resource management challenges.
- Trends in HRM
- Global vs local HRM practices
- HRM from Islamic and indigenous perspective
- Basic Islamic philosophy of managing human resource
- Conducting Job analysis.
- HR Planning
- Job Description
- Job Specification
- Staffing
- Recruiting and selecting employees
- Recruitment techniques
- Sources of recruitment
- Selection tests and Interviewing techniques
- Employee development
- Performance appraisals
- Performance management
- Training and development
- Training the employees
- Types of training
- Technique of training
- Project Description and discussion

- Compensations
- Managing compensation
- Types of compensation
- Rewarding performance
- Pay for Performance
- Designing and administering benefits
- Types of benefits
- Employee relations

ASSESSMENT

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

SUGGESTED INSTRUCTIONAL/READING MATERIALS

1. By Luis R. Gomez Mejia, David B. Balkin, Robert L. Cardy Managing Human Resources. (Fourth ed.)

ORGANIZATIONAL BEHAVIOUR

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

At the conclusion of the course, the students will be able to:

1. Explain the role of individual characteristics, abilities, and learning in organizational behavior.
2. Understand organizational behavior principles from Islamic and indigenous perspectives. Analyze human psychology through the lens of Quran and Sunnah.
3. Identify and classify different attitudes and behaviors in the workplace.
4. Recognize the importance of perception and its role in individual decision-making.
5. Apply motivation concepts, both content and process theories, and use them to design effective reward systems.

COURSE CONTENT/COURSE OUTLINE

- Foundations of Individual Behaviour:
- Biographical Characteristics, Ability, Learning
- Organizational behaviour from Islamic and indigenous perspective
- Understanding human psychology through the lenses of Quran and Sunnah
- Attitudes and Job Satisfaction
- Types of attitudes
- Types of behaviours
- Perception and Individual Decision Making
- Why perception is important
- Types of decision making
- Biases and errors in decision making
- Motivation concept
- Content theories of Motivational
- Process theories of motivation
- Motivation: from concept to application
- Applying motivation concepts for designing reward system

ASSESSMENT

Quizzes, Assignments, Mid Exam, Final Exam

SUGGESTED INSTRUCTIONAL/READING MATERIALS

1. Robbins, P. S., & Judge, T. A. (2009). Organizational Behaviour. 13th ed.

ENGINEERING LAW

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

At the conclusion of the course, the students will be able to:

1. Define key terms: legal studies, law, sources of law.
2. Comprehend the fundamental principles of contract law as they relate to engineers.
3. Recognize the duty of care for engineers and grasp the concept of negligence in engineering. Gain insight into aspects of employment law relevant to engineers.
4. Understand intellectual property concepts, including designs, patents, copyright, and their application in engineering.
5. Learn how to enforce rights to intellectual property in the context of engineering.

COURSE CONTENT/COURSE OUTLINE

- Introduction to legal studies,
- Concepts and sources of law,
- Basic principles of the law contract as it relates to engineers,
- The duty of care for engineers and the concept of negligence,
- Aspects of employment law;
- Intellectual property,
- Designs, patents,
- Copyright in engineering,
- Enforcing rights to intellectual property.

ASSESSMENT

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

SUGGESTED INSTRUCTIONAL/READING MATERIALS

1. R E laidlaw, C R Young, A R Dick, Engineering Law, University Press, 1958.
2. C F Allen, Business law for engineers, University of Michigan library, 1919.

ENGINEERING ECONOMICS

Credits: 02
Pre-Requisite: Nil

COURSE LEARNING OUTCOMES

At the conclusion of the course, the students will be able to:

1. Apply economic principles to analyze engineering projects.
2. Utilize cost analysis methods to evaluate project feasibility and make decisions.
3. Manage risks and uncertainties in engineering economic assessments.
4. Consider economic factors such as inflation and taxation in decision making.
5. Integrate ethical and sustainable considerations into economic analyses.

COURSE CONTENT/COURSE OUTLINE

1. **Introduction**
   - Engineering Costs
   - Estimation Models & Cash Flow Diagram
   - Life cycle cost

2. **Time value of Money**
   - Time value of money, equivalence, use of spread sheet, simple and compound interest
   - Uniform series & Arithmetic & geometric gradient
   - Nominal & effective, continuous compounding Economic criteria,
   - Present Worth, future worth and annuity

3. **Rate of Return**
   - Minimum acceptable rate of return(MARR),
   - Internal rate of return, External rate of return
   - Choosing the best alternative
   - Incremental Analysis

4. **Benefits and Cost ratio and Payback period**
   - Benefit and cost ratio (B/C Ratio), discounted benefit and cost ratio
   - Simple payback period, discounted payback period
   - Sensitivity & breakeven analysis
   - Principle of comparative advantage

5. **Depreciation**
   - Depreciation

- Depreciation using Unit of Production
- Depreciation using straight line method
- Depreciation using Depletion

6. **Taxes**
   - Income Taxes, After tax RoR
   - Replacement analysis
   - Design life, salvage value
   - Up gradation Vs replacement

7. **Risk and Uncertainty**
   - Estimation of future events
   - Monte Carlo Simulation
   - Bayes theorem

8. **Concepts of Imports and Exports**
   - Basic concepts of import and export
   - Dumping and anti-dumping and related laws

9. **Teaching Methodology**
   - Lecturing
   - Written Assignments
   - Presentation

ASSESSMENT

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

SUGGESTED INSTRUCTIONAL/READING MATERIALS

1. William G. Sullivan and Elin M. Wicks, Estimation of future events
2. N. M. Fraser and E. M. Jewkes, Engineering Economics: Financial Decision Making for Engineers
3. D. G. Newnan, J. Whittaker, T. G. Eschenbach and J. P. Lavelle, Engineering Economic Analysis
4. J. Tarquin, L. T. Blank, Engineering Economy, McGraw Hill

APPLIED PSYCHOLOGY

Credit Hours: 2
Pre-Requisites: Nil

COURSE OUTLINE

Understanding Psychology

- Psychology: Scientific perspective
- Historical perspective
- Schools of psychology
- Methods of psychology
- Ethical issues
- Fields of psychology and their application

Biological Basis of Behavior

- Neuron and its function
- Central nervous system
- Peripheral nervous system
- Endocrine system

Sensation and Perception

- Senses: Vision, audition, smell, taste and kinesthetic
- Introduction to perception
- Gestalt principles
- Binocular and monocular cues
- Illusions and extra sensory perception

Learning

- Definition of learning
- Types of learning: Classical and operant conditioning
- Punishment and its effects
- Latent and observational learning

Memory

- Definition and types of memory
- Processes and techniques of improving memory
- Forgetting: Nature and causes

Cognition and Language

- Concept of cognition
- Problem solving
- Judgment and decision making
- Language development
- Language and cognition

- Language and culture

Intelligence and Creativity

- Concept of intelligence
- Theories of intelligence
- Assessment of intelligence
- Mental retardation
- Concept of creativity and its stages

Motivation and Emotion

- Introduction to motivation
- Factors affecting motivation
- Introduction to emotions
- Types of emotions
- Physiology and emotion
- Theories of emotion

Personality

- Defining personality
- Theories of personality
- Personality assessment

Social Thinking and Social Influence

- Social facilitation
- Attribution theory
- Crowd behavior
- Conformity, Obedience
- Helping behavior

SUGGESTED TEACHING AND ASSESSMENT METHODS

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

Assessment:

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

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Atkinson R. C., & Smith, E. E. (2000).Introduction to psychology (13th ed.). NY: Harcourt
2. Brace College Publishers.
3. Coon, D., &Mutterer, J. (2008).Introduction to psychology: Gateways to mind and behavior
4. (12th ed.). USA: Wadsworth Cengage Learning.

5. Fernald, L. D., & Fernald, P.S (2005).Introduction to psychology. USA; WMC Brown Publishers

ENGINEERING MANAGEMENT

Credit Hours: 2+0
Pre-Requisites: Nil

DESCRIPTION

This course delves into the multifaceted aspects of technology commercialization, offering a comprehensive exploration of industrial networks, product and process development, and the critical skills required for successful business ventures. Participants will gain practical knowledge and experience in navigating the journey from concept to market, with a focus on problem-solving, teamwork, and outreach activities.

COURSE LEARNING OUTCOMES

Upon completion, participants will possess the skills and knowledge necessary for successfully commercializing new technological inventions. They will be adept at navigating the various stages, from proof of concept to market distribution, and equipped to develop robust business plans aligned with market demands and technological advancements.

COURSE OUTLINE

- Industrial networks
- Fundamentals of Product and Process development
- Business Community and New Generations of Managers
- Practical Skills Knowledge and Experience in Commercialization of New Technological Inventions
- Use of Multidisciplinary Science Based Knowledge,
- Problem Solving, Teamwork and Outreach Activity,
- Major steps in proof of concept to intellectual property protection,
- Prototype development
- Fabrication and assembly routes
- Materials procurement,
- Identification and creation of new markets
- Development of business plan
- Appropriate technology and marketing
- Distribution and financing
- Routes and strategies for specific technology under development.

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. R. A. Bulgelman, Strategic Management of Technology and innovation, latest Edition McGraw Hill.

FINANCIAL MANAGEMENT

Credit Hours: 2
Pre-Requisites: Nil

COURSE OUTLINE

Risk and return (Required rate)

- Risk and Return Fundamentals: Definition, and Meanings; Basic Model; Risk Preference, Risk Preferences Behaviors; Risk of a Single Asset: (1) Risk Assessment including Scenario Analysis and Probability Distribution and (2) Risk Measurement including Standard Deviation and Coefficient of Variation; Risk of a Portfolio: Portfolio Return and Standard Deviation, Correlation, Diversification; The Capital Asset Pricing Model (CAPM): (1) Types of risk and (2) The CAPM Model covering Beta Coefficient, The Equation, The Graph, The security Market Line (SML) and Shifts in the security Market Line

Short-term Financing Decisions (Current Assets and Current Liabilities)

- Current Asset Investment Policies
- Working Capital Management
- Working Capital Terminologies: Gross VS Net; Trade-off between Profitability and Risk

Cash Operating / Conversion Cycle

- Calculating Cash Conversion Cycle; Funding Requirement of the Cash Conversion Cycle; Cash Management Alternative Strategies; Cash Budget

Management of Marketable Securities

- Inventory Management
- Inventory Levels and Costs; Common Techniques for managing Inventory

Receivables Management

- Credit Selection and Standards; Credit Terms and Policy; Credit Monitoring

Management of Receipts and Disbursements

- Float; Speeding-up Receipts and Slowing-down Payments; Cash Concentration; Zero-balance Accounts

Generic Current Assets' Management

- Financing Current Assets; Alternative Current Asset Financing Policies; Advantages and disadvantages of Short Term Financing

Management of Current Liabilities

- Sources of Short Term Financing; Spontaneous Liabilities; Accounts Payable Management; Accruals; Unsecured Sources of Short Term

Financing; Bank Loans; Commercial Papers; Secured Sources of Short Term Financing; Accounts Receivables as Collaterals; Inventory as Collateral

Leverage and Capital Structure

- Leverage; Meanings and Use of Leverage; Breakeven Analysis; Operating Leverage; Financing Leverage; Capital Structure; Types/Dimensions of Capital; External Assessment of Capital Structure; Theory of Capital Structure; Target/Optimal Capital Structure, and its Determination; EBIT – EPS Approaches to Capital Structure; Variations in Capital Structures; Comparing Alternative Capital Structures; Capital Structure and Risk; Value Estimation; Maximizing Value VS Maximizing EPS

Payout Policy

- Mechanics of Payout Policy; Factors affecting Dividend Policy; Classification of Dividend Policies (General and w.r.t. Pakistan)

Long-term Debt Management

- Long-term Debt Considerations; Corporate Bonds; Preferred Stock; Leases; Mergers of Definition of Mergers; Convertible Securities; Options of Major Types of Options

SUGGESTED TEACHING AND ASSESSMENT METHODS

Teaching Methodology (Proposed as applicable):

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

Assessment:

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

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Brigham F Eugene, Houston F Joel (Latest edition), Fundamentals of Financial Management, South Western Publishers, Ohio
2. Lawrence J. Gitman, Latest Edition, 'Principles of Managerial Finance'
3. Horne Van, Jr. Wackowicz (Latest Edition), Fundamentals of Financial Management,
4. Apprentice Hall International Inc, New Jersey

MARKETING MANAGEMENT

Credit Hours: 2+0
Pre-Requisites: Nil

COURSE OUTLINE

- Defining Marketing For The 21st Century. Importance and scope of Marketing.
- Discussion on Course Outline:
- Some fundamental Marketing Concepts, How Marketing Management changed. How does the Marketing affect customer Value? Discussion on Project Outline
- Identifying Market Segments and Targets. Different levels of market segmentation & requirements of effective segmentation? How companies divide a market into segments?
- Creating and delivering Customer Value, satisfaction and loyalty. What is the lifetime value of customers and how can marketers maximize it? How can companies cultivate strong customer relationship? How can companies both attract and retain customers?
- Analyzing Consumer Markets & Globalization How do consumer characteristics influence buying behavior & major psychological processes influence consumer Reponses to the marketing program?
- Crafting the Brand Positioning How can a firm choose and communicate an effective positioning in the market & how brands are differentiated.
- Creating Brand Equity Neuro Marketing How brands create brand Equity
- Setting Product Strategy Product characteristics & classification How companies differentiate products?
- How should a company set prices initially for products or services? When should company initiate a price change? How should a company respond to a competitor's price change?
- Designing and Managing Value Networks and Channels. The students need to recognize the importance of designing marketing channel system
- Managing Retailing, Wholesaling Why companies choose different marketing channels and how these marketing channels perform?
- Designing & Managing Integrated Marketing Communications Role of Marketing Communication. What are the guidelines for effective marketing communication mix?
- Managing Mass Communications: What steps are required in developing an advertising program? How should sales promotion decisions be made?

What are the guidelines for effective brand-building events and experiences?

- Sales Promotions, Events Public Relations. Service Marketing------ Presentation

SUGGESTED TEACHING AND ASSESSMENT METHODS

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

Assessment:

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

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Marketing Management 16th Edition (A South Asian Perspective) by Philip Kotler & Kevin Lane Keller.
2. Basic Marketing (1st Edition) by Salman Zaheer
3. Blue Ocean Strategy by Renée Mauborgne and W. Chan Kim

LEADERSHIP AND PERSONAL GROOMING

Credit Hours: 2
Pre-Requisites: Nil

COURSE OUTLINE

Fundamentals of Leadership and Servant Leadership

- What is leadership; Leadership Traits; Servant Leadership

Foundations of Community Development

- The frame work for community and economic development; Seven theories for seven community developers; Bases of community development; Process of community development; Challenges of the process

Social Capital, Community Building and Community Development Practices

- Social capital; Community social capacity and how does it influence development • Intentional action to increase social capacity; Factors that influence the success of community-building efforts; Principles and process of practicing community development; How does community development practice relate to economic development? Professional standards of ethical practices in community development

Community development assessment,

- Community Asset mapping and surveys, Assessing local economy.
- Community Mapping; Surveys Forms; The importance of asset mapping.

Building Powerful Community Organizations

- Bringing a group together; Scanning the functions of Community Organizations present in the market; The idea generation; Developing Vision, Mission and Goals; Structuring the Organization; Defining SOPs

Marketing your Organization

- Marketing a Community Organization; Effective role and guidelines for conducting meetings

Mobilizing Resources: Raising Money

- Community development finance; Finding sources of money; Securing grants for community development projects; Preparing grant proposals

Measuring Progress

- Community development indicators, Best practices & Benchmarking

SUGGESTED TEACHING AND ASSESSMENT METHODS

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

Assessment:

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

RECOMMENDED TEXT AND REFERENCE BOOKS

1. The heart of leadership: A leader people want to follow by Mark Miller, Berret-Kohler Publisher 2013.
2. Leadership and Art of Struggle by Steven Snyder & B. Geage Berret Kohler Publisher 2013.
3. Strategic Leadership: How to think and plan by John Adair, Kogan Page Ltd 2010

PROJECT MANAGEMENT

Credits: 02
Pre-Requisite: Nil

DESCRIPTION

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

COURSE LEARNING OUTCOMES

By the end of this course, students will be able to:

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

COURSE OUTLINE

- **Project Management Concepts**

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

- **Project Proposal Development**

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

- **Project Feasibility**

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

- **Project Selection Criteria (Economic Analysis of Engineering Projects)**

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

- **Project Contract & Procurement Management**

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

- **Project Planning and Scheduling**

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

- **Project Costing & Estimation**

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

- **Project HRM & Communication Management**

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

- **Project Risk Management**

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

- **Computer Application in Project Management**

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

- **Project Quality Management**

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

- **Project Closure & Termination**

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

SUGGESTED TEACHING & ASSESSMENT METHODS

Lectures (audio/video aids),Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Project/Field Visits Group discussion, Community Service, Report Writing Social Impact Review and Social Audit of Engg Project

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

SUGGESTED INSTRUCTIONAL/READING MATERIALS

1. Project Management: A system Approach to Planning, Scheduling and Controlling 11th Edition, Harold Kerzner
2. Bennett, F. Lawrence. 1996. The management of engineering. New York: Wiley
3. Cleland, David. Field guide to project management. New York: Wiley.
4. Eisner, H. Essentials of project management and systems engineering management. New York: Wiley
5. Frame, J. D. Managing projects in organizations. San Francisco: Jossey-Bass
6. Goldratt, Eliyahu. Critical chain. North River Press
7. Haynes, M.E. Project management: From idea to implementation. Los Altos, CA: Crisp Publications.
8. Lewis, James, Project planning, scheduling & control. New York: McGraw-Hill
9. Lewis, James, P. 1998. Mastering project management. New York: McGraw-Hill
10. Lientz, Bennet & Rea, Kathryn. 1995. Project management for the 21st century. San Diego: Academic Press.
11. Miller, Roger & Lessard, Donald. 2000. The strategic management of large engineering projects. Cambridge, MA: MIT Press.
12. Nicholas, J.M. Managing business & engineering projects. Englewood Cliffs, NJ: Prentice Hall
13. Shtub, Avraham, Bard, Jonathan, & Globerson, Shlomo. 1994. Project management: Engineering, technology, and implementation. Englewood Cliffs, Prentice-Hall
14. Project Management by Adrienne Watt
15. J.R. Meredith and S.J. Mantel. Project Management: A Managerial Approach. John Wiley and Sons. New York. 2019. (Reference).

