Department of
Information and Communication Technology (ICT)
Comilla University

Curriculum
For
Bachelor of Science
Information and Communication Technology

Session: 2025-2026, 2026-2027, 2027-2028

1. Title of the academic Program:
Bachelor of Science (Engineering) in Information and Communication Technology (ICT)

2. Name of the University:
Comilla University

3. Vision of the University:
Comilla University is committed to empowering society, advancing development, promoting human welfare and sustainable planet.

4. Mission of the University:

1. To educate a wide variety of students through effective teaching-learning to achieve academic excellence.
2. To create an ambience for creative and innovative academic exercise through high quality research.
3. To undertake actions regarding collaboration which entails opportunities for long-term interaction with academia and industry for producing competent graduate at workplace.
4. To develop human potential to its fullest extent so that intellectually capable and socially responsible leaders can emerge in a range of profession.

5. Name of the Program Offering Entity:
Department of Information and Communication Technology

6. Vision of the Program Offering Entity:
To become a center of excellence in Information and communication technology with a strong teaching and research environment by producing globally competitive professional as well as leaders, committed and socially oriented human beings.

7. Mission of the Program Offering Entity

In order to accomplish the vision, the department will

- Educate students for academic and research excellence, IT industry, entrepreneurship, and national or international organization through innovative teaching and learning with ICT based pedagogy
- Create new knowledge through innovative research and collaboration among the faculty and the students to create state of the art research environment
- Develop leadership and soft skill by life- long learning and carry out responsibilities through social and professional ethics.
- Motivate students to acquire entrepreneur skills to become global leader.

8. Objectives of the Program Offering Entity:

- To demonstrate students through fundamentals and problem-solving skills to analyze, design and develop economically feasible solutions for technical and social problems.
- To prepare students for employment and advanced studies and provide them with significant experiences in contemporary development skills which will allow them to successfully adapt to evolving technologies throughout their professional careers.
- To teach students effective hard and soft skills that enables them to work with others effectively in their professional careers.
- To acknowledge students about research trends, higher education and entrepreneurial opportunities along with work ethically towards society.
- To develop cooperative research relationships within and outside the computer science discipline, as well as with industry, government, alumni, and local organizations.

9. Name of the Degree:
Bachelor of Science (Engineering) in Information and Communication Technology (ICT)

10. Description of the program:
Department of Information and Communication Technology in Comilla University has commenced its academic activities from the session2009-2010. The Department of Information and Communication Technology (ICT) offers a 4-year program of Bachelor of Science (Engineering) in Information and Communication Technology (ICT). To become a graduate in this field one has to complete 156 credit hours. The program is designed to satisfy the growing demand for IT professionals throughout the country. It gives students the opportunity to obtain a broad-based knowledge of Computer Science, Communication Engineering and Information Technology. Moreover there are sufficient number of Mathematics, Electrical Engineering, Communication Engineering, Basic sciences, Commerce and Arts courses.

The Bachelor of Science (Engineering) degree courses in Information and Communication Technology shall extended over a period of four academic year and shall be divided into eight semesters: First year first semester, first year second semester, second year first semester, second year second semester etc. One semester will extend for a period of 15 weeks. For the purpose of assessment, 100 marks will be assigned to 3 credits and 50 marks will be assigned to 2 credits. 3 credit means 3 contact hours/week in a semester. In the same way 2 credit means 2 contact hours/week in a semester.

11. Graduate Attributes (Based on need assessment)

- Collaborative Team/Group Work
- New Technology Develop and Innovation
- Always interested to meet up with new technology
- Achieve the multi-disciplinary knowledge to develop a model
- Decision making based on critical thinking as well as technical skills.
- Leadership along with ethical issues on technology.
- Strong personality with kind human being for the welfare of the society.

12. Program Educational Objectives (PEOs):

The Program Educational Objectives (PEOs) are defined and developed based on the interactions with various stakeholders such as students, employers, alumni, faculty etc. Their interests, social relevance and contributions are taken into account in defining and developing the PEOs. The program educational objectives are as follows

PEO1	Graduates of the program will have successful professional both in industry and government and/or will be able to successfully pursue advanced degrees as well as apply information technology and engineering theory blended with mathematics and modern tools and techniques to solve real-life problems.
PEO2	Graduates will apply analysis, design, optimization and implementation skills in order to formulate and solve Information and Communication Technology and multidisciplinary complex engineering problems.
PEO3	Graduate will communicate effectively with team members, engage in applying technologies and lead teams in industry for information systems as well as work collaboratively maintaining high Year of ethical and professional values for improving the society.
PEO4	Impart analytic and critical thinking skills to develop initiative and innovative ideas for research and development (R&D), industry and societal requirements.
PEO5	Graduates will engage in lifelong learning , career enhancement and adapt to changing professional and societal needs as well as take leadership positions in the industry and also initiate businesses offering innovative technical solutions to national and international problems.