ENTREPRENEURSHIP

UGE Policy V1.1: General Education Course

Credits: 02
Pre-Requisites: Nil

DESCRIPTION

This course is designed to promote entrepreneurial spirit and outlook among students, encouraging them to think critically, identify opportunities, and transform their ideas into successful ventures. It aims at imparting them with the requisite knowledge; skills and abilities, enabling them to seize the identified opportunities for initiating ventures and successfully navigating the challenges that come with starting business and managing it. The course covers topics relevant to entrepreneurship including setting up and initiation of business (including requirements for registration and incorporation with regulators such as SECP and others), market research, opportunity identification, business planning, financial literacy for managing finances and securing funding, marketing and sales, team building and innovation. Overall, the course is geared towards personal growth and professional development for pursing innovative ideas, availing opportunities and initiating start-ups.

COURSE LEARNING OUTCOMES

By the end of this course, students shall have:

1. Knowledge of fundamental entrepreneurial concepts, skills and process;
2. Understanding on different personal, social and financial aspects associated with entrepreneurial activities;
3. Basic understanding of regulatory requirements to set up an enterprise in Pakistan, with special emphasis on export;
4. Ability to apply knowledge, skills and abilities acquired in the course to develop a feasible business plan for implementation.

COURSE OUTLINE

1. **Introduction to Entrepreneurship:**
   - Definition and concept of entrepreneurship;
   - Why to become an entrepreneur?
   - Entrepreneurial process;
   - Role of entrepreneurship in economic development.
2. **Entrepreneurial Skills:**
   - Characteristics and qualities of successful entrepreneurs (including stories of successes and failures);
   - Areas of essential entrepreneurial skills and ability areas such as creative and critical thinking, innovation and risk taking.

3. **Opportunity Recognition and Idea Generation:**
   - Opportunity identification, evaluation and exploitation;
   - Idea generation techniques for entrepreneurial ventures.
4. **Marketing and Sales:**
   - Target market identification and segmentation;
   - Four P's of Marketing;
   - Developing a marketing strategy;
   - Branding.
5. **Financial Literacy:**
   - Basic concepts of income, savings and investments;
   - Basic concepts of assets, liabilities and equity;
   - Basic concepts of revenue and expenses;
   - Overview of cash-flows;
   - Overview of banking products including Islamic modes of financing;
   - Sources of funding for startups (angel financing, debt financing, equity financing etc.)
6. **Team Building for Startups:**
   - Characteristics and features of effective teams;
   - Team building and effective leadership for startups
7. **Regulatory Requirements to Establish Enterprises in Pakistan:**
   - Types of enterprises (e.g., sole proprietorship; partnership; private limited companies etc.);
   - Intellectual property rights and protection;
   - Regulatory requirements to register an enterprise in Pakistan, with special emphasis on export firms;
   - Taxation and financial reporting obligation.

PRACTICAL REQUIREMENTS

As part of the overall learning requirements, students shall be tasked with presenting a comprehensive business plan at the end of the course for a hypothetical or real business idea. This practical exercise will allow them to apply the knowledge, skills and abilities acquired in the course to develop a feasible business plan and where possible explore the possibility of implementing the plan with support and assistance from established business-persons and entrepreneurs.

SUGGESTED INSTRUCTIONAL/ READING MATERIALS

1. "Entrepreneurship: Successfully Launching New Ventures" by Bruce R. Barringer and R. Duane Ireland.
2. "Entrepreneurship: Theory, Process, and Practice" by Donald F. Kuratko.
3. "New Venture Creation: Entrepreneurship for the 21st Century" by Jeffry A. Timmons, Stephen Spinelli Jr., and Rob Adams.
4. "Entrepreneurship: A Real-World Approach" by Rhonda Abrams.

5. "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses" by Eric Ries.
6. "Effectual Entrepreneurship" by Stuart Read, Saras Sarasvathy, Nick Dew, Robert Wiltbank, and Anne-Valérie Ohlsson.

APPLICATIONS OF ICT

UGE Policy V1.1: General Education Course

Credits: 2+1=3
Pre-Requisite: Nil

DESCRIPTION

This course is designed to provide students with an exploration of the practical applications of Information and Communication Technologies (ICT) and software tools in various domains. Students will gain hands-on experience with a range of software applications, learning how to leverage ICT to solve daily life problems, enhance productivity and innovate in different fields. Through individual and interactive exercises and discussions, students will develop proficiency in utilizing software for communication, creativity, and more.

COURSE LEARNING OUTCOMES

By the end of this course, students will be able to:

1. Explain the fundamental concepts, components, and scope of Information and Communication Technologies (ICT).
2. Identify uses of various ICT platforms and tools for different purposes.
3. Apply ICT platforms and tools for different purposes to address basic needs in different domains of daily, academic, and professional life.
4. Understand the ethical and legal considerations in use of ICT platforms and tools.

COURSE OUTLINE

1. **Introduction to Information and Communication Technologies:**
   - Components of Information and Communication Technologies (basics of hardware, software, ICT platforms, networks, local and cloud data storage etc.).
   - Scope of Information and Communication Technologies (use of ICT in education, business, governance, healthcare, digital media and entertainment, etc.).
   - Emerging technologies and future trends.
2. **Basic ICT Productivity Tools:**
   - Effective use of popular search engines (e.g., Google, Bing, etc.) to explore World Wide Web.
   - Formal communication tools and etiquettes (Gmail, Microsoft Outlook, etc.).
   - Microsoft Office Suites (Word, Excel, PowerPoint).

- Google Workspace (Google Docs, Sheets, Slides).
- Dropbox (Cloud storage and file sharing), Google Drive (Cloud storage with Google Docs integration) and Microsoft OneDrive (Cloud storage with Microsoft Office integration).
- Evernote (Note-taking and organization applications) and OneNote (Microsoft's digital notebook for capturing and organizing ideas).
- Video conferencing (Google Meet, Microsoft Teams, Zoom, etc.).
- Social media applications (LinkedIn, Facebook, Instagram, etc.).

3. **ICT in Education:**
   - Working with learning management systems (Moodle, Canvas, Google Classrooms, etc.).
   - Sources of online education courses (Coursera, edX, Udemy, Khan Academy, etc.).
   - Interactive multimedia and virtual classrooms.
4. **ICT in Health and Well-being:**
   - Health and fitness tracking devices and applications (Google Fit, Samsung Health, Apple Health, Xiaomi Mi Band, Runkeeper, etc.).
   - Telemedicine and online health consultations (OLADOC, Sehat Kahani, Marham, etc.).
5. **ICT in Personal Finance and Shopping:**
   - Online banking and financial management tools (JazzCash, Easypaisa, Zong PayMax, 1LINK and MNET, Keenu Wallet, etc.).
   - E-commerce platforms (Daraz.pk, Telemart, Shophive, etc.)
6. **Digital Citizenship and Online Etiquette:**
   - Digital identity and online reputation.
   - Netiquette and respectful online communication.
   - Cyberbullying and online harassment.
7. **Ethical Considerations in Use of ICT Platforms and Tools:**
   - Intellectual property and copyright issues.
   - Ensuring originality in content creation by avoiding plagiarism and unauthorized use of information sources.
   - Content accuracy and integrity (ensuring that the content shared through ICT platforms is free from misinformation, fake news, and manipulation).

PRACTICAL REQUIREMENTS

As part of overall learning requirements, the course will include:

1. Guided tutorials and exercises to ensure that students are proficient in commonly used software applications such as word processing software (e.g., Microsoft Word), presentation software (e.g., Microsoft PowerPoint), spreadsheet software (e.g., Microsoft Excel) among such other tools students may be assigned practical tasks that require them to create documents, presentations and spreadsheets etc.

2. Assigning of tasks that involve creating, managing, and organizing files and folders on both local and cloud storage systems.. students will practice file naming conventions, creating directories, and using cloud storage solutions (e.g., Google Drive, OneDrive).
3. The use of online learning management systems (LMS) where students can access course materials, submit assignments, participate in discussion forums, and take quizzes or tests. This will provide students with the practical experience with online platforms commonly used in education and the workplace.

SUGGESTED INSTRUCTIONAL/ READING MATERIALS

1. "Discovering Computers" by Vernmaat, Shaffer, and Freund.
2. "GO! With Microsoft Office" Series by Gaskin, Vargas, and McLellan.
3. "Exploring Microsoft Office" Series by Grauer and Poatsy
4. "Computing Essentials" by Morley and Parker
5. "Technology in Action" by Evans, Martin and Poatsy

CALCULUS AND ANALYTICAL GEOMETRY

Credit Hours: 3+0
Pre-Requisites: Nil

COURSE LEARNING OUTCOMES

1. To develop a clear understanding of fundamental concepts of single variable calculus
2. To apply concepts of differentiation and integration to solve complex engineering problems

COURSE OUTLINE

1. **Analytical Geometry:**
   - Review of vectors, scalars and vector products.
   - Three dimensional coordinate system and equation of straight line and plane
2. **Functions Limit and Continuity**
   - Review of functions and graphs,
   - Limits & Continuity,
   - Techniques of Finding Limits,
   - Discontinuity,
   - Limits of Sine and Cosine and Exponential Functions
3. **Differentiation:**
   - Introduction to Derivatives
   - Examples of Derivatives
   - Derivative as Rate of Change
   - Derivative's Rules
   - Implicit Differentiation
   - Higher order derivative
   - Leibnitz Theorem
4. **Applications of Derivatives:**
   - Applications of Derivatives
   - Monotonic functions
   - Optimization problems
   - Relative and Absolute extrema
   - First and second derivative tests
   - Point of inflection
   - Concavity

- Curvature
- Indeterminate Forms and L' Hospital rule
- Differentials

5. **Integration:**
   - Integrals and Properties of Integrals
   - Techniques of Integration
   - Integration by Parts
   - Definite Integrals
   - Integration of Trigonometric
   - Exponential and Inverse Functions
   - Integration by Partial Fractions
   - Reduction Rules
6. **Applications of Integration:**
   - Applications of Integration
   - Area under the curve
   - Area between curves
   - Solids of Revolution
   - Volume of Solids of revolution by disk
   - washer, Cylindrical shell & Cross Section Methods
   - Center of Pressure and Depth of Center of Pressure
   - Center of mass
   - Arc length
7. **Improper Integrals:**
   - Improper Integral
   - Integrals and Singularities
   - Convergence of improper integrals
8. **Infinite Sequence and Series:**
   - Sequence and Infinite Series
   - Convergence and Divergence of sequences and series
   - Positive Term Series
   - Integral Test
   - Basic Comparison Test
   - Limit Comparison Test
   - Ratio and Root tests
   - Alternating series
   - Absolute and Conditional Convergence
9. **Power and Taylor Series:**
   - Power series
   - Maclaurin and Taylor Series and its Applications

SUGGESTED TEACHING & ASSESSMENT METHODS

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker,

Industrial/ Field Visits, Group discussion, Report Writing

Assessment

Midterm Exam, Home Assignments, Quizzes, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Thomas' Calculus by George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass, Pearson, USA.
2. Swokowski, Onlinick & Pence: Calculus
3. Robert T. Smith & Roland B. Minton: Calculus
4. Calculus: Early Transcendentals by James Stewart. Brooks/Cole USA.

LINEAR ALGEBRA

Credit Hours: 2+0
Pre-Requisites: Nil

DESCRIPTION

The knowledge units in this area collectively encompass the following:

1. To comprehend basic concepts of Linear Algebra and optimization
2. To apply techniques of Linear Algebra and optimization for solution of engineering problems

COURSE OUTLINE

1. Matrices: Introduction to Matrices, Elementary row operations, Echelon and reduce Echelon form, Inverse of a matrix by using elementary row operations, type of matrices (singular, non- singular, symmetric, non-symmetric, upper, lower, diagonal tri-diagonal matrix), rank of a matrix using row operations
2. Determinants: Introduction to Determinants, Properties of determinants of order n, Application of determinants
3. Linear Systems of Equations: Introduction to Linear systems, Homogeneous and non-homogeneous linear equations, Gaussian Elimination and Gauss-Jordan Methods, Consistency criterion for solution of homogeneous and nonhomogeneous systems of linear equations, Applications of systems of linear equations.
4. Vector Spaces and Subspaces: Vector spaces and subspaces, Linear combination, Linear independence and linear dependence, Linear Transformations. Eigen Values and Eigen Vectors Introduction to Eigen values and Eigen vectors, Diagonalization, Applications of Eigen values and Eigen vectors

SUGGESTED TEACHING & ASSESSMENT METHODS

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

Assessment

Midterm Exam, Home Assignments, Quizzes, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Lay, D. C. (2012). Linear Algebra and its Applications (4th ed.). Boston: Addison-Wesley. ISBN-13:978-0321385178

2. Howard Anton, (2014). Elementary Linear Algebra (11th edition), John Willy & Sons. ISBN: 978-1-119-62569-8

DIFFERENTIAL EQUATIONS

Credit Hours: 2+0=2
Pre-Requisites: Nil

DESCRIPTION

The knowledge units in this area collectively encompass the following:

1. To comprehend basic concepts of formation and solutions of differential equations
2. To solve differential equation relevant to the engineering problems

COURSE OUTLINE

- Ordinary Differential Equations: Differential Equations and their Classification, Formulation of Differential Equations
- First Order Differential Equations: Solution of differential equations, Separable differential equation, Homogeneous differential equation, Exact differential Equations, Integrating factor, Linear differential Equations, Bernoulli differential equations, Applications of first order differential equations
- Second and higher Order Differential Equations: Solution of Homogeneous Linear 2nd and higher order differential Equations, Solution of nonhomogeneous Linear 2nd and higher order differential Equations, The Cauchy Euler Equation, Application of 2nd and higher order differential equations.
- Partial Differential Equations: Basic concepts and formation of partial differential equations, linear homogeneous partial differential equations, solution of first order linear and special types of second and higher order differential equations, wave equations.

SUGGESTED TEACHING & ASSESSMENT METHODS

Lectures, written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion

Assessment

Midterm Exam, Home Assignments, Quizzes, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Zill, D. G., & Wright, W. S. (2013). Differential equations: with boundary value problems (8th ed.). Boston, MA: Brooks/Cole, Cengage Learning.ISBN-13: 978-1111827069
2. Nielsen, K. L. (1966). Differential equations (2d ed.). New York: Barnes & Noble. ISBN-13:978-0064600729

COMPLEX VARIABLES & TRANSFORMS

Credit Hours: 3+0=3
Pre-Requisites: Nil

COURSE LEARNING OUTCOMES

1. The knowledge units in this area collectively encompass the following:
2. Explain the concept of complex number system, complex function, limit, continuity, differentiability and integral of complex valued functions
3. Utilize the theory of complex integration and power series (Taylor series. Laurent series) to solve problems from the area of residue calculus
4. Apply various transforms to solve complex integration.

COURSE OUTLINE

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

2. **Complex Differentiation and Integration**
   - Derivatives of complex valued functions, Differentiability,
   - Analyticity, Cauchy Riemann Equations, Harmonic Functions,
   - Complex integrals, Cauchy-Goursat Theorem, Independence of Path, Cauchy's Integral Formulas and Their Consequences, Applications

3. **Power Series:**
   - Taylor Series, Laurent Series, Singularities, Zeros and poles, Residue integration method, Residue theorem,
   - Conformal mapping

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

5. **Special functions and Fourier Transforms:**
   - (Gamma, Beta functions, Periodic functions, Error function),
   - Fourier Series, Fourier Sine and Cosine series,
   - Fourier transform, Fourier cosine and sine transform, properties.
   - Applications in relevant engineering discipline
6. **Z-Transformation:**
   - Z-transform, Properties of Z-transform, linearity and scaling, Standard Z-transform, Inverse Z-transform,
   - Inverse Z- transform by using residue, convolution theorem of Z-transform,
   - Formation of difference equation and its solution using Z-transform.

SUGGESTED TEACHING & ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

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

NUMERICAL METHODS

Credit Hours: 2+1=3
Pre-Requisites: Nil

DESCRIPTION

This course provides a concise exploration of essential topics in numerical analysis with a focus on practical applications in engineering. Topics include error analysis, interpolation methods, numerical differentiation and integration techniques, solutions for linear systems, iterative methods for linear and nonlinear equations, numerical methods for solving initial and boundary value problems, computing eigenvalues, and optimization methods. Relevant engineering case studies are integrated throughout, offering students a robust understanding of numerical methods and their application in solving real-world engineering problems.

COURSE LEARNING OUTCOMES

Upon completion of this comprehensive numerical analysis course, students will develop a strong proficiency in interpolation, understanding various types and sources of errors, norms of vectors and matrices. They will apply interpolation techniques to solve real-world engineering problems, demonstrated through case studies. The course will equip students with the skills for numerical differentiation and integration, solving linear systems and implementing iterative approaches for linear and nonlinear equations with convergence analysis. Students will also master numerical methods for solving initial value problems, applying them to relevant engineering scenarios through case studies. Furthermore, participants will gain insights into computing eigenvalues and delve into numerical optimization techniques, with practical applications illustrated through case studies. This comprehensive skill set will empower students to effectively address diverse mathematical challenges in engineering and optimization.

COURSE OUTLINE

1. **Error Analysis and Interpolation**

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

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

2. Numerical Differentiation and Integration

- Derivation of numerical differentiation of first order and second order derivatives using two points, three points, and five points formulas along with its application in engineering, Relevant case studies
- Numerical integration: Trapezoidal rule, Simpson's rules, Composite Trapezoidal Simpson Rules and Romberg integration, Applications of numerical in engineering, Relevant case studies

3. Methods of Solution a System of Linear Equations

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

4. Iterative Methods for Linear and Nonlinear Equations

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

5. Numerical Methods for IVPs and BVPs

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

6. Numerical Methods for Computing Eigenvalues

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

7. Numerical Optimization

- Unconstrained Optimization,

- Golden search ratio, Lagrange Multipliers,
- Method of steepest descent
- Applications of optimization in engineering disciplines

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Numerical Analysis: By Richard L. Burden, J. Douglas Faires, (Latest Edition).
2. Numerical Methods for Scientists and Engineers by R.W. Hamming (Latest Edition).
3. Numerical Methods for Engineers by Steven C. Chapra and R. P. Canale (Latest Edition).