13. Program Learning Outcomes (PLO):

After completion of the B.Sc. Engineering degree in Information and Communication Technology (ICT) graduates will be able to

PLO-1: **Engineering Knowledge:** Utilize the basic knowledge of mathematics, science and engineering in Information and Communication Technology field.

PLO-2: **Problem Analysis:** Identify, formulate, research and analyze complex Information and Communication Engineering problems to achieve demonstrated conclusions using mathematical principles and engineering sciences.

PLO-3: **Design/Development of Solutions:** Design system components for complex Information and Communication Engineering problem that meet the requirement of public safety and offer solutions to the societal and environmental concerns.

PLO-4: **Investigation:** Conduct investigation to design and conduct experiments, analyze, synthesize and interpret the data pertaining to Information and Communication Engineering problems and arrive at valid conclusions.

PLO-5: **Modern Tool Uses:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools required for Information and Communication Engineering applications.

PLO-6: **The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

PLO-7: **Environment and Sustainability:** Examine the impact of Information and Communication Engineering solutions in global and environmental context and utilize the knowledge for sustainable development.

PLO-8: **Ethics:** Develop consciousness of professional, ethical and social responsibilities as experts in the field of Information and Communication Engineering.

PLO-9: **Individual Work and Teamwork:** Function effectively as an individual and as a member or leader of diverse teams and in multidisciplinary settings.

PLO-10: **Communication:** Communicate effectively about complex Information and Communication Engineering activities with the engineering community and with society at large in both oral and written.

PLO-11: **Project Management and Finance:** Demonstrate knowledge and understanding of Information and Communication Engineering and management principles and apply these to one's work as a team member or a leader to manage projects in multidisciplinary environments.

PLO-12: **Life-Long Learning:** Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.

14. Mapping mission of the university with PEOs:

	Mission 01	Mission 02	Mission 03	Mission 04
PEO1	√			
PEO2	√			
PEO3			√	
PEO4		√		
PEO5				√

15. Mapping PLO with PEO:

PLO	PEO1	PE02	PEO3	PEO4	PEO5
PLO 1	√				
PLO 2	√				
PLO 3		√			
PLO 4	√				
PLO 5		√			
PLO 6			√		
PLO 7				√	
PLO 8			√	√	
PLO 9		√	√		
PLO 10				√	
PLO 11					√
PLO 12					√

Course Schedule:

First Year First Semester

SN.	*Course Code (BNQF)*	*Course Code*	*Course Title*	*Class hours/week*		*Credit*
				Theory	*Lab*	
1.	05411101	MATH-1101	Differential and Integral Calculus	3.00	0.00	3.00
2.	06111103	ICT-1103	ICT Fundamental	3.00	0.00	3.00
3.	06131105	ICT-1105	Structured Programming	3.00	0.00	3.00
4.	02311107	ENG-1107	Technical and Communicative English	2.00	0.00	2.00
5.	07131109	EEE-1109	Basic Electrical Engineering	3.00	0.00	3.00
6.	05331111	PHY-1111	Physics	3.00	0.00	3.00
7.	06131106	ICT-1106	Structured Programming Sessional	0.00	3.00	1.00
8.	02311108	ENG-1108	Technical and Communicative English Sessional	0.00	2.00	1.00
9.	07131110	EEE-1110	Basic Electrical Engineering Sessional	0.00	3.00	1.00
					Total	**20.00**

First Year Second Semester

SN.	*Course Code (BNQF)*	*Course Code*	*Course Title*	*Class hours/week*		*Credit*
				Theory	*Lab*	
1.	05411201	MATH-1201	Algebra of Matrix and Geometry	3.00	0.00	3.00
2.	05421203	STAT-1203	Applied Statistics	3.00	0.00	3.00
3.	07141205	EEE-1205	Electronic Device and Circuit	3.00	0.00	3.00
4.	02221207	HUM-1207	Bangladesh Studies	2.00	0.00	2.00
5.	06111209	ICT-1209	Discrete Mathematics	3.00	0.00	3.00
6.	06131211	ICT-1211	Data Structures	3.00	0.00	3.00
7.	07141206	EEE-1206	Electronic Device and Circuit Sessional	0.00	3.00	1.00
8.	06131212	ICT-1212	Data Structures Sessional	0.00	3.00	1.00
9.	06111200	ICT-1200	Viva-voce	0.00	0.00	1.00
					Total	**20.00**