DISCREATE MATHEMATICS

Credit Hours: 2+0=2
Pre-Requisites: Nil

DESCRIPTION

The knowledge units in this area collectively encompass the following:

1. To improve reasoning and problem-solving skills
2. To learn techniques for discrete structures relevant to engineering problems

COURSE OUTLINE

1. **Basics definition:** Mathematical logic, sets, functions, algorithms, complexity of algorithms, mathematical reasoning, induction, recursion, sequences and sums, recursive definitions, recursive algorithms.
2. **Counting Techniques:** The pigeonhole principal, permutations and combinations, binomial coefficients, discrete probability, expected value and variance, recurrence relations, solving recurrence relations, divide-and-conquer relations, generating functions, inclusion-exclusion relations and their properties, representing relations, closures of relations, equivalence relations, partial ordering
3. **Introduction to graphs:** Graph terminology, representing graphs and graph isomorphism, connectivity, Euler and Hamilton paths, shortest path problems, introduction to trees, applications of trees, tree traversal, spanning trees and minimum spanning trees.

SUGGESTED TEACHING & ASSESSMENT METHODS

Teaching Methodology (Proposed as applicable):
Lectures, written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion

Assessment:
Midterm Exam, Home Assignments, Quizzes, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Kenneth H. Rosen (2019). Discrete Mathematics and its Applications (8th ed.), McGraw Hill. ISBN- 978-1-260-09199-1
2. Ken Levasseur, Al Doerr, (2012). Applied Discrete Structures (11th edition), John Willy & Sons. ISBN: 978-1-105-55929-7

APPLIED PHYSICS

Credit Hours: 2+1
Pre-Requisites: Nil

DESCRIPTION

An Applied Physics course covers fundamental topics such as vectors, mechanics, electrostatics, and magnetism, providing a strong foundation in classical physics. It then delves into specialized areas like semiconductor physics, exploring the behavior of materials crucial to modern electronics. Additionally, students study waves, oscillations, optics, and lasers, exploring into the principles behind light and its applications. The course may conclude with an overview of modern physics, offering insights into cutting-edge research and technologies.

COURSE OUTLINE

1. **Vectors:**

- Review of vectors, Ordinary Differentiation of Vector, Gradient of Scaler field, Divergence and Curl of Vector Field, Line and Surface Integrals with applications.

2. **Mechanics:**

- Newton Laws and their Applications(Simple Accelerometer, Banked Curve and Rotor), Frictional Forces and determination of Co-efficient of Friction, Work-Energy Theorem, applications of law of Conservation of Energy, Angular Momentum, Centre of Mass of two-particles, Many-particles and Solid Object, Rotational Inertia of Solid Bodies.

3. **Electrostatics And Magnetism:**

- Electric field due to Discrete and Continuous Charge Distribution, Electrostatic Potential of discrete and Continuous charges, Applications of Gauss's Law, Lorentz Force and Hall effect, Ampere's Law, Magnetic Field due to Circular Current Loop and Solenoid, Magnetic dipole, Atomic and Nuclear Magnetism, Magnetization, Magnetic Materials.

4. **Semiconductor Physics:**

- Energy levels in a Semiconductor, Hole concept, Intrinsic and Extrinsic regions, Law of Mass Action. P-N junction, Transistors

5. **Waves And Oscillations:**

- Simple Harmonic Oscillator, Damped Harmonic Oscillation, Forced Oscillation and Resonance, Types of Wave and Superposition Principle, Wave Speed on a stretched string. Wave equation, Energy & Power of a Wave.

6. **Optics And Lasers:**

- Huygens Principle, Two-slit interference, Single-Slit Diffraction, Resolving power of Optical Instruments. Principles for Laser action, Types of Laser, Applications of Laser.

7. **Modern Physics:**

- Planck's explanations of Black Body Radiation Photoelectric Effect, Compton Effect, De-Broglie Hypothesis, Electron Microscope, Atomic structure, X-rays and Moseley's Law, Atomic Nucleus and Properties of Nucleus, Radioactive Decay and Radioactive Dating, Radiation Detection Instruments, Nuclear Reactions

COURSE OUTLINE (PRACTICALS)

Note: "Labs/ Practical: The course practical/labs should be defined and synchronized with the course outline"

SUGGESTED TEACHING & ASSESSMENT METHODS

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

Suggested Assessment Methods

Assessment

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

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Physics, By: Halliday, Resnick & Krane, Edition: 10th Edition.
2. University Physics, BY: Hugh D. Young and R.A. Freedman, EDITION: 12 Physics for Scientist & Engineers, BY: Serway, Jewett, (latest edition)

15.2 Engineering Domain

FUNDAMENTALS OF COMPUTING

Credit Hours: 2+1=3
Pre-Requisites: Nil

DESCRIPTION

This course provides a comprehensive introduction to the fundamental concepts of computing, covering both theoretical foundations and practical applications. Students will learn about the basic principles of computer architecture, programming languages, algorithms, data structures, and software development methodologies. The course aims to develop essential computing skills and a solid understanding of the core principles that underpin modern computing systems.

COURSE LEARNING OUTCOMES

Upon completing this course, participants will have a solid understanding of computer systems, programming paradigms, and key software development principles. They will be proficient in programming fundamentals, data structures, and algorithms. Additionally, participants will gain practical knowledge of object-oriented programming, software development methodologies, database management, and the basics of web development, positioning them well for further exploration in the field of computing.

COURSE OUTLINE

Introduction to Computing

- Overview of computer systems and their components
- History and evolution of computing
- Introduction to programming languages and software development tools

Computer Architecture and Organization

- Basic components of a computer system
- CPU, memory, and input/output devices
- Instruction execution cycle and assembly language programming

Programming Fundamentals

- Programming paradigms and concepts
- Variables, data types, and expressions
- Control structures: conditionals and loops

Data Structures and Algorithms

- Basic data structures: arrays, lists, stacks, and queues
- Searching and sorting algorithms
- Introduction to algorithm analysis and complexity

Object-Oriented Programming

- Principles of object-oriented programming
- Classes, objects, and inheritance
- Encapsulation, polymorphism, and abstraction

Software Development Methodologies

- Software development life cycle
- Agile methodologies: Scrum, Kanban
- Version control systems and collaboration tools

Databases and SQL

- Introduction to databases and database management systems
- Structured Query Language (SQL) basics
- Database design and normalization principles

Introduction to Web Development

- Basics of web technologies: HTML, CSS, JavaScript
- Client-server architecture and HTTP protocol
- Introduction to web frameworks and libraries

SUGGESTED TEACHING AND ASSESSMENT METHODS

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

Suggested Assessment Methods Theory

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

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Computer Systems: A Programmer's Perspective"
   Author: Randal E. Bryant, David R. O'Hallaron
   Publisher: Pearson
   Year: 2020
2. Title: "Introduction to the Theory of Computation"
   Author: Michael Sipser
   Publisher: Cengage Learning
   Year: 2012
3. Title: "Algorithms, Part I"
   Author: Robert Sedgewick, Kevin Wayne
   Publisher: Addison-Wesley Professional
   Year: 2020
4. Title: "Clean Code: A Handbook of Agile Software Craftsmanship"
   Author: Robert C. Martin
   Publisher: Prentice Hall
   Year: 2008
5. Title: "Database Systems: The Complete Book"
   Author: Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom
   Publisher: Pearson
   Year: 2020

DATA STRUCTURES AND ALGORITHMS

Credit Hours: 3+1=4
Pre-Requisites: Nil

DESCRIPTION

This course provides a comprehensive exploration of fundamental data structures and algorithms, equipping students with the knowledge and skills needed to design efficient and scalable software solutions. The practical implementation in multiple programming languages ensures versatility and applicability in real-world scenarios.

COURSE LEARNING OUTCOMES

Upon completion, participants will possess a solid foundation in data structures and algorithms. They will be proficient in implementing and analyzing essential data structures such as stacks, queues, linked lists, trees, and graphs. Additionally, participants will acquire practical skills in sorting and searching algorithms, as well as an understanding of memory management techniques. The course equips participants to apply these concepts across programming projects using languages such as C, C++, Java, or Python.

COURSE OUTLINE

- Abstract data types, complexity analysis, Big Oh notation, Stacks (linked lists and array implementations), Recursion and analyzing recursive algorithms, divide and conquer algorithms
- Sorting algorithms (selection, insertion, merge, quick, bubble, heap, shell, radix, bucket), queue, dequeuer, priority queues (linked and array implementations of queues), linked list & its various types, sorted linked list, searching an unsorted array, binary search for sorted arrays,
- Hashing and indexing, open addressing and chaining, trees and tree traversals, binary search trees, heaps, M-way tress, balanced trees, graphs, breadth-first and depth-first traversal, topological order, shortest path, adjacency matrix and adjacency list implementations, memory management and garbage collection.

Programming language: C/C++/ Java/ Python.

SUGGESTED TEACHING AND ASSESSMENT METHODS

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Data Structures and Algorithms in C++ by Adam Drozdek
2. Data Structures and Algorithm Analysis in Java by Mark A. Weiss
3. Data Structures and Abstractions with Java by Frank M. Carrano & Timothy M. Henry
4. Data Structures and Algorithm Analysis in C++ by Mark Allen Weiss
5. Java Software Structures: Designing and Using Data Structures by John Lewis and Joseph Chase

OBJECT ORIENTED PROGRAMMING (OOP)

Credit Hours: 3+1=4
Pre-Requisites: Nil

DESCRIPTION

This course provides a comprehensive foundation in object-oriented design and programming concepts, offering practical skills and knowledge applicable across multiple programming languages. Students will emerge with a solid understanding of OOP principles and the ability to implement them in real-world scenarios using their preferred programming language.

COURSE LEARNING OUTCOMES

Upon completion, participants will possess a solid understanding of object-oriented design and programming. They will be proficient in creating classes, handling relationships between classes, and implementing advanced features like polymorphism and generic programming. Participants will gain practical experience in using object-oriented languages such as C, C++, Java, or Python, and be well-equipped to apply these concepts in real-world programming scenarios.

COURSE OUTLINE

- Introduction to object-oriented design, history and advantages of object-oriented design,
- Introduction to object-oriented programming concepts, classes, objects, data encapsulation, constructors, destructors, access modifiers, const vs non-const functions,
- static data members & functions, function overloading, operator overloading, identification of classes and their relationships, composition, aggregation, inheritance, multiple inheritance, polymorphism, abstract classes and interfaces,
- Generic programming concepts, function & class templates, standard template library, object streams, data and object serialization using object streams, exception handling.

Programming language: C/C++/ Java/ Python.

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Starting Out with C++ from Control Structures to Objects, 9th Edition, Tony Gaddis
2. C++ How to Program, 10th Edition, Deitel & Deitel.

3. Object Oriented Programming in C++, 3rd Edition by Robert Lafore
4. Java: How to Program, 9th Edition by Paul Deitel
5. Beginning Java 2, 7th Edition by Ivor Horton
6. An Introduction to Object Oriented Programming with Java, 5th Edition by C. Thomas Wu

ARTIFICIAL INTELLIGENCE

Credit Hours: 3+1=4

Pre-Requisites: Nil

DESCRIPTION

This course provides a comprehensive introduction to the field of Artificial Intelligence (AI), covering key concepts, techniques, and applications. Students will gain a deep understanding of AI methodologies, including machine learning, natural language processing, computer vision, and expert systems. The course explores the ethical implications of AI and its impact on various industries. Practical implementations and case studies will be used to enhance the learning experience.

COURSE LEARNING OUTCOMES

Upon completing the course, participants will acquire a profound understanding of AI principles and applications. They will be adept at applying machine learning algorithms for various tasks, including cybersecurity, healthcare, and business processes. Participants will gain practical insights into Natural Language Processing, Computer Vision, and Expert Systems, empowering them to leverage AI technologies in diverse fields.

COURSE OUTLINE

Introduction to Artificial Intelligence

- Overview of AI and its applications
- Historical development of AI
- Ethical considerations in AI

Machine Learning

- Supervised, unsupervised, and reinforcement learning.
- Classification and regression algorithms
- Neural networks and deep learning

Natural Language Processing

- Basics of natural language processing (NLP)
- Text preprocessing and feature extraction
- Sentiment analysis and language generation

Computer Vision

- Image and video processing techniques
- Object detection and recognition
- Deep learning for computer vision

Expert Systems and Knowledge Representation

- Rule-based expert systems
- Knowledge representation and reasoning

- Expert systems development tools

AI in Information Security

- Machine learning for cyber-attack detection
- Machine learning for Internet traffic classification
- User behavior analytics

AI in Healthcare

- Applications of AI in healthcare
- Medical image analysis
- AI-driven diagnostics and treatment

AI in Business and Industry

- AI applications in business processes
- Predictive analytics and forecasting
- AI-driven automation and optimization

SUGGESTED TEACHING AND ASSESSMENT METHODS

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

Assessment:

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

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Artificial Intelligence: A Modern Approach"
   Author: Stuart Russell, Peter Norvig
   Publisher: Pearson
   Year: 2021
2. Title: "Deep Learning"
   Author: Ian Goodfellow, Yoshua Bengio, Aaron Courville
   Publisher: MIT Press
   Year: 2016
3. Title: "Natural Language Processing with Python"
   Author: Steven Bird, Ewan Klein, Edward Loper
   Publisher: O'Reilly Media
   Year: 2020
4. Title: "Computer Vision: Algorithms and Applications"
   Author: Richard Szeliski
   Publisher: Springer
   Year: 2010
5. Title: "Artificial Intelligence in Healthcare"
   Author: Adam Bohr, Mahesh Bhatt, Ganapathi Pulipaka
   Publisher: CRC Press
   Year: 2021

OPERATING SYSTEMS AND SYSTEMS PROGRAMMING

Credit Hours: 3+1=4
Pre-Requisites: Nil

DESCRIPTION

This course provides a comprehensive study of operating systems and systems programming, focusing on the design, implementation, and interaction of software with the underlying operating system. Students will learn about the core concepts and mechanisms of operating systems, as well as the practical aspects of systems programming. The course covers topics such as process management, memory management, file systems, system-level I/O, and concurrency.

COURSE LEARNING OUTCOMES

Upon completion, participants will possess a profound understanding of operating system concepts and functions, from process and memory management to file systems and I/O operations. Armed with knowledge about virtualization, containerization, and emerging trends, participants will be well-prepared to navigate the evolving landscape of operating systems and systems programming.

COURSE OUTLINE

Introduction to Operating Systems

- Overview of operating system concepts and functions
- History and evolution of operating systems
- Types of operating systems (batch, time-sharing, distributed, etc.)

Process Management

- Process creation, execution, and termination
- Process scheduling algorithms and policies
- Inter-process communication and synchronization

Memory Management

- Memory hierarchy and address spaces
- Memory allocation techniques (contiguous, non-contiguous, virtual memory)
- Paging and segmentation

File Systems

- File system organization and structure
- File operations (creation, deletion, read, write, etc.)
- File system integrity and recovery

System-Level I/O

- Device drivers and I/O operations
- Buffering and caching mechanisms
- File and network I/O

Concurrency and Synchronization

- Principles of concurrency and parallelism

- Synchronization primitives (locks, semaphores, condition variables)
- Deadlock detection and prevention

Virtualization and Containerization

- Virtual machines and hypervisors
- Container technologies (Docker, Kubernetes)
- Virtualization and containerization benefits and challenges

Emerging Trends in Operating Systems and Systems Programming

- Cloud computing and operating systems
- Operating systems for IoT and edge computing
- Real-time operating systems and embedded systems

SUGGESTED TEACHING AND ASSESSMENT METHODS

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

Assessment:

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

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Operating System Concepts"
   Author: Abraham Silberschatz, Peter B. Galvin, Greg Gagne
   Publisher: Wiley
   Year: 2018
2. Title: "Operating Systems: Principles and Practice"
   Author: Thomas Anderson, Michael Dahlin
   Publisher: Recursive Books
   Year: 2014
3. Title: "Modern Operating Systems"
   Author: Andrew S. Tanenbaum, Herbert Bos
   Publisher: Pearson
   Year: 2014
4. Title: "Operating Systems: Three Easy Pieces"
   Author: Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau
   Publisher: Arpaci-Dusseau Books
   Year: 2014
5. Title: "Advanced Programming in the UNIX Environment"
   Author: W. Richard Stevens, Stephen A. Rago
   Publisher: Addison-Wesley Professional
   Year: 2013

WORKSHOP PRACTICE

Credit Hours: 0+1=1
Pre-Requisites: Nil

COURSE OUTLINE

Workshop safety

- Demonstration of safety equipment
- Tools and safety gear in accordance with safety regulations
- Electric shock treatment.

Measurements

- Measurement of bolt using Vernier calipers, micrometer, and thread pitch gauge
- Familiarization with different bench fitting tools and equipment.

Preparation of Work Piece

- Preparation of work pieces of required dimensions and joining of metal work pieces in lap, butt and T-joints using electric arc welding

Familiarization with Lathe Machine

- Introduction to a lathe machine, its parts, accessories, and operations

Familiarization with Electric Cables and Switching Devices

- Familiarization with the types of cables and electric accessories including switches, plugs, circuit breakers, fuses etc., comprehending their symbols for electrical wiring schematics.

Wiring Circuits & Earthing Concepts

- Assembling a parallel electric wiring circuit for a hotel and its testing in accordance with wiring regulations.
- Demonstration of earthing concepts and installation of an earthing cable

Assembling and disassembling of a computer system

- Assembling and dissembling of a modern computer system along with its accessories.

Introduction to Circuit designing & PCB Printing

- Introduction to circuit designing and simulation using Proteus.
- Introduction to PCB printing (Fabrication of a PCB) and etching in PCB design.
- Demonstration and evaluation of a complete PCB design and fabrication.

Open Ended Lab or Semester Project:

Students will do a project in the last three weeks to summarize the technical knowledge and skills learnt in Electrical Workshop Practice and prepare a report.

SUGGESTED TEACHING AND ASSESSMENT METHODS

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

Assessment:

Mid Term, Project Report writing/ Presentation, Lab experiment evaluation, Assignments, Quizzes, Final Term

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Umesh Rathore and Naresh Kumar Sharma, "A Textbook of Electrical Workshop Practices", S.K. Kataria & Sons, 1st Ed. 2019
2. S. K. Choudhury, "Elements of Workshop Technology", Vol. 1, Media Promoters & Publishers.
3. Chapman, "Workshop Technology", Part-I, II, III, CBS

COMPUTER AND COMMUNICATION NETWORKS (CCN)

Credit Hours: 3+1=4
Pre-Requisites: Nil

DESCRIPTION

This course provides a comprehensive understanding of computer networking, covering foundational concepts, protocols, and the latest trends. Practical aspects, including addressing, routing, and protocols, are emphasized to ensure students are well-prepared for real-world networking challenges.

COURSE LEARNING OUTCOMES

Upon completion, participants will possess a solid understanding of networking fundamentals, from layering concepts and transmission media to routing protocols and application layer protocols. Proficiency in addressing schemes, switching techniques, and the latest trends in computer networks will equip participants to navigate the dynamic landscape of modern networking.

COURSE OUTLINE

- Fundamental concepts of networking, network models and topologies, network layering concepts and protocols, OSI and Internet Protocol (IP) reference model and associated control protocols (TCP/UDP).
- Physical layer functionality, data link layer functionality, addressing schemes at link layer, network and transport layer, channel access/ multiple access techniques, transmission media and its characteristics, switching techniques, circuit switching and packet switching,
- LAN technologies, wireless networks, MAC addressing, IP routing protocols, multicast, overview of application layer protocols (HTTP, FTP, SMTP etc.), multimedia protocols (RTP, RTSP, RTCP).
- Networking devices, network layer protocols, IPv4 and IPv6, IP addressing, sub netting, CIDR, routing protocols, transport layer protocols, ports and sockets, connection establishment, flow and congestion control, application layer protocols, latest trends in computer networks.
- ISP Architecture, Multiprotocol Label Switching (MPLS), QoS in computer Networks.

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS
1. Computer Networking: A Top-Down Approach Featuring the Internet, 6th edition by James F. Kurose and Keith W. Ross
2. Computer Networks, 5th Edition by Andrew S. Tanenbaum
3. Data and Computer Communications, 10th Edition by William Stallings
4. Data Communication and Computer Networks, 5th Edition by Behrouz A. Forouzan

DIGITAL LOGIC DESIGN

Credit Hours: 3+1=4
Pre-Requisites: Nil

DESCRIPTION

This course aims to provide a solid foundation in digital design, covering essential concepts from number systems and Boolean algebra to the implementation of complex digital circuits using tools like Verilog and FPGAs. Practical aspects and hands-on projects are emphasized to ensure students gain valuable experience in designing and implementing digital systems.

COURSE LEARNING OUTCOMES

Upon completion of this course, students will emerge with a robust understanding of digital design principles and techniques. They will be adept at designing and analyzing a variety of digital circuits, ranging from basic logic gates to complex systems like ALUs. Proficiency in using Verilog for circuit description and simulation will equip students with practical skills applicable in the industry. Additionally, exposure to FPGA programming ensures that students are well-prepared for the dynamic field of digital design, where reconfigurable devices play a pivotal role. Overall, graduates of this course will have the knowledge and hands-on experience necessary for success in digital design and related fields.

COURSE OUTLINE

- Number Systems & Boolean algebra
- Logic Simplification, Combinational Logic, Sequential Logic, Latches, Flip-Flops and their applications.
- Adders, Multiplexers, Counters, Shift Registers, and simple Arithmetic Logic Unit (ALU).
- Design and implementation of combinational circuits in Verilog, Introduction to FPGA.

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. M. Morris Mano and Micheal D. Ciletti, "Digital Design with an introduction to the Verilog HDL", Prentice Hall, 5th Edition.
2. Morris Mano and Charles R. Kime, "Logic and Computer Design Fundamentals", Prentice Hall. Latest Edition

3. Tocci and Widmer, "Digital Systems: Principles and Applications". Prentice Hall. Latest Edition

COMPUTER ARCHITECTURE & ORGANIZATION

Credit Hours: 3+1=4
Pre-Requisites: Nil

DESCRIPTION

This comprehensive course provides a deep understanding of computer architecture, covering topics from the basics of programming models to advanced concepts like memory hierarchy, parallel processing, and pipelining. Hands-on assembly language programming and debugging experience enhance practical skills, ensuring students are well-equipped to tackle real-world challenges in computer architecture.

COURSE LEARNING OUTCOMES

Upon completion, participants will possess a profound understanding of computer architecture principles, from the basics of data representation to the intricacies of memory hierarchy and parallel processing. With practical experience in assembly language programming and microprogramming, participants will be equipped to analyze and design computer systems, understanding the trade-offs between different architectures and their implications for system performance.

COURSE OUTLINE

- Introduction to Computer Architecture
- Evolution of Computers, Types of Computers, Hardware, Firmware and Software. Future trends.
- Programming model of 8086 family. Addressing Modes.
- Data types, complements, fixed point representation, floating point representation, binary codes.
- Register Transfer Language.
- Bus and Memory Transfer.
- Arithmetic Micro- operations, Logic Micro-operations, shift micro-operation, Arithmetic Logic Unit. Instruction Codes, Computer Register, Computer Instruction, Timing and Control, Instruction Cycle, Memory-Reference Instruction, Input-Output, Interrupt, Complete description and design of Basic Computer.
- Design of Accumulator and ALU.
- Assembly Language Programming with help of MASM and Debugger. Control Memory, Address Sequencing, Micro program, Computer Configuration, Microinstruction format, Symbolic Microinstruction.
- The Fetch Routine, Symbolic Micro program, Binary Micro program, Design of Control Unit, Micro program Sequencer.

- Memory Hierarchy, Main Memory, Cache Memory, Virtual Memory, Memory Management. General Register Organization, Stack Organization, Instruction format, Addressing Modes, Date transfer and manipulation, Program Control, RISC & CISC Computer and their characteristics. Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Vector Processing.

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Computer Architecture and Organization by John P. Hayes, 3rd Edition, McGraw -Hill.
2. David A. Patterson, John L. Hennessy, "Computer Organization & Design ", 5th Edition, Morgan Kaufmann, or Latest Edition.
3. Computer System Architecture by M. Morris Mano, Third Edition
4. Computer Architecture by Morio De Blasi.
5. Computer Architecture & Organization by A.J.Van De Goor.

DATABASE MANAGEMENT AND DESIGN

Credit Hours: 3+1=4
Pre-Requisites: Nil

DESCRIPTION

This course provides a comprehensive study of database management systems (DBMS) and database design principles. Students will learn about the fundamental concepts of database management, including data modeling, relational databases, SQL querying, database administration, and database security. The course emphasizes both theoretical foundations and practical skills through hands-on exercises and real-world case studies.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess a comprehensive understanding of database management, from foundational concepts to advanced techniques. They will be proficient in designing efficient relational databases, querying databases using SQL, and administering databases to ensure performance, security, and integrity. Additionally, students will be equipped with knowledge about emerging trends in database management, preparing them for the evolving landscape of data management in various industries. Graduates will be well-prepared to contribute to the design, administration, and optimization of database systems in real-world scenarios.

COURSE OUTLINE

Introduction to Databases

- Overview of database management systems (DBMS)
- Evolution of data models: hierarchical, network, relational
- Database architecture and components

Relational Database Design

- Entity-relationship (ER) modeling
- Functional dependencies and normalization
- Designing relational schemas

SQL and Database Querying

- Structured Query Language (SQL) basics
- Data manipulation and retrieval
- Advanced SQL querying techniques

Database Administration

- Database system architecture and administration tasks
- Backup and recovery procedures
- Performance tuning and optimization

Transaction Management and Concurrency Control

- ACID properties of transactions
- Concurrency control techniques

- Deadlock detection and prevention

Database Security and Integrity

- Access control and authorization
- Data encryption and authentication
- Auditing and monitoring database activities

Data Warehousing and Business Intelligence

- Data warehouse architecture and design
- Extract, Transform, Load (ETL) processes.
- Online Analytical Processing (OLAP) and data mining

Emerging Trends in Database Management

- NoSQL databases and big data technologies
- Cloud-based database systems
- Blockchain and distributed ledger technologies

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Database System Concepts"
   Author: Abraham Silberschatz, Henry F. Korth, S. Sudarshan
   Year: 2020
   Publisher: McGraw-Hill Education
2. Title: "Database Design for Mere Mortals: A Hands-On Guide to Relational Database Design"
   Author: Michael J. Hernandez
   Year: 2018
   Publisher: Addison-Wesley Professional
3. Title: "SQL Queries for Mere Mortals: A Hands-On Guide to Data Manipulation in SQL"
   Author: John L. Viescas, Michael J. Hernandez
   Year: 2018
   Publisher: Addison-Wesley Professional
4. Title: "Database Systems: Design, Implementation, and Management"
   Author: Carlos Coronel, Steven Morris, Peter Rob
   Year: 2019
   Publisher: Cengage Learning
5. Title: "Data Warehousing, Mining, and Business Intelligence: Concepts, Methodologies, Tools, and Applications"
   Author: Mehdi Khosrow-Pour
   Year: 2017
   Publisher: IGI Global

PROBABILITY AND STATISTICS FOR ENGINEERS

Credit Hours: 3+0=3
Pre-Requisites: Nil

DESCRIPTION

This course provides the students with a deeper understanding about the theory of probability and the concepts of statistical data analysis. It discusses the types, collection, interpretation, and analysis of statistical data and gives an insight about its use in inferential statistics like regression, confidence ranges, and hypothesis testing. The course enables the students to learn and apply the tools for curve fitting via linear regression and correlation. The course also enables them to aptly deal with the problems of probability and random functions later in their engineering degree program.

COURSE OUTLINE

Basic Statistical Parameters and Data Representation

- Importance of statistics, population, sample, variables, and measurement
- Primary and secondary data,
- Frequency distribution, stem, and leaf display,
- Histogram, frequency polygon, cumulative frequency polygon,
- Simple & Multiple Bar diagrams

Measure of Central Tendency and Dispersion

- Measures of central tendency, AM, GM, HM
- Quantiles, Mode, Applications of averages
- Quartile and mean deviation, Variance, Standard deviation,
- Moments, Moment ratios, Skewness, Kurtosis
- Applications of Measure of dispersion in Engineering

Regression, Correlation and Curve Fitting

- Regression theory, Simple linear regression line
- Correlation, coefficient of correlation,
- Fitting of a first- and second-degree curves
- Principle of least squares.

Fundamental Concepts of Probability

- Set Operation
- Sample Space
- Events and Probabilities
- Probability Axioms
- Conditional Probability
- Independence

- Bayes' Theorem

Discrete Random Variables

- Probability Mass Function
- Bernoulli, Geometric, Binomial and Poisson Random Variable
- Variance and Standard Deviation
- Conditional Probability Mass Function

Continuous Random Variables

- CDF of Continuous Random Variables
- Probability density function
- Expected Value
- Uniform, Gaussian, Standard Normal Random Variables
- Probability Models
- Error Functions and Q-Functions
- Finding probabilities of a normally distributed random variable by using Standard Normal Curve.

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Probability, Statistics and Random Processes for Electrical Engineering by Alberto Leon Garcia, 3rd Edition
2. Probability and Stochastic Processes – A friendly introduction for Electrical and Computer Engineers by Roy D. Yates & David J. Goodman, John Wiley and Sons Inc., 2005, Ed: 3rd
3. Probability, Random variables and Stochastic Processes by Papoulis and Pillai, Ed: 4th
4. Statistical Methods and Estimations by M. Anwar Solangi
5. Applied Statistics and Probability for Engineering by Douglas C. Montgomery
6. A First Course in Probability by Sheldon Ross 9th Edition, Prentice Hall

INFORMATION SECURITY

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course provides a comprehensive introduction to information security, covering the principles, techniques, and practices necessary to protect digital information from unauthorized access, use, disclosure, disruption, modification, or destruction. Students will learn about various aspects of information security, including network security, cryptography, risk management, access control, and incident response. The course emphasizes both theoretical foundations and practical applications to develop strong information security skills.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess a deep understanding of information security concepts, practices, and technologies. They will be able to identify and assess security risks, design and implement secure networks and systems, and develop and maintain secure software applications. Graduates will be proficient in incident response and disaster recovery, with the ability to contribute to the legal, ethical, and professional aspects of information security. Additionally, students will be well-prepared to address emerging trends in information security, such as cloud security, mobile device security, and the security challenges posed by the Internet of Things. Overall, this course equips students with the knowledge and skills necessary to navigate the complex and ever-changing landscape of information security.

COURSE OUTLINE

Introduction to Information Security

- Overview of information security concepts and terminology
- Evolution of information security threats and challenges
- Legal, ethical, and professional aspects of information security

Network Security

- Network vulnerabilities and attacks
- Firewalls, intrusion detection systems, and intrusion prevention systems
- Secure network design and protocols

Cryptography and Data Protection

- Principles of cryptography
- Symmetric and asymmetric encryption algorithms
- Cryptographic protocols and applications

Risk Management and Security Governance

- Risk assessment and analysis
- Security policies, standards, and procedures
- Security governance frameworks and compliance

Access Control and Identity Management

- Authentication methods and mechanisms

- Access control models: discretionary, mandatory, role-based
- Identity management and single sign-on solutions

Secure Software Development

- Secure coding practices and principles
- Software vulnerabilities and secure coding techniques
- Secure software development life cycle (SDLC)

Incident Response and Disaster Recovery

- Incident response planning and management
- Computer forensics and evidence handling
- Business continuity and disaster recovery planning

Emerging Trends in Information Security

- Cloud security and virtualization
- Mobile device security
- Internet of Things (IoT) security

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Principles of Information Security"
   Author: Michael E. Whitman, Herbert J. Mattord
   Publisher: Cengage Learning
   Year: 2020
2. Title: "Cryptography and Network Security: Principles and Practice"
   Author: William Stallings
   Publisher: Pearson
   Year: 2019
3. Title: "The CERT Guide to Insider Threats: How to Prevent, Detect, and Respond to Information Technology Crimes"
   Author: Dawn M. Cappelli, Andrew P. Moore, Randall F. Trzeciak
   Publisher: Addison-Wesley Professional
   Year: 2012
4. Title: "Security Engineering: A Guide to Building Dependable Distributed Systems"
   Author: Ross J. Anderson
   Publisher: Wiley
   Year: 2008
5. Title: "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws"
   Author: Dafydd Stuttard, Marcus Pinto
   Publisher: Wiley Year: 2020

CRYPTOGRAPHY AND NETWORK SECURITY

Credit Hours: 3+1=4

Pre-Requisites: Nil

DESCRIPTION

This course offers a comprehensive study of cryptography and network security, covering the principles, algorithms, protocols, and practices used to secure data transmission and protect information in computer networks. Students will learn about various cryptographic techniques, network security protocols, authentication mechanisms, and security management practices. The course combines theoretical foundations with hands-on exercises to develop practical skills in cryptography and network security.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess a thorough understanding of cryptographic principles, algorithms, and protocols. They will be equipped to design and implement secure communication channels, detect and counteract network threats, and establish secure access control mechanisms. Graduates will have the knowledge and skills necessary to contribute to the development and maintenance of secure network architectures, ensuring the confidentiality, integrity, and availability of information in various network environments. Additionally, students will be prepared to address the evolving challenges of wireless network security and contribute to the overall security posture of organizations.

COURSE OUTLINE

Introduction to Cryptography

- Overview of cryptography and its role in network security
- Historical development and evolution of cryptography
- Basic cryptographic concepts and terminology

Symmetric Key Cryptography

- Symmetric encryption algorithms (e.g., DES, AES)
- Modes of operation for block ciphers
- Cryptographic hash functions and message authentication codes (MAC)

Public Key Cryptography

- Public key encryption algorithms (e.g., RSA, ElGamal)
- Digital signatures and certificates
- Key management and distribution

Cryptographic Protocols

- Secure key exchange protocols (e.g., Diffie-Hellman)
- Secure communication protocols (e.g., SSL/TLS)
- Secure email and secure file transfer protocols

Network Security Principles

- Threats and vulnerabilities in computer networks
- Network attacks and countermeasures
- Network security policies and best practices

Authentication and Access Control

- Password-based authentication
- Biometric authentication
- Access control models and mechanisms

Virtual Private Networks (VPNs)

- VPN concepts and architectures
- Tunneling protocols (e.g., IPsec, SSL VPN)
- VPN deployment and management

Wireless Network Security

- Security challenges in wireless networks
- Wi-Fi security protocols (e.g., WEP, WPA, WPA2)
- Wireless intrusion detection and prevention

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Cryptography and Network Security: Principles and Practice"
   Author: William Stallings
   Publisher: Pearson
   Year: 2022
2. Title: "Introduction to Cryptography with Coding Theory"
   Author: Wade Trappe, Lawrence C. Washington
   Publisher: Pearson
   Year: 2014
3. Title: "Applied Cryptography: Protocols, Algorithms, and Source Code in C"
   Author: Bruce Schneier
   Publisher: Wiley
   Year: 1995
4. Title: "Network Security Essentials: Applications and Standards"
   Author: William Stallings
   Publisher: Pearson

Year: 2017

5. Title: "Wireshark Network Analysis: The Official Wireshark Certified Network Analyst Study Guide"
   Author: Laura Chappell, Gerald Combs
   Publisher: Laura Chappell University
   Year: 2017

COMPUTER FORENSICS

Credit Hours: 3+1=4

Pre-Requisites: Nil

DESCRIPTION

This course provides a comprehensive overview of computer forensics, focusing on the principles, techniques, and practices used to investigate and analyze digital evidence in computer systems. Students will learn about the legal and ethical aspects of computer forensics, as well as the tools and methodologies employed to collect, preserve, and analyze digital evidence. The course combines theoretical knowledge with hands-on practical exercises to develop the necessary skills for computer forensic investigations

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess a deep understanding of computer forensics principles, methodologies, and techniques. They will be equipped to conduct comprehensive digital investigations, recover and analyze digital evidence, and contribute to incident response efforts. Graduates will have the skills necessary to conduct forensic analysis on various operating systems, mobile devices, and digital platforms. Additionally, students will be prepared to address challenges in malware analysis, memory forensics, and online investigations. The course emphasizes ethical and legal considerations, preparing students for expert witness testimony and ensuring the admissibility of digital evidence in legal proceedings. Overall, graduates will be well-prepared to contribute to the field of computer forensics and play a crucial role in addressing cyber threats and incidents.

COURSE OUTLINE

Introduction to Computer Forensics

- Overview of computer forensics and its role in digital investigations
- Legal and ethical considerations in computer forensic examinations
- Digital evidence and the forensic investigation process

File Systems and Disk Analysis

- File system fundamentals and analysis techniques
- Disk imaging and data recovery
- File carving and deleted file recovery

Data Acquisition and Preservation

- Methods and tools for acquiring digital evidence.
- Evidence handling and preservation best practices.
- Chain of custody and documentation

Network Forensics

- Network protocols and packet analysis
- Intrusion detection and log analysis
- Investigating network-based attacks

Forensic Analysis of Operating Systems

- Windows forensics: registry analysis, event logs, and artifacts
- Linux and macOS forensics: file system analysis and system logs
- Live system forensics and memory analysis

Mobile and Digital Device Forensics

- Mobile device forensics: iOS and Android investigations
- Digital device forensics: cameras, GPS devices, and IoT devices
- Cloud forensics and online investigations

Malware and Memory Forensics

- Malware analysis techniques and tools
- Memory forensics: analyzing volatile data
- Rootkit detection and analysis

Incident Response and Reporting

- Incident response procedures and methodologies
- Writing forensic reports and presenting findings
- Expert witness testimony and legal considerations

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Computer Forensics: Cybercriminals, Laws, and Evidence"
   Author: Marie-Helen Maras
   Publisher: Pearson
   Year: 2019
2. Title: "Computer Forensics: Investigating File and Operating Systems, Wireless Networks, and Storage"
   Author: EC-Council
   Publisher: Cengage Learning
   Year: 2017
3. Title: "File System Forensic Analysis"
   Author: Brian Carrier
   Publisher: Addison-Wesley Professional
   Year: 2020
4. Title: "The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics"
   Author: John Sammons
   Publisher: Syngress
   Year: 2014

5. Title: "Digital Forensics and Incident Response: From the Field"
   Author: Gerard Johansen, Paula K. Johansen
   Publisher: CRC Press
   Year: 2021

SOFTWARE AND SYSTEMS SECURITY

Credit Hours: 2+1=3

Pre-Requisites: Nil

DESCRIPTION

This course provides a comprehensive study of software and systems security, focusing on the principles, techniques, and practices used to secure software applications and computer systems. Students will learn about common vulnerabilities, attack vectors, and security countermeasures for protecting software and systems against threats. The course covers topics such as secure coding practices, secure software development life cycle, security assessment and testing, secure system administration, and security architectures.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess a deep understanding of software and systems security principles, techniques, and best practices. They will be equipped to develop secure software, assess and test for vulnerabilities, implement effective security measures in web applications, networks, and systems, and respond to security incidents. Graduates will have the skills necessary to design and administer secure computing environments, considering emerging trends such as cloud computing, mobile and IoT security, and blockchain technologies. Overall, the course prepares students for careers in software and systems security, where they can contribute to the protection of digital assets and the ongoing development of secure computing practices.

COURSE OUTLINE

Introduction to Software and Systems Security

- Overview of software and systems security concepts
- Common security threats and attack vectors
- Legal and ethical considerations in security

Secure Software Development Life Cycle (SDLC)

- Secure coding practices and principles
- Threat modeling and risk assessment
- Security requirements engineering

Security Assessment and Testing

- Static and dynamic analysis techniques
- Penetration testing and vulnerability assessment
- Security code review and debugging

Web Application Security

- Web application vulnerabilities and attacks
- Secure authentication and authorization
- Input validation and output encoding

Network and System Security

- Network security protocols and mechanisms
- Host and server hardening

- Intrusion detection and prevention systems

Cryptography in Software and Systems Security

- Cryptographic protocols and algorithms
- Key management and secure key storage
- Cryptographic attacks and countermeasures

Security Administration and Incident Response

- System administration best practices
- Security policies and access control
- Incident handling and response procedures

Emerging Trends in Software and Systems Security

- Cloud security and virtualization
- Mobile and IoT security
- Blockchain and decentralized systems security

SUGGESTED TEACHING AND ASSESSMENT METHODS

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Security Engineering: A Guide to Building Dependable Distributed Systems"
   Author: Ross J. Anderson
   Publisher: Wiley
   Year: 2020
2. Title: "Secure Coding in C and C++"
   Author: Robert C. Seacord
   Publisher: Addison-Wesley Professional
   Year: 2013
3. Title: "The Tangled Web: A Guide to Securing Modern Web Applications"
   Author: Michal Zalewski
   Publisher: No Starch Press
   Year: 2011
4. Title: "Applied Cryptography: Protocols, Algorithms, and Source Code in C"
   Author: Bruce Schneier
   Publisher: Wiley
   Year: 1995
5. Title: "Hacking: The Art of Exploitation"
   Author: Jon Erickson
   Publisher: No Starch Press
   Year: 2008

MOBILE SECURITY/ ENDPOINT SECURITY

Credit Hours: 3+1=4
Pre-Requisites: Nil

DESCRIPTION

This course offers a comprehensive study of mobile security and endpoint security, focusing on the principles, techniques, and best practices for securing mobile devices and endpoints in enterprise environments. Students will learn about the unique security challenges posed by mobile platforms and endpoint devices, including threats to data privacy, device integrity, and application security. The course covers topics such as mobile device security configuration, endpoint protection strategies, secure application development, and incident response

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess in-depth knowledge of mobile and endpoint security concepts, strategies, and technologies. They will be equipped to implement effective security measures for mobile devices and endpoints, address vulnerabilities in mobile applications, and respond to security incidents. Graduates will have the skills necessary to protect data on mobile devices, ensure secure network connectivity, and navigate the evolving landscape of mobile and endpoint security. Additionally, students will be prepared to address emerging trends, including IoT security and cloud-based mobile security solutions, contributing to the overall security posture of organizations in an increasingly mobile-centric computing environment.

COURSE OUTLINE

Introduction to Mobile and Endpoint Security

- Overview of mobile and endpoint security concepts
- Mobile device and endpoint landscape
- Legal and ethical considerations in mobile and endpoint security

Mobile Device Security

- Mobile device vulnerabilities and threats
- Mobile device configuration and hardening
- Mobile device management and security policies

Mobile Application Security

- Mobile application vulnerabilities and risks
- Secure mobile application development practices
- Mobile application security testing and assessment

Endpoint Protection

- Endpoint security challenges and solutions
- Endpoint protection platforms and technologies
- Endpoint security policies and controls

Data Protection and Privacy

- Data protection mechanisms on mobile devices and endpoints
- Secure data storage and transmission
- Privacy considerations in mobile and endpoint security

Network Security for Mobile and Endpoints

- Secure network connectivity for mobile devices and endpoints
- VPN and secure communication protocols
- Wireless network security considerations

Incident Response and Forensics

- Incident response procedures for mobile and endpoint security incidents
- Digital forensics in mobile and endpoint investigations
- Incident recovery and lessons learned.

Emerging Trends in Mobile and Endpoint Security

- Internet of Things (IoT) security considerations
- Cloud-based mobile security solutions
- Mobile threat intelligence and detection

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Mobile Security: How to Secure, Privatize, and Recover Your Devices"
   Author: Tim Speed, Joe Grand, Ray Davidson, et al.
   Publisher: McGraw-Hill Education
   Year: 2019
2. Title: "Endpoint Security"
   Author: Mark Kadrich
   Publisher: Apress
   Year: 2019
3. Title: "Mobile Application Security"
   Author: Himanshu Dwivedi
   Publisher: McGraw-Hill Education
   Year: 2014
4. Title: "Mobile Forensic Investigations: A Guide to Evidence Collection, Analysis, and Presentation"
   Author: Lee Reiber
   Publisher: McGraw-Hill Education Year: 2018
5. Title: "Mobile Security and Privacy: Advances, Challenges and Future Research Directions"
   Author: Man Ho Au, Raymond Choo, Shujun Li, et al.
   Publisher: Springer Year: 2017

Major Based Core (MBC) Depth Electives
• Security Management and Risk Assessment • Vulnerability Assessment and Penetration testing • Cloud Architecture & Security • Malware reverse engineering • Web Application Security • IoT Security • Ethical Hacking • Cyber Crime and Law • Secure Software Engineering • Data Protection and Disaster Recovery • Information Security Compliance • Cyber Threat Intelligence • Incident Response • Network Forensics • Database Security • Secure Intelligent Systems

SECURITY MANAGEMENT AND RISK ASSESSMENT

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course provides an in-depth understanding of security management principles and risk assessment techniques. Students will learn how to develop and implement effective security strategies to protect assets, mitigate risks, and ensure business continuity. The course covers various aspects of security management, including threat assessment, risk analysis, security policies, incident response, and security governance. Through practical case studies and real-world examples, students will gain the knowledge and skills necessary to manage security risks in today's complex and evolving threat landscape.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess a comprehensive understanding of security management principles and practices. They will be equipped to assess and manage risks, develop and enforce effective security policies, and respond to security incidents and crises. Graduates will have the skills necessary to ensure compliance with regulatory standards, implement security technologies, and contribute to the development and maintenance of business continuity plans. Additionally, students will be prepared to address emerging trends in security management, including the integration of new technologies and evolving threat landscapes. Overall, the course prepares students for leadership roles in security management, where they can contribute to the resilience and security of organizations in a dynamic and challenging environment.

COURSE OUTLINE

Introduction to Security Management

- Overview of security management principles
- Importance of risk assessment in security management
- Legal and ethical considerations in security management

Threat Assessment and Risk Analysis

- Understanding threats and vulnerabilities
- Risk identification, assessment, and prioritization
- Risk mitigation strategies and controls

Security Policies and Procedures

- Developing effective security policies and procedures
- Policy implementation and enforcement
- Monitoring and evaluation of policy effectiveness

Incident Response and Crisis Management

- Incident response planning and execution
- Incident detection, containment, and recovery
- Crisis management and communication strategies

Security Governance and Compliance

- Security governance frameworks and models
- Compliance requirements and regulatory standards
- Auditing and assurance in security management

Security Technologies and Tools

- Overview of security technologies and their roles
- Security assessment tools and methodologies
- Security awareness and training programs

Business Continuity Planning

- Understanding business continuity and its importance
- Business impact analysis and recovery strategies
- Testing and maintenance of business continuity plans

Emerging Trends in Security Management

- Security in the digital age: IoT, cloud, and virtualization
- Cybersecurity management and threat intelligence
- Security risk assessment in a changing threat landscape

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Security Management: A Critical Thinking Approach"
   Author: Karim Vellani
   Publisher: Butterworth-Heinemann
   Year: 2018
2. Title: "Effective Security Management"
   Author: Charles A. Sennewald, Curtis Baillie
   Publisher: Butterworth-Heinemann
   Year: 2016
3. Title: "Risk Assessment: Tools, Techniques, and Their Applications"
   Author: Lee T. Ostrom, Cheryl A. Wilhelmsen
   Publisher: CRC Press
   Year: 2012
4. Title: "Business Continuity and Risk Management: Essentials of Organizational Resilience"
   Author: Kurt J. Engemann, Douglas M. Henderson
   Publisher: Rothstein Associates Inc.
   Year: 2014
5. Title: "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up"
   Author: Evan Wheeler
   Publisher: Syngress Year: 2011

VULNERABILITY ASSESSMENT AND PENETRATION TESTING

Credit Hours: 3

Pre-Requisites: Nil

DESCRIPTION

This course provides a comprehensive study of vulnerability assessment and penetration testing, focusing on the principles, methodologies, and tools used to identify and mitigate security vulnerabilities in computer systems, networks, and applications. Students will learn the fundamentals of vulnerability assessment, including vulnerability scanning techniques and analysis, as well as the techniques and best practices for conducting penetration tests. The course covers topics such as reconnaissance, vulnerability exploitation, post-exploitation, and reporting

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess advanced skills in vulnerability assessment and penetration testing. They will be equipped to identify, assess, and exploit security vulnerabilities in a variety of environments, including web applications, networks, and physical security systems. Graduates will have the knowledge and expertise to conduct social engineering assessments and red teaming exercises, providing a holistic evaluation of an organization's security posture. Additionally, students will be proficient in generating comprehensive reports and recommendations for remediation, contributing to the overall security resilience of organizations.

COURSE OUTLINE

Introduction to Vulnerability Assessment and Penetration Testing

- Overview of vulnerability assessment and penetration testing concepts
- Legal and ethical considerations in vulnerability assessment and penetration testing
- Security standards and frameworks related to assessment and testing.

Information Gathering and Reconnaissance

- Passive and active information gathering techniques.
- Network scanning and enumeration
- Open-source intelligence (OSINT) gathering.

Vulnerability Assessment

- Vulnerability scanning and analysis tools.
- Vulnerability assessment methodologies
- Vulnerability identification and prioritization

Exploitation and Penetration Testing

- Exploitation techniques and tools
- Penetration testing methodologies and frameworks

- Privilege escalation and post-exploitation activities

Web Application Testing

- Web application security vulnerabilities
- Web application testing methodologies
- OWASP Top 10 and beyond

Network and Infrastructure Testing

- Network security assessment techniques
- Wireless network penetration testing
- IoT security testing

Social Engineering and Physical Security Testing

- Social engineering tactics and techniques
- Physical security assessment and testing
- Red teaming exercises

Reporting and Remediation

- Vulnerability assessment reports and recommendations
- Penetration testing reporting and deliverables
- Vulnerability remediation and management

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws"
   Author: Dafydd Stuttard, Marcus Pinto
   Publisher: Wiley
   Year: 2011
2. Title: "Metasploit: The Penetration Tester's Guide"
   Author: David Kennedy, Jim O'Gorman, Devon Kearns, Mati Aharoni
   Publisher: No Starch Press
   Year: 2011
3. Title: "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy"
   Author: Patrick Engebretson
   Publisher: Syngress
   Year: 2013
4. Title: "The Art of Software Security Assessment: Identifying and Preventing Software Vulnerabilities"
   Author: Mark Dowd, John McDonald, Justin Schuh
   Publisher: Addison-Wesley Professional

Year: 2006
5. Title: "Penetration Testing: A Hands-On Introduction to Hacking"
Author: Georgia Weidman
Publisher: No Starch Press
Year: 2014

CLOUD ARCHITECTURE ENGINEERING & SECURITY

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This in-depth course on Cloud Computing and Security covers a wide spectrum of topics, starting from fundamental concepts to practical hands-on experiences with major cloud service providers. It provides a thorough understanding of cloud deployment models, security architecture, and data protection strategies. Emphasis is placed on secure isolation of infrastructure components and effective access control measures. The course also explores the emerging field of cloud forensics and delves into high-performance parallel computing using technologies like Hadoop and MapReduce. The hands-on component allows students to apply theoretical knowledge on popular public cloud platforms, ensuring they gain practical expertise. By the end of the course, students will possess a holistic skill set, well-prepared to navigate the intricacies of cloud computing and security, make informed decisions, and contribute effectively to this dynamic field.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess a deep understanding of cloud computing fundamentals, security design principles, and data protection strategies. They will be proficient in enforcing access controls, monitoring cloud environments, and conducting cloud forensics. Additionally, students will gain hands-on experience with public cloud services and explore cutting-edge technologies, preparing them to address complex challenges in cloud computing and security.

COURSE OUTLINE

- **Fundamentals of Cloud Computing and Architectural Characteristics**: Introduction to Cloud Computing, Understand the Cloud deployment models, Scope of Control: SaaS, PaaS, IaaS, Cloud Computing Roles, Risks and Security Concerns.
- **Security Design and Architecture for Cloud Computing**: Guiding Security design principles for Cloud Computing, Common attack vectors and threats.
- **Secure Isolation of Physical & Logical Infrastructure**: Isolation: Compute, Network and Storage, Secure Isolation Strategies.

- **Data Protection for Cloud Infrastructure and Services:** Understand the Cloud based Information Life Cycle, Data protection for Confidentiality and Integrity, Management, Assuring data deletion, Data Protection Strategies.
- **Enforcing Access Control for Cloud Infrastructure based Services:** Understand the access control requirements for Cloud infrastructure, Common attack vectors and threats, Enforcing Access Control Strategies: Compute, Network and Storage.
- **Monitoring, Auditing and Management:** Proactive activity monitoring, Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges, IDS, Auditing – Record generation, Reporting and Management, Quality of Services, Secure Management.
- **Cloud Identity and Access Management:** Provisioning and De-provisioning, Centralized Directory Services, Privileged User Management, Access Policy Management, Audit and Reporting, Cloud Trust Management: Models and Techniques, Cloud Policies: How to write policies, XACML, SAML.
- **Cloud Forensics:** Step-by-step approach to understanding the science of cloud forensics Identification, examination, collection and analysis of cloud data.
- **High Performance Parallel Computing with Cloud:** Analyze different parallel processing principles including data dependency, processor communication, mapping, granularity, and concurrency, etc. Introduction to Hadoop, Dyrad and CGL MapReduce, Discussing different parallel processing use-cases. Implementation of complex problems using parallel processing such as matrix multiplication.
- **Case Study and Hands-On:** Study existing public cloud infrastructures such as AWS, google cloud etc., Sign-up for a free-tier account, create a S3 bucket through, Launch an EC2 instance, Advanced level architectural hands-on including new user creation, policy creation, credential rotation for IAM users, hosting a Static Website on the public cloud, Migrating and retrieving data from the public cloud
- **Introducing state-of-the-art cloud services such as block chain-as-a-service**
- **Searchable Encryption-as-a-Service**
- **Monitoring-as-a-service etc. and different use cases.**

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field

visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Cloud Computing Security, Foundations and Challenges, First Edition, John R. Vacca
2. Securing the Cloud: Cloud Computer Security Techniques and Tactics, First Edition

MALWARE REVERSE ENGINEERING

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course provides an in-depth exploration of malware reverse engineering techniques. Students will learn the fundamentals of analyzing malicious software to understand its behavior, identify vulnerabilities, and develop effective countermeasures. The course covers various aspects of reverse engineering, including static and dynamic analysis, malware detection, code DE obfuscation, and malware classification. Students will also gain hands-on experience using industry-standard tools and techniques to dissect real-world malware samples.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess advanced skills in malware reverse engineering. They will be able to analyze malware using both static and dynamic analysis techniques, understand malware behavior, and employ advanced methods to reverse engineer sophisticated threats. Graduates will be proficient in detecting and mitigating malware, attributing malware to specific threat actors, and implementing effective defenses against evolving threats. Additionally, students will be well-equipped to contribute to incident response efforts and develop strategies for securing systems against malware attacks in diverse computing environments.

COURSE OUTLINE

Introduction to Malware Reverse Engineering

- Overview of malware types and their impact
- Ethics and legal considerations in malware analysis
- Introduction to reverse engineering concepts and methodologies

Malware Analysis Techniques

- Static analysis: File structure, header analysis, and disassembly
- Dynamic analysis: Debugging, monitoring system behavior, and runtime analysis
- Code deobfuscation and unpacking techniques

Malware Behavior Analysis

- Studying malicious code execution flow
- Identifying and analyzing malware payloads and network communications
- Memory forensics and runtime behavior analysis

Malware Detection and Evasion Techniques

- Signature-based detection and pattern matching
- Heuristic and behavioral analysis

- Anti-reverse engineering and anti-debugging techniques employed by malware.

Advanced Malware Reverse Engineering

- Rootkit analysis and detection
- Reverse engineering of mobile malware
- Analyzing malware targeting specific platforms or architectures

Malware Classification and Attribution

- Taxonomy and classification of malware families
- Identifying common characteristics and code reuse
- Techniques for attributing malware to specific threat actors or campaigns

Malware Mitigation and Defense

- Developing effective countermeasures and defenses against malware
- Malware incident response and recovery strategies
- Best practices for securing systems against malware attacks

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. "Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software" by Michael Sikorski and Andrew Honig
   Publisher: No Starch Press
2. "Malware Analyst's Cookbook: Tools and Techniques for Fighting Malicious Code" by Michael Ligh, Steven Adair, Blake Hartstein, and Matthew Richard
   Publisher: Wiley
3. "The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory" by Michael Hale Ligh, Andrew Case, Jamie Levy, and AAron Walters
   Publisher: Wiley
4. "The IDA Pro Book: The Unofficial Guide to the World's Most Popular Disassembler" by Chris Eagle
   Publisher: No Starch Press
5. "Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation" by Bruce Dang, Alexandre Gazet, Elias Bachaalany, and Sébastien Josse
   Publisher: Wiley

WEB APPLICATION SECURITY

Credit Hours: 3

Pre-Requisites: Nil

DESCRIPTION

This course provides an in-depth understanding of web application security principles, techniques, and best practices. Students will learn how to identify common vulnerabilities in web applications and implement effective security measures to protect against various attacks. The course covers topics such as authentication, authorization, session management, input validation, secure coding practices, and security testing methodologies.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess the knowledge and skills necessary to secure web applications effectively. They will understand common threats and vulnerabilities, implement secure coding practices, and utilize tools and techniques for web application security testing. Graduates will be capable of configuring and managing Web Application Firewalls (WAFs) and conducting comprehensive security assessments, contributing to the development of secure and resilient web applications. Additionally, students will be well-equipped to address emerging challenges and trends in web application security.

COURSE OUTLINE

Introduction to Web Application Security

- Overview of web application security
- Common threats and vulnerabilities
- Security principles and best practices

Web Application Architecture

- Client-side versus server-side security
- Understanding web application components
- Secure coding guidelines

Authentication and Authorization

- User authentication methods
- Secure password storage
- Role-based access control

Input Validation and Output Encoding

- Importance of input validation
- Common input validation vulnerabilities
- Output encoding and XSS prevention.

Secure Coding Practices

- Secure coding guidelines and principles
- Secure coding in popular programming languages
- Handling file uploads securely

Introduction to WAFs

- Configuring and managing a WAF
- WAF evasion techniques

Web Application Security Testing

- Techniques for testing web application security
- Vulnerability scanning and penetration testing.
- Code review and security auditing

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws"
   Author: Dafydd Stuttard, Marcus Pinto
   Publisher: Wiley
   Year: 2021
2. Title: "Web Application Security: A Beginner's Guide"
   Author: Bryan Sullivan, Vincent Liu, Michael Howard
   Publisher: McGraw-Hill Education
   Year: 2020
3. Title: "OWASP Testing Guide v4"
   Author: Andrew van der Stock et al.
   Publisher: CreateSpace Independent Publishing Platform
   Year: 2014
4. Title: "Secure Programming with Static Analysis"
   Author: Brian Chess, Jacob West
   Publisher: Addison-Wesley Professional
   Year: 2007
5. Title: "The Tangled Web: A Guide to Securing Modern Web Applications"
   Author: Michal Zalewski
   Publisher: No Starch Press
   Year: 2011

IOT SECURITY

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course explores the fundamental concepts and challenges associated with securing Internet of Things (IoT) devices and networks. Students will gain knowledge and practical skills to identify vulnerabilities, mitigate risks, and implement security measures in IoT systems. The course covers topics such as IoT architecture, communication protocols, authentication, encryption, secure firmware development, and security monitoring in IoT environments.

COURSE LEARNING OUTCOMES

Upon completing this course, students will have a deep understanding of IoT security challenges and possess the skills to implement robust security measures in IoT systems. They will be proficient in securing IoT communication, authenticating devices, implementing encryption, and ensuring secure firmware development. Graduates will be equipped to address network security in IoT environments, including the protection of gateways and edge devices. Additionally, students will gain expertise in security monitoring and incident response tailored for the unique characteristics of IoT systems. Overall, the course prepares students to contribute to the development and maintenance of secure and resilient IoT ecosystems.

COURSE OUTLINE

Introduction to IoT Security

- Overview of IoT security challenges
- IoT architecture and components
- Threat modeling in IoT systems

IoT communication protocols

- Common IoT communication protocols
- Security considerations for IoT protocols
- Securing data transmission and integrity

Authentication and Access Control

- Authentication methods for IoT devices
- Role-based access control in IoT networks
- Device provisioning and secure bootstrapping

Encryption and Cryptography in IoT

- Symmetric and asymmetric encryption in IoT
- Key management and secure key exchange
- Secure protocols for IoT device communication

Secure Firmware Development

- Secure coding practices for IoT devices
- Secure over-the-air (OTA) updates
- Secure storage and memory protection

IoT Network Security

- Securing IoT gateways and edge devices
- Network segmentation and isolation
- Intrusion detection and prevention in IoT networks

IoT Security Monitoring and Incident Response

- Security monitoring and log management
- Real-time threat detection in IoT environments
- Incident response and recovery in IoT systems

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Practical IoT Security: A Practical Guide to Building Secure Connected Devices and Applications"
   Author: Brian Russell, Drew Van Duren
   Publisher: Packt Publishing
   Year: 2022
2. Title: "IoT Security: A Comprehensive Handbook"
   Author: Nitesh Dhanjani, Billy Rios, Brett Hardin
   Publisher: Elsevier
   Year: 2018
3. Title: "Building Secure and Reliable IoT Applications: Overcoming Limitations in IoT Security"
   Author: Daniele Antonioli, Lorenzo Fontana, Kasper Rasmussen
   Publisher: O'Reilly Media
   Year: 2020
4. Title: "Security Engineering for the Internet of Things: Designs and Standards"
   Author: Kumar A. Shiralagi, Indrakshi Ray, Indrajit Ray
   Publisher: CRC Press
   Year: 2020
5. Title: "IoT Security: Protecting Connected Devices"
   Author: James Cannady
   Publisher: Apress
   Year: 2019

ETHICAL HACKING

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course provides a comprehensive introduction to ethical hacking, focusing on the techniques, tools, and methodologies used to identify and mitigate security vulnerabilities. Students will learn the principles of ethical hacking, legal considerations, and various attack vectors. The course covers topics such as reconnaissance, scanning, enumeration, exploitation, post-exploitation, and ethical hacking best practices.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess the skills and knowledge necessary to ethically hack systems, networks, and applications. They will be proficient in reconnaissance, scanning, exploitation, and post-exploitation activities, contributing to effective penetration testing. Graduates will also understand the legal and ethical considerations surrounding ethical hacking, enabling them to operate responsibly. Overall, the course prepares students to contribute to cybersecurity efforts by identifying and addressing vulnerabilities in a proactive and ethical manner.

COURSE OUTLINE

Introduction to Ethical Hacking

- Understanding ethical hacking and its importance
- Legal and ethical considerations
- Overview of common attack types

Foot printing and Reconnaissance

- Gathering information about the target system
- Techniques for foot printing and information gathering.
- Tools for reconnaissance in ethical hacking

Scanning and Enumeration

- Port scanning and vulnerability scanning
- Service enumeration and fingerprinting
- Identifying potential targets and vulnerabilities

System Hacking and Exploitation

- Exploiting vulnerabilities in operating systems
- Privilege escalation techniques
- Buffer overflow attacks and shellcode development

Network Hacking and Wireless Security

- Network enumeration and sniffing
- Man-in-the-middle attacks.
- Wireless network security and cracking techniques

Web Application Security Testing

- Understanding web application vulnerabilities
- SQL injection, cross-site scripting (XSS), and CSRF attacks
- Web application penetration testing methodologies

Social Engineering and Physical Security

- Techniques for social engineering attacks
- Physical security assessments and bypassing techniques
- Social engineering prevention and awareness

Post-Exploitation and Penetration Testing

- Maintaining access and post-exploitation activities
- Introduction to penetration testing
- Reporting and documentation in ethical hacking

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws"
   Author: Dafydd Stuttard, Marcus Pinto
   Publisher: Wiley
   Year: 2021
2. Title: "Metasploit: The Penetration Tester's Guide"
   Author: David Kennedy, Jim O'Gorman, Devon Kearns, Mati Aharoni
   Publisher: No Starch Press
   Year: 2011
3. Title: "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy"
   Author: Patrick Engebretson
   Publisher: Syngress
   Year: 2013
4. Title: "Social Engineering: The Science of Human Hacking"
   Author: Christopher Hadnagy
   Publisher: Wiley
   Year: 2018
5. Title: "The Art of Intrusion: The Real Stories Behind the Exploits of Hackers, Intruders & Deceivers"
   Author: Kevin D. Mitnick, William L. Simon
   Publisher: Wiley
   Year: 2005

CYBER CRIME AND LAW

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course examines the legal aspects and implications of cybercrime, focusing on the laws, regulations, and international frameworks related to cybercrime prevention, investigation, and prosecution. Students will explore various types of cybercrimes, their impact on individuals and organizations, and the legal measures in place to combat cyber threats. The course covers topics such as cybercrime legislation, digital forensics, cyber incident response, privacy laws, and ethical considerations in cybercrime investigations.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess a thorough understanding of cybercrime, its legal implications, and the strategies employed to combat it. They will be equipped with the skills to investigate cyber incidents, analyze digital evidence ethically, and collaborate with law enforcement agencies. Graduates will also have a solid understanding of privacy laws and data protection, ensuring compliance with relevant regulations. The course prepares students to navigate the complex landscape of cybercrime investigations, applying ethical standards and contributing to the development of effective cybersecurity policies and practices.

COURSE OUTLINE

Introduction to Cyber Crime and Law

- Understanding cybercrime and its impact
- Overview of cybercrime laws and regulations
- International cooperation in combating cyber threats.

Types of Cyber Crimes

- Computer hacking and unauthorized access
- Cyber fraud and financial crimes
- Cyber harassment, stalking, and bullying

Legal Framework for Cyber Crime

- Cybercrime legislation and jurisdiction
- Investigating and prosecuting cybercriminals
- Legal challenges in cybercrime cases

Introduction to digital forensics

- Collecting and analyzing digital evidence
- Chain of custody and admissibility of digital evidence
- Module 5: Cyber Incident Response and Management

Cyber Incident Response and Management

- Incident response planning and procedures
- Handling cyber incidents and breach investigations
- Collaboration with law enforcement and incident reporting

Privacy Laws and Data Protection

- Overview of privacy laws and regulations
- GDPR, CCPA, and other privacy frameworks
- Data breach notification and compliance requirements

Ethical Considerations in Cyber Crime Investigations

- Ethics in digital investigations
- Balancing privacy and security concerns
- Professional standards for cybercrime investigators

Cyber Crime and Law Case Studies

- Analysis of real-world cybercrime cases
- Legal challenges and outcomes
- Lessons learned and best practices.

SUGGESTED TEACHING AND ASSESSMENT METHODS

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Cybercrime and Digital Forensics: An Introduction"
   Author: Thomas J. Holt, Adam M. Bossler
   Publisher: Routledge
   Year: 2021
2. Title: "Cybercrime: The Investigation, Prosecution and Defense of a Computer-Related Crime"
   Author: Ralph D. Clifford
   Publisher: Routledge
   Year: 2018
3. Title: "Computer Crime, Investigation, and the Law"
   Author: Chuck Easttom
   Publisher: Cengage Learning
   Year: 2019
4. Title: "Digital Forensics and Cyber Crime: Fifth International ICST Conference, ICDF2C 2013, Moscow, Russia, September 26-27, 2013, Revised Selected Papers"
   Author: Petr Matousek et al.
   Publisher: Springer
   Year: 2014

5. Title: "Cybercrime and the Law: Challenges, Issues, and Outcomes"
   Author: Susan W. Brenner
   Publisher: Routledge
   Year: 2018

SECURE SOFTWARE ENGINEERING

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course offers a comprehensive study of secure software engineering and testing, focusing on the principles, methodologies, and best practices for developing and testing secure software applications. Students will learn about the secure software development life cycle (SDLC), secure coding practices, and techniques for identifying and mitigating software vulnerabilities. The course covers topics such as threat modeling, secure requirements engineering, security testing, and secure software deployment.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess the skills and knowledge needed to design, develop, and maintain secure software applications. They will understand the importance of integrating security throughout the software development life cycle and be proficient in secure coding practices, testing methodologies, and deployment strategies. Graduates will also be aware of emerging trends in secure software engineering, including DevOps integration, cloud security, and considerations for mobile and IoT applications. Overall, the course prepares students to contribute to the development of secure and resilient software systems in a dynamic and evolving cybersecurity landscape.

COURSE OUTLINE

Introduction to Secure Software Engineering

- Overview of secure software engineering concepts and principles
- Legal and ethical considerations in secure software development
- Secure software development life cycle (SDLC) models

Threat Modeling and Secure Requirements Engineering

- Threat modeling methodologies and techniques
- Secure requirements elicitation and analysis
- Security use cases and abuse cases

Secure Design and Architecture

- Secure design principles and patterns
- Secure software architecture and component selection
- Security controls and mechanisms

Secure Coding Practices

- Secure coding guidelines and best practices
- Input validation and output encoding

- Handling of sensitive data and secure memory management

Security Testing

- Security testing methodologies and techniques
- Static and dynamic code analysis
- Security testing tools and automation

Secure Software Deployment and Maintenance

- Secure software deployment strategies
- Patch management and vulnerability remediation
- Secure software maintenance and updates

Secure Software Assurance

- Software security assurance processes
- Security requirements traceability and verification
- Third-party software security considerations

Emerging Trends in Secure Software Engineering

- Secure DevOps and continuous integration/continuous deployment (CI/CD)
- Secure software development for cloud and container environments
- Secure coding for mobile and IoT applications

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Secure Coding in C and C++"Author: Robert C. Seacord
   Publisher: Addison-Wesley Professional
   Year: 2013
2. Title: "The Art of Software Security Testing: Identifying Software Security Flaws"
   Author: Chris Wysopal, Lucas Nelson, Dino Dai Zovi, Elfriede Dustin
   Publisher: Addison-Wesley Professional
   Year: 2006
3. Title: "Threat Modeling: Designing for Security"
   Author: Adam Shostack
   Publisher: Wiley
   Year: 2014
4. Title: "Secure Software Development: A Security Programmer's Guide"
   Author: Jason Grembi
   Publisher: CRC Press
   Year: 2018

5. Title: "Building Secure Software: How to Avoid Security Problems the Right Way"
Author: John Viega, Gary McGraw
Publisher: Addison-Wesley Professional
Year: 2002

DATA PROTECTION AND DISASTER RECOVERY

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course provides a comprehensive study of data protection and disaster recovery, focusing on the principles, strategies, and best practices for safeguarding data assets and ensuring business continuity in the face of potential disasters. Students will learn about data protection technologies, backup and recovery solutions, and disaster recovery planning. The course covers topics such as data backup and replication, data encryption, disaster recovery methodologies, and incident response.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess the knowledge and skills necessary to design, implement, and manage effective data protection and disaster recovery strategies. They will understand legal and regulatory requirements, be proficient in backup and recovery technologies, and be capable of developing comprehensive disaster recovery plans. Graduates will also be prepared to address emerging trends, ensuring organizations can adapt to new challenges in data protection and disaster recovery. Overall, the course equips students to contribute to the resilience and security of organizational data in the face of potential threats and disasters.

COURSE OUTLINE

Introduction to Data Protection and Disaster Recovery

- Overview of data protection and disaster recovery concepts
- Legal and regulatory requirements for data protection
- Business impact analysis and risk assessment

Data Backup and Replication

- Data backup strategies and methodologies
- Backup and recovery technologies and tools
- Replication techniques for data redundancy

Data Storage and Encryption

- Data storage technologies and architectures
- Data encryption algorithms and protocols
- Key management and secure data storage practices

Disaster Recovery Solutions and Technologies

- High availability and fault tolerance
- Virtualization and cloud-based disaster recovery
- Data center recovery and alternative processing sites

Disaster Recovery Planning and Business Continuity

- Disaster recovery planning methodologies
- Recovery time objectives (RTO) and recovery point objectives (RPO)

- Business continuity management and strategies

Incident Response and Crisis Management

- Incident response planning and execution
- Crisis communication and stakeholder management
- Post-incident analysis and lessons learned.

Data Protection Regulations and Compliance

- Data protection regulations and frameworks (e.g., GDPR, CCPA)
- Compliance requirements for data protection
- Privacy considerations in data protection and disaster recovery

Emerging Trends in Data Protection and Disaster Recovery

- Data protection in hybrid and multi-cloud environments
- Ransomware mitigation and recovery strategies
- Artificial intelligence and automation in disaster recovery

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Data Protection: Governance, Risk Management, and Compliance"
   Author: Theo Zschaler, Sebastian Meissner
   Publisher: Springer
   Year: 2020
2. Title: "Disaster Recovery Planning: Preparing for the Unthinkable"
   Author: Jon William Toigo
   Publisher: Prentice Hall
   Year: 2014
3. Title: "Enterprise Data Protection: Guidelines and Best Practices for Data Loss Prevention"
   Author: Giampiero Nanni
   Publisher: CRC Press
   Year: 2015
4. Title: "The Disaster Recovery Handbook: A Step-by-Step Plan to Ensure Business Continuity and Protect Vital Operations, Facilities, and Assets"
   Author: Michael Wallace, Lawrence Webber
   Publisher: AMACOM
   Year: 2017
5. Title: "Data Protection and Information Lifecycle Management"
   Author: Tom Petrocelli
   Publisher: Auerbach Publications
   Year: 2004

INFORMATION SECURITY COMPLIANCE

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course offers a comprehensive study of information security compliance, focusing on the principles, regulations, and best practices for ensuring the confidentiality, integrity, and availability of information assets within an organization. Students will learn about compliance frameworks, risk management, security policies, and procedures, as well as the strategies and techniques for implementing and maintaining information security compliance. The course covers topics such as regulatory compliance, security audits, incident response, and security awareness.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess the expertise to design, implement, and manage information security compliance programs. They will be equipped to conduct risk assessments, develop and enforce security policies, and execute incident response plans. Graduates will also demonstrate proficiency in security auditing, assessment methodologies, and compliance reporting. Overall, the course prepares students to address evolving challenges in information security compliance and contribute to the establishment of secure and compliant organizational practices.

COURSE OUTLINE

Introduction to Information Security Compliance

- Overview of information security compliance concepts and principles
- Legal and regulatory requirements for information security
- Compliance frameworks and standards

Risk Management and Compliance

- Risk assessment and management methodologies
- Security controls and compliance alignment
- Compliance-driven risk mitigation strategies

Security Policies, Procedures, and Documentation

- Development and implementation of security policies and procedures
- Security awareness and training programs
- Security documentation and record-keeping

Regulatory Compliance

- Overview of industry-specific compliance regulations (e.g., GDPR, HIPAA, PCI DSS)
- Compliance requirements and implementation challenges
- Compliance audits and assessments

Incident Response and Security Breach Management

- Incident response planning and execution

- Security breach detection and reporting
- Lessons learned and continuous improvement.

Security Auditing and Assessment

- Security audit planning and execution
- Vulnerability assessment and penetration testing
- Compliance-driven auditing frameworks (e.g., ISO 27001)

Security Compliance Monitoring and Reporting

- Security compliance metrics and measurement
- Security compliance reporting and communication
- Continuous monitoring and compliance assessment

Emerging Trends in Information Security Compliance

- Privacy and data protection regulations
- Cloud security compliance challenges and solutions
- Automation and technology advancements in compliance management

SUGGESTED TEACHING AND ASSESSMENT METHODS

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Information Security Management Principles"
   Author: David Alexander, Amanda Finch
   Publisher: BCS, The Chartered Institute for IT
   Year: 2016
2. Title: "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up"
   Author: Evan Wheeler
   Publisher: Syngress
   Year: 2011
3. Title: "The Certified Information Security Manager (CISM) Prep Guide"
   Author: Ronald L. Krutz, Russell Dean Vines
   Publisher: Wiley
   Year: 2016
4. Title: "IT Auditing: Using Controls to Protect Information Assets"
   Author: Chris Davis, Mike Schiller, Kevin Wheeler
   Publisher: McGraw-Hill Education
   Year: 2011
5. Title: "Information Governance: Concepts, Strategies, and Best Practices"
   Author: Robert F. Smallwood
   Publisher: Wiley
   Year: 2014

CYBER THREAT INTELLIGENCE

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course provides a comprehensive study of cyber threat intelligence, focusing on the collection, analysis, and utilization of information to proactively identify and mitigate cyber threats. Students will learn about threat intelligence methodologies, threat actors, and the tools and techniques used in threat intelligence operations. The course covers topics such as threat modeling, indicator of compromise (IOC) analysis, threat hunting, and incident response.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess the knowledge and skills required to navigate the cyber threat intelligence landscape. They will be adept at planning, collecting, and analyzing threat intelligence, contributing to effective incident response and overall cybersecurity strategies. Graduates will be equipped to understand the motivations and tactics of different threat actors, attribute cyber threats, and leverage threat intelligence platforms and tools. Overall, the course prepares students to make informed decisions in the ever-evolving field of cyber threat intelligence.

COURSE OUTLINE

Introduction to Cyber Threat Intelligence

- Overview of cyber threat intelligence concepts and principles
- Cyber threat landscape and evolving threat actors
- Legal and ethical considerations in cyber threat intelligence

Threat Intelligence Lifecycle

- Threat intelligence planning, collection, and processing
- Threat analysis and intelligence production
- Intelligence dissemination and consumption

Cyber Threat Actors and Attribution

- Types of threat actors (e.g., nation-state, hacktivists, organized crime)
- Attribution techniques and challenges
- Insider threats and internal actor analysis

Indicator of Compromise (IOC) Analysis

- IOC types and formats
- IOC identification and analysis techniques
- IOC sharing and collaboration platforms.

Threat Hunting and Intrusion Detection

- Threat hunting methodologies and techniques
- Intrusion detection systems and technologies
- Network and host-based threat hunting

Incident Response and Cyber Threat Intelligence

- Threat intelligence-driven incident response
- Threat intelligence fusion centers
- Incident response coordination and information sharing

Threat Intelligence Platforms and Tools

- Threat intelligence platform features and capabilities
- Open-source intelligence (OSINT) tools and techniques
- Threat intelligence automation and orchestration

Emerging Trends in Cyber Threat Intelligence

- Machine learning and artificial intelligence in threat intelligence
- Threat intelligence in cloud and hybrid environments
- Threat intelligence sharing and collaboration initiatives.

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Cyber Threat Intelligence: Analyzing Information to Protect Against Cyber Threats"
   Author: Steve Santorelli
   Publisher: Syngress
   Year: 2018
2. Title: "The Threat Intelligence Handbook: A Practical Guide for Security Teams to Unlocking the Power of Intelligence"
   Author: Recorded Future
   Publisher: Recorded Future, Inc.
   Year: 2021
3. Title: "Cyber Intelligence: From Identity Theft to Botnets and Advanced Persistent Threats"
   Author: Steve Santorelli
   Publisher: Syngress
   Year: 2011
4. Title: "Hunting Cyber Criminals: A Hacker's Guide to Online Intelligence Gathering Tools and Techniques"
   Author: Vinny Troia
   Publisher: Syngress
   Year: 2014
5. Title: "Threat Intelligence and Me: Applied Cyber Threat Intelligence for Information Security Professionals"
   Author: Mano Paul
   Publisher: Cyber Defense Matrix, LLC
   Year: 2016

INCIDENT RESPONSE

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course offers a comprehensive study of incident response, focusing on the strategies, processes, and best practices for effectively detecting, responding to, and recovering from security incidents. Students will learn about incident management frameworks, incident classification, and the tools and techniques used in incident response operations. The course covers topics such as incident triage, containment and eradication, forensic analysis, and post-incident lessons learned.

COURSE LEARNING OUTCOMES

Upon completing this course, students will possess the expertise to navigate the incident response lifecycle, from detection to recovery, in various environments. They will master incident detection techniques, develop skills in containment and eradication, and understand the intricacies of forensic analysis. Graduates will be capable of forming and leading incident response teams, applying legal and regulatory considerations, and leveraging incident response tools effectively. With a focus on continuous improvement, students will be prepared to address emerging challenges and contribute to the evolving field of incident response.

COURSE OUTLINE

Introduction to Incident Response

- Overview of incident response concepts and principles
- Incident response lifecycle and incident management frameworks
- Legal and regulatory considerations in incident response

Incident Detection and Triage

- Incident detection techniques and tools
- Incident response team formation and roles
- Incident classification and prioritization

Incident Containment and Eradication

- Incident containment strategies and tactics
- Malware analysis and removal
- System restoration and recovery

Forensic Analysis and Evidence Collection

- Digital forensic investigation methodologies
- Volatile and non-volatile data collection
- Chain of custody and evidence preservation

Incident Response Tools and Technologies

- Incident response platforms and automation
- Network and host-based analysis tools
- Threat intelligence integration in incident response

Post-Incident Activities and Reporting

- Lessons learned and post-incident analysis.
- Incident response reporting and documentation
- Incident response metrics and continuous improvement

Incident Response in Cloud and Hybrid Environments

- Incident response challenges in cloud environments
- Incident response for virtualized and containerized systems
- Incident response for IoT and mobile devices

Emerging Trends in Incident Response

- Threat hunting and proactive incident response
- Incident response in the age of artificial intelligence
- Incident response in the context of ransomware and advanced threats

SUGGESTED TEACHING AND ASSESSMENT METHODS

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Title: "Incident Response & Computer Forensics"
   Author: Jason T. Luttgens, Matthew Pepe, Kevin Mandia
   Publisher: McGraw-Hill Education
   Year: 2014
2. Title: "The Practice of Network Security Monitoring: Understanding Incident Detection and Response"
   Author: Richard Bejtlich
   Publisher: No Starch Press
   Year: 2013
3. Title: "Computer Incident Response and Forensics Team Management: Conducting a Successful Incident Response"
   Author: Leighton Johnson
   Publisher: Auerbach Publications
   Year: 2013
4. Title: "Incident Response: A Strategic Guide to Handling System and Network Security Breaches"
   Author: E. Eugene Schultz, Russell Shumway
   Publisher: Syngress
   Year: 2016
5. Title: "Digital Forensics and Incident Response: Incident Response Techniques and Procedures"
   Author: Gerard Johansen
   Publisher: Packt Publishing
   Year: 2020

NETWORK FORENSICS

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course takes a modular approach, guiding students from fundamental concepts to advanced topics. Starting with the basics of the HTTP protocol, forensic value, and tracking, the curriculum progresses through artifact extraction, log formats, and analysis methods. Advanced subjects include tunneling, logging methods, amplified attacks, and the creation of rules and signatures for cyber-attack prevention. The course explores various log sources such as sys log, Microsoft OS & Application-level events, firewalls, SSL, TLS, MITM, and network protocol reverse engineering. Students will also tackle advanced topics like forensic duplication and analysis, network surveillance, anti-forensics techniques, and concepts of anonymity and pseudo-anonymity.

COURSE LEARNING OUTCOMES

Upon completion, students will possess a solid understanding of cybersecurity principles and practices. They will be adept at preventing, detecting, responding to, and investigating cyber-attacks. The modular structure ensures a deep dive into topics like log analysis, network surveillance, and anti-forensics, equipping students with practical skills. The course aims to develop proficiency in handling various log sources, implementing security measures, and understanding advanced cybersecurity concepts. Students will be well-prepared to navigate the complex landscape of cybersecurity, contributing to effective prevention and response strategies in the field.

COURSE OUTLINE

- Cyber-attack prevention, planning, detection, response, and investigation.
- The modular distribution of the course starts from the basics of HTTP protocol, forensic value, tracking and artifact extraction, log formats, analysis methods, tunneling, logging methods, amplified attacks, rules and signatures.
- Log sources including sys log, Microsoft OS & Application level events and firewalls, SSL, TLS, MITM, and network protocol reverse engineering will also be covered in the course.

- Advance topics will include forensic duplication and analysis, network surveillance, anti-forensics techniques, anonymity and pseudo anonymity.

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Sherri Davidoff and Jonathan Ham, Network Forensics: Tracking Hackers through Cyberspace. 2012
2. Ric Messier, Network Forensics. 2017
3. Fundamental of Network Forensics, Joshi R.C , Pilli, Emmanuel S
4. Cyber Crime Investigator's Field Guide, Bruce Middleton, Boca Raton, Florida

DATABASE SECURITY

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course covers fundamental concepts, various database models, and advanced security measures. The curriculum commences with an exploration of Database Management Systems, highlighting their advantages over traditional file systems. Database models, including Network, Hierarchical, Relational, and Object-Oriented Database (OODB), are examined in detail, providing insights into their implementation, storage, and data retrieval strategies. An emphasis is placed on the Relational Model, encompassing Relational Algebra syntax and its applications in client-server and single-user environments. The course introduces Query languages such as SQL, including embedded SQL in other languages. Transaction Processing is thoroughly addressed, covering types, different stages of transactions, rollbacks, and recovery techniques.

COURSE LEARNING OUTCOMES

Upon completing this course, participants will gain a profound understanding of Database Management Systems, various database models, and transaction processing. They will master the use of SQL and embedded SQL, and comprehend the complexities of parallel execution and isolation in transactions. The exploration of Distributed Database Systems will equip students to navigate challenges in distributed environments. The course also covers essential aspects of database security and privacy, addressing accidental threats and providing in-depth knowledge of security models, auditing practices, and special topics such as authentication, authorization, and protection against SQL injection. Graduates will be well-prepared to implement robust and secure database systems in diverse scenarios.

COURSE OUTLINE

- **Concept of Databases**: Database Management Systems. Advantages of database management systems over file systems.
- **Various Database Models:** Implementation, storage and data retrieval strategies of Network three data models- Network, Hierarchical and relational data model, OODB, comparison with each other.
- **Intro to the Relational Model**: Relational Algebra– its syntax and use in Client server and single user environments.
- **Query languages**: SQL, embedded SQL in other languages.

- **Transaction Processing**: Types and Different stages of transactions, aborted/incomplete transactions, Roll Back and different techniques of recovery from the exceptional situation.
- **Parallel Execution of Transactions**: Inherent problems, limitations, serialization of transactions. Isolation in transaction.
- **Distributed Database System**.
- **Accidental Threats to Database Security:** User errors, Communications system errors, OS or database server errors.
- **Database security and privacy:** Database application security models, Database auditing models, Application data auditing, Practices of database auditing.
- **Special Topics in Database security**: Authentication, User Profiles, Authorization, SQL injection and protection, Parameterized Statements, Escaping Inputs, Sanitizing Inputs, Data encryption and password hashing.

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Ricardo, C. M. (1990). Database systems: principles, design, and implementation. New York: Macmillan ISBN-13: 978- 0023996658
2. Date, C. J. (2004). An introduction to database systems (8th ed.). Boston: Pearson/Addison Wesley. ISBN-13:978-0321197849
3. Databases Illuminated 3rd Ed., Catherine Ricardo and Susan Urban, Jones and Bartlett, 2017 (ISBN 978-1-284-05694-5)
4. Tech Sig Movie ser 29, "What is Electronic Data Processing Concept" – 30mins

SECURE INTELLIGENT SYSTEMS

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This comprehensive course. offers an introduction to fundamental principles, techniques, and applications of AI, the curriculum covers a wide spectrum, including knowledge representation, logic, inference, problem-solving, search algorithms, game theory, perception, learning, planning, and agent design. Students will engage in practical programming using AI language tools, fostering hands-on experience. The course extends into advanced areas, exploring expert systems, neural networks, fuzzy logic, robotics, natural language processing, and computer vision. A unique emphasis on cybersecurity showcases the application of AI to identify and predict security threats, develop intelligent systems for detecting unusual patterns and attacks, and test the effectiveness of AI cybersecurity algorithms and tools.

COURSE LEARNING OUTCOMES

Upon completion of this course, participants will possess a solid foundation in AI principles and applications. They will have hands-on experience in programming AI language tools and exploring advanced AI domains like expert systems, neural networks, and robotics. The cybersecurity focus will enable students to apply AI in identifying and predicting security threats, developing intelligent systems, and assessing the efficacy of AI cybersecurity tools. Graduates will be well-equipped to navigate the dynamic field of AI, contributing to advancements and innovations in various domains, including cybersecurity.

COURSE OUTLINE

- An introduction to the basic principles, techniques, and applications of Artificial Intelligence.
- Coverage includes knowledge representation, logic, inference, problem solving, search algorithms, game theory, perception, learning, planning, and agent design. Students will experience programming in AI language tools.
- Potential areas of further exploration include expert systems, neural networks, fuzzy logic, robotics, natural language processing, and computer vision.
- Identify and predict security threats using artificial intelligence,
- Develop intelligent systems that can detect unusual and suspicious patterns and attacks,

- Learn how to test the effectiveness of AI cyber security algorithms and tools.

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. S. J. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Prentice-Hall.
2. Koller and Friedman. Probabilistic Graphical Models.
3. Sutton and Barto. Reinforcement Learning: An Introduction.
4. Hastie, Tibshirani, and Friedman. The elements of statistical learning.
5. Parisi Alessandro., Hands-On: Artificial Intelligence for Cyber Security.
6. Kumar, G., Kumar, D: AI Elementary to Advanced Practices, Cyber Defence Mechanisms, Security, Privacy and Challenges

Multi-Disciplinary Electives

- Linear Control Systems
- Microprocessor Systems
- Analog Communication Systems
- Electronic Devices and Circuits
- Digital Signal Processing
- Digital Communication Systems
- Signals & System
- Electrical Network Analysis

LINEAR CONTROL SYSTEMS

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This comprehensive course covers fundamental concepts, mathematical modeling, and advanced analysis techniques. Participants will explore Basic Control Systems Concepts, gaining a strong foundation in the principles that govern electro-mechanical systems. The curriculum delves into the Mathematical Modeling of Electro-mechanical Systems, emphasizing transfer functions and state equations for physical systems. Students will master Laplace Transforms of State Equations to analyze transient responses effectively. Block Diagrams and Reduction techniques will be covered extensively, providing participants with multiple methods for simplifying complex systems. Stability analysis, including the Routh-Hurwitz Criterion, offers insights into system behavior. Root Locus Analysis and Design techniques will equip students to understand and optimize control system performance. The course also covers design using sinusoids, lag-lead compensation, and state space analysis, providing a comprehensive skill set for control system engineers.

COURSE LEARNING OUTCOMES

Upon completion of the course, participants will possess a profound understanding of control systems, from basic concepts to advanced analysis and design methodologies. Students will be adept at mathematically modeling electro-mechanical systems, employing transfer functions and state equations. The mastery of transient response analysis and stability criteria will enable participants to design robust control systems. Root Locus techniques and sinusoidal design methods will further enhance their skills, allowing for nuanced control system optimization. Lag-lead compensation and state space analysis proficiency will make graduates well-equipped to tackle real-world challenges in control system engineering, contributing valuable insights to the field.

COURSE OUTLINE

- Basic Control Systems Concepts,
- Mathematical Modeling of Electro-mechanical Systems – Transfer Functions,
- State Equations for Physical Systems,
- Transient Response – Laplace Transform of State Equations

- Block Diagrams and Reduction of Block Diagrams using multiple methods
- Stability and Routh-Hurwitz Criterion
- Root Locus Analysis, Root Locus Design
- Design using Sinusoids
- Lag-lead Compensation,
- State Space Analysis, State Space Design

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Modern Control Systems (Eleventh Edition), by Richard C. Dorf and Robert H. Bishop, Prentice-Hall, Inc., 2001, ISBN: 0-13-030660-6
2. Modern Control Engineering (Fourth Edition), by K. Ogata, Prentice-Hall, Inc., 2002, ISBN: 0-13-060907-2

MICROPROCESSORS SYSTEMS

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course focuses on the Intel 80x86 microprocessor and the 8051 microcontroller. This course provides a comprehensive exploration of the main components and working principles of these processors, enabling participants to program and debug in assembly language effectively. Understanding the fundamental aspects of computer architecture, memory organization, and memory interfacing is crucial, and this course equips participants with the knowledge and skills to master these concepts. Practical elements include input/output device programming, data movement, addressing modes, and programming arithmetic, logic, and branch instructions. Hands-on experience using the KEIL software for programming and debugging enhances participants' proficiency. The course also delves into critical aspects such as hardware connections, initial circuit setup, I/O port programming, machine cycles, timing delay calculation, and programming for timers, counters, interrupts, and serial communication.

COURSE LEARNING OUTCOMES

Upon completion of the course, participants will have a profound understanding of the Intel 80x86 microprocessor and the 8051 microcontroller. They will be adept at programming and debugging in assembly language, demonstrating proficiency in essential aspects like data movement, addressing modes, and arithmetic and logic instructions. The practical knowledge gained in KEIL software enhances participants' capabilities in real-world applications. The course empowers students to perform input/output device programming, comprehend memory organization and interfacing, and master the intricacies of timers, counters, interrupts, and serial communication programming. With a solid foundation in microprocessor architecture, graduates will be well-equipped for tackling challenges in this dynamic field.

COURSE OUTLINE

- understand the main components and working principals of the Intel 80x86 microprocessor and 8051 program and debug in assembly language,
- understand the basic computer architecture,
- Understand the memory organization and memory interfacing,

- Perform input/output device programming in assembly,
- Data Movement,
- Different Addressing Modes,
- Memory Structure and Registers of 8051.
- Arithmetic, Logic and Branch Instructions Programming and Debugging in KEIL software,
- Hardware connection
- Initial Circuit Setup
- I/O port programming
- Machine Cycles
- Timing Delay Calculation and programming
- Timers and Counters Programming
- Interrupt Programming
- Serial Communication Programming

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Assembly Language for x86 Processors By KIP R. Irvine, 7th Edition(Reference Book)
2. 8051 by Scott Mackenzi

ANALOG COMMUNICATION SYSTEM

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This comprehensive course covers fundamental theories and advanced modulation techniques. Beginning with the basics, participants delve into the communication model and signal characteristics. Linear modulation techniques, such as various forms of Amplitude Modulation (AM) and Quadrature Amplitude Modulation (QAM), are extensively covered. The curriculum progresses to Angle Modulation, analyzing Frequency Modulation (FM) and Phase Modulation (PM) waves. Students also gain insights into random processes and the impact of noise on analog systems. By the course end, participants will be well-equipped to navigate communication systems, from modulation principles to handling interference and noise.

COURSE LEARNING OUTCOMES

Upon completion of the course, participants will have acquired a thorough understanding of communication systems, from fundamental theories to advanced modulation techniques. They will be proficient in analyzing linear modulation methods, including amplitude and angle modulation, and comprehend the nuances of signal acquisition and demodulation processes. Students will be well-versed in handling interference in angle modulation and implementing pre-emphasis and de-emphasis techniques effectively. The course prepares graduates to navigate random processes and their impact on analog systems, providing valuable insights into the behavior of communication systems in the presence of noise.

COURSE OUTLINE

- Introduction. Basic Communication model, Shannon's eqn. Essential BW of a
- Signal, ESD, PSD convolution, Correlation. Fourier series, Fourier Transform.
- 6hrs Linear Modulation.
- Analysis of Linear Modulation Techniques in time and
- Frequency domains.
- Base band and Carrier Communication
- Amplitude Modulation: DSB, SSB, VSB,
- QAM. Signal Acquisition: Phase-locked loop, super heterodyne AM Receiver, Angle Modulation.

- Instantaneous Frequency, Bandwidth of Angle Modulated Waves, Generation of FM and PM Waves, Demodulation of FM and PM, Waves, Interference in Angle Modulation, Pre-emphasis and De-emphasis,
- Random Processes, Random Variable and Random Process, Power Spectral Density of a Random Process, Auto Correlation of a R.P classification of R.P .Power of a R.P.
- Behavior of Analog Systems in Presence of Noise.
- Amplitude Modulated Signal,
- Angle Modulated Systems,
- Optimum Pre-emphasis / De-emphasis Systems

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Modern Digital and Analog Communications Systems - B. P. Lathi (4th Edition).
2. Reference Books: Principles of Digital Comm by Robert Gallager

ELECTRONIC DEVICES AND CIRCUITS

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This is a comprehensive course covering operational amplifiers, semiconductor physics, and analog electronics applications. The curriculum delves into essential topics such as PN junctions, diode applications, and advanced subjects like BJT and MOSFET physics, I-V characteristics, and DC biasing. Students explore the intricacies of small signal amplifiers using BJT and MOSFET, along with the design and operation of CMOS logic gates. The course emphasizes hands-on learning, incorporating software simulations to validate circuit designs. Operational amplifiers take center stage, with a focus on inverting and non-inverting configurations. Diode applications, including AC to DC converters and limiters, are thoroughly explored, providing a solid understanding of real-world applications. The study of bipolar junction transistors (BJTs) and MOS field-effect transistors (MOSFETs) further enriches participants' knowledge, culminating in the exploration of CMOS logic gates and pass-transistor logic.

COURSE LEARNING OUTCOMES

Upon completion of the course, participants will possess a deep understanding of operational amplifiers, semiconductor physics, and analog electronics applications. They will be proficient in designing and analyzing circuits involving PN junctions, diodes, BJTs, and MOSFETs, with a focus on small signal amplifiers. Students will gain practical experience in software simulations, enabling them to validate and optimize circuit designs. The exploration of CMOS logic gates enhances participants' knowledge of digital electronics. Graduates of this course will be well-equipped to tackle challenges in electronic circuit design, making informed decisions in real-world applications.

COURSE OUTLINE

- The course presents an overview of operational amplifiers, semiconductor physics. PN junction, diode applications.
- The course also covers the advanced topics of BJT and MOSFET physics and I-V characteristics, DC basing,
- Analog electronics applications (BJT and MOSFET small signal amplifiers) and CMOS logic gate.
- Software simulations are conducted to verify the circuit designs.

- Operational amplifiers: Ideal operational amplifiers, inverting and non-inverting configurations
- Diodes: Ideal diode, modeling of real diode, Zener diode, AC to DC converter, Limiter, Physical operation of diode,
- Bipolar junction transistors (BJTs):BJT, BJT amplifier, DC biasing in BJT amplifier, MOS field-effect transistors (MOSFETs):MOSFET, MOSFET amplifier, CMOS:CMOS logic gate, pass-transistor logic

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Microelectronics Circuits (sixth edition) by Adel S. Sedra and Kenneth C.Smith
2. Electronics devices conventional current version (ninth edition) by Thomas L. Floyd

DIGITAL SIGNAL PROCESSING

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course explores the advanced signal processing concepts with this course, covering the Z-Transform, Fourier Analysis of Continuous-Time and Discrete-Time Signals, and Sampling & Reconstruction of a Signal. Participants will delve into the intricacies of Transform Analysis of Linear Time-Invariant (LTI) Systems, examining system structures and implementation. The curriculum extends to Infinite Impulse Response (IIR) and Finite Impulse Response (FIR) Filter Design, providing a deep understanding of digital filter design techniques. The course encompasses crucial topics like the Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT), and their practical applications in signal processing. Participants will also witness a demonstration of a complete digital system, offering real-world insights into the application of the learned concepts. The course concludes with a comprehensive revision, solidifying the participants' grasp of the entire digital signal processing landscape.

COURSE LEARNING OUTCOMES

Upon completion, participants will possess an in-depth understanding of advanced signal processing techniques. They will be adept at utilizing the Z-Transform and performing Fourier Analysis for both continuous-time and discrete-time signals. The course equips students with the skills to analyze and design IIR and FIR filters, showcasing their capabilities in digital filter design. Participants will gain practical experience in applying the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) in signal processing applications. The comprehensive course revision ensures a strong foundation in digital signal processing, preparing graduates for tackling complex challenges in the field.

COURSE OUTLINE

- The Z-Transform
- Fourier Analysis of Continuous-Time and Discrete-Time Signals
- The Z-Transform Returns + Sampling & Reconstruction of a Signal,
- Sampling & Reconstruction of a Signal, Transform Analysis of LTI Systems
- System Structures & Implementation,
- IIR Filter Design, FIR Filter Design,
- Discrete Fourier Transform (DFT)
- Fast Fourier Transform (FFT)
- Application of FFT and DSP

- Demonstration of a Complete Digital System & Course Revision

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Alan V. Oppenheim, Ronal W, Scahfer,"Discrete Time Signal Processing", Pearson Education .,ISBN-978-93-325-3503-9
2. John G.Proakis, Dimitris G. Manolakis,"Digital Signal Processing", Pearson Education .,ISBN-978-81-317-1000-5
3. Digital Signal Processing: Principles, Algorithm, and Signal Processing First by James H. McClellan

SIGNALS AND SYSTEMS

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

This course covers the fundamental concepts of signals and systems with this comprehensive course. Beginning with an exploration of continuous time and discrete time signals, the curriculum covers essential topics like periodic signals, even and odd signals, and exponential and sinusoidal signals. Students delve into the unit impulse and unit step functions, examining their significance in signal processing. The course navigates through continuous time and discrete time systems, emphasizing Linear Time-Invariant (LTI) systems and introducing concepts like causality, BIBO stability, convolution, and correlation. The discrete-time Fourier transforms are dissected, providing a robust foundation for understanding the time and frequency characterization of signals and systems. Additionally, the course delves into the analysis and design of continuous-time systems using Laplace transforms, explores the sampling theorem and aliasing, and concludes with the sampling of discrete-time signals.

COURSE LEARNING OUTCOMES

Upon completion of this course, participants will acquire a deep understanding of signals and systems, from their basic characteristics to advanced topics like convolution and Fourier transforms. Students will develop the skills to analyze and design continuous-time systems using Laplace transforms and comprehend the critical concepts of sampling, aliasing, and the discrete-time signals. This foundational knowledge prepares graduates to tackle complex problems in signal processing, laying the groundwork for further exploration in this dynamic field.

COURSE OUTLINE

- Continuous time and discrete time signals
- Periodic signals
- Even and odd signals
- Exponential and sinusoidal signals
- The unit impulse and unit step functions
- Continues time and discrete time systems
- Linear time invariant (LTI) systems
- Difference equation
- Causality
- BIBO stability
- Convolution and correlation

- Discrete time Fourier transforms
- Time and frequency characterization of signals and systems
- Analysis and design of continuous time systems using Laplace transforms
- The sampling theorem, aliasing
- Sampling the discrete time signals

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and Systems", 2nd Edition, Prentice Hall, 1996
2. M. J. Roberts, "Fundamentals of Signals and Systems", McGraw-Hill, 2007
3. B. P. Lathi, "Linear Systems and Signals", 2nd Edition, Oxford, 2004
4. S. Haykin and B. Van Veen, "Signals and Systems", 2nd Edition, Wiley, 2002
5. C. L. Phillips, J. M. Parr and E. A. Riskin, "Signals, Systems, and Transforms", 4th Edition, Prentice Hall, 2007.

DIGITAL COMMUNICATION SYSTEM

Credit Hours: 3
Pre-Requisites: Nil

DESCRIPTION

The course begins with foundational concepts such as baseband modulation, analogue-to-digital conversion, and the principles of sampling theory. Delve into advanced topics like Pulse Code Modulation (PCM), differential encoding, and digital modulation techniques, including Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), and Phase Shift Keying (PSK). Explore the intricacies of TDM and FDM multiplexing, and grasp the principles of error correction through Forward Error Correction (FEC) codes. By the course's conclusion, participants will possess a comprehensive understanding of digital communication, from fundamental encoding principles to the performance evaluation of various modulation schemes.

COURSE LEARNING OUTCOMES

Upon completion, participants will master the core principles of digital communication, including PCM, TDM, and various digital modulation techniques. Proficiency in understanding error correction through FEC codes and evaluating the performance of different modulation schemes will be attained. The course equips graduates with the knowledge to design optimum receivers, comprehend synchronization, and address challenges like inter-symbol interference and equalization in digital communication systems.

COURSE OUTLINE

- Significance of Digital Communication
- Base Band Modulation,
- Analogue To Digital Conversion,
- Sampling Theory and Its Application,
- Quantization and Its Types (Uniform and Non-Uniform Quantization).
- Pulse Code Modulation, Differential PCM, Delta Modulation, ADPCM, PCM Pulse-shaping,
- Inter-Symbol Interference, Equalization, Synchronization,
- Basic Detection Theory and Optimum Receiver Design,
- Multiplexing, TDM, FDM,
- T-1 Systems and Hierarchy,
- E-1 Systems Hierarchy,
- Digital Modulation Techniques,

- Amplitude Shift Keying (ASK),
- Frequency Shift Keying (FSK), and Phase Shift Keying (PSK, DPSK, DEPSK, QPSK),
- Differential Encoding and M-Ary Signaling,
- Performance of Binary and M-Ary Signaling,
- Performance comparisons of modulation schemes,
- Forward Error Correction Codes,
- Basic concepts of information and coding.

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. Digital Comm Sys, by Bernard Sklar
2. Principal of Comm Sys, by Taub &Schiling
3. Analog & Digital Comm Technologies, by Grehame
4. Modern Digital & Analog Comm , by B P Lathi

ELECTRICAL NETWORK ANALYSIS

Credit Hours: 3

Pre-Requisites: Nil

DESCRIPTION

The course covers a range of topics, including the analysis of current and voltage transients, RLC circuits with both DC and AC excitations, and the transient and step responses of second-order circuits. Delve into resonant circuits, understanding series and parallel resonance in AC circuits, Q-Factor, and analog filters. Gain insights into the phase representation of alternating voltage and current, single-phase circuit analysis, and the application of star-delta transformation for both DC and AC circuits. Unravel the complexities of three-phase circuits, including power measurement methods. The course also encompasses the analysis of two-port networks, their interconnections, and the application of Laplace transform in circuit analysis.

COURSE LEARNING OUTCOMES

Upon completion of the course, participants will possess a profound understanding of electrical circuits' transient responses, resonance phenomena, and the analysis of both single-phase and three-phase circuits. Proficiency in the application of Laplace transform for circuit analysis and the analysis of two-port networks will be achieved. Graduates will be equipped to analyze RLC circuits under various excitations and comprehend the intricacies of analog filters and resonant circuits.

COURSE OUTLINE

- Current and voltage transients,
- RLC circuits with DC and AC excitation,
- Transient response and step response of second order circuits.
- Resonant circuit: series and parallel resonance in AC circuit, Q-Factor, analog filters, introduction to phase or representation of alternating voltage and current, single-phase circuit analysis, star-delta transformation for DC and AC circuits, three phase circuits, power in three phase circuits and different methods of its measurements.
- Two-port networks and their interconnections. Application of Laplace transform in circuit analysis.

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. S. Franco, "Electric Circuits Fundamentals", Oxford University Press, (Latest Edition).
2. V.V. Burg, "Network Analysis", (Latest Edition)
3. R E Thomas, A. J. Rosa and G. J. Toussaint, "The Analysis and Design of Linear Circuits" John Wiley, 6th Edition, 2009
4. C. Alexander and M. Sadiku, "Fundamentals of Electric Circuits", McGraw-Hill, 4th Edition, 2008
5. J. D. Irwin and R. M. Nelms, "Basic Engineering Circuit Analysis", Wiley, 9th Edition, 2008
6. W. Hayt, J. Kemmerly and S. Durbin, "Engineering Circuit Analysis", McGrawHill, 7th Edition, 2007.

OCCUPATIONAL HEALTH AND SAFETY

Credit Hours: 1+0=1

Pre-Requisites: Nil

DESCRIPTION

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

COURSE LEARNING OUTCOMES

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

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

COURSE OUTLINE

(1) Health and Safety Foundations:

(a) Nature and scope of health and safety

(b) Reasons/benefits and barriers for good practices of health and safety

(c) Legal frame work and OHS Management System

(2) Fostering a Safety Culture:

(a) Four principles of safety- RAMP (Recognize, Assess, Minimize, Prepare)

(b) Re-thinking safety-learning from incidents

(c) Safety ethics and rules

(d) Roles and responsibilities towards safety

(e) Building positive attitude towards safety

(f) Safety cultures in academic institutions

(3) Recognizing and Communicating Hazards:

(a) Hazards and Risk

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

(c) Learning the language of safety: Signs, symbols and labels

(4) Finding Hazard Information

(a) Material safety data sheets

(b) Safety data sheets and the GHS (Globally Harmonized Systems)

(5) Accidents & Their Effect on Industry

(a) Costs of accidents

(b) Time lost

(c) Work injuries, parts of the body injured on the job

(d) Chemical burn injuries

(e) Construction injuries

(f) Fire injuries

(6) Assessing and Minimizing the Risks from Hazards

(a) Risk Concept and Terminology

(b) Risk assessment procedure

(c) Risk Metric's

(d) Risk Estimation and Acceptability Criteria

(e) Principles of risk prevention

(f) Selection and implementation of appropriate Risk controls

(g) Hierarchy of controls

(7) Preparing for Emergency Response Procedures

(a) Fire

(b) Chemical Spill

(c) First Aid

(d) Safety Drills / Trainings:

(e) Firefighting

(f) Evacuation in case of emergency

(8) Stress and Safety at Work environment

(a) Workplace stress and sources

(b) Human reaction to workplace stress

(c) Measurement of workplace stress

(d) Shift work, stress and safety

(e) Improving safety by reducing stress

(f) Stress in safety managers

(g) Stress and workers compensation

(9) Incident Investigation

(a) Importance of investigation

(b) Recording and reporting

(c) Techniques of investigation

(d) Monitoring
(e) Review
(f) Auditing Health and Safety

SUGGESTED TEACHING AND ASSESSMENT METHODS

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Midterm Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

RECOMMENDED TEXT AND REFERENCE BOOKS

1. The A-Z of health and safety by Jeremy Stranks, 2006.
2. The Manager's Guide to Health & Safety at Work by Jeremy Stranks, 8th edition, 2006.
3. Occupational safety and health law handbook by Ogletree, Deakins, Nash, Smoak and Stewarts, second edition, 2008.

Available at:
http://www.pec.org.pk