Second Year First Semester

SN.	*Course Code (BNQF)*	*Course Code*	*Course Title*	*Class hours/week*		*Credit*
				Theory	*Lab*	
1.	05412101	MATH-2101	Differential Equation, Fourier Analysis and Laplace Transform	3.00	0.00	3.00
2.	06132103	ICT-2103	Object Oriented Programming	3.00	0.00	3.00
3.	03112105	ECO-2105	Economics	3.00	0.00	3.00
4.	06132107	ICT-2107	Algorithm Design	3.00	0.00	3.00
5.	06112109	MATH-2109	Numerical Analysis	3.00	0.00	3.00
6.	04132111	MGT-2111	Entrepreneurship Management	3.00	0.00	3.00
7.	06132104	ICT-2104	Object Oriented Programming Sessional	0.00	3.00	1.00
8.	06132108	ICT-2108	Algorithm Design Sessional	0.00	3.00	1.00
9.	06112110	MATH-2110	Numerical Analysis Sessional	0.00	3.00	1.00
					Total	**21.00**

Second Year Second Semester

SN.	*Course Code (BNQF)*	*Course Code*	*Course Title*	*Class hours/week*		*Credit*
				Theory	*Lab*	
1.	0612 2201	ICT-2201	Electromagnetic Theory and Antenna	3.00	0.00	3.00
2.	06112203	ICT-2203	Digital Logic Design	2.00	0.00	2.00
3.	0612 2205	ICT-2205	Database Management Systems	3.00	0.00	3.00
4.	06112207	ICT-2207	Computer Organization and Architecture	3.00	0.00	3.00
5.	06122209	ICT-2209	Analog and Digital Communication	3.00	0.00	3.00
6.	06112204	ICT-2204	Digital Logic Design Sessional	0.00	3.00	1.00
7.	06122206	ICT-2206	Database Management Systems Sessional	0.00	3.00	1.00
8.	06122210	ICT-2210	Analog and Digital Communication Sessional	0.00	3.00	1.00
9.	06112200	ICT-2200	Viva-voce	0.00	0.00	1.00
					Total	**18.00**

Third Year First Semester

SN.	*Course Code (BNQF)*	*Course Code*	*Course Title*	*Class hours/week*		*Credit*
				Theory	*Lab*	
1.	0612 3101	ICT-3101	Data Communication and Networks	3.00	0.00	3.00
2.	0613 3103	ICT-3103	Software Engineering	3.00	0.00	3.00
3.	0611 3105	ICT-3105	Microprocessor and Embedded System	3.00	0.00	3.00
4.	0611 3107	ICT-3107	Operating System	3.00	0.00	3.00
5.	06133109	ICT-3109	Internet Programming	3.00	0.00	3.00
6.	06123102	ICT-3102	Data Communication and Networks Sessional	0.00	3.00	1.00
7.	06133104	ICT-3104	Software Engineering Sessional	0.00	3.00	1.00
8.	06113106	ICT-3106	Microprocessor and Embedded System Sessional	0.00	3.00	1.00
9.	06113108	ICT-3108	Operating System Sessional	0.00	3.00	1.00
10.	06133110	ICT-3110	Internet Programming Sessional	0.00	3.00	1.00
					Total	**20.00**

Third Year Second Semester

SN.	*Course Code (BNQF)*	*Course Code*	*Course Title*	*Class hours/week*		*Credit*
				Theory	*Lab*	
1.	0612-3201	ICT-3201	Digital Signal Processing	3.00	0.00	3.00
2.	0612-3203	ICT-3203	IT Management	3.00	0.00	3.00
3.	06123205	ICT-3205	Optical Fiber Communication	3.00	0.00	3.00
4.	06123207	ICT-3207	Telecommunication Engineering	3.00	0.00	3.00
5.	06133209	ICT-3209	Artificial Intelligence	3.00	0.00	3.00
6.	06133211	ICT-3211	Software development Project	0.00	0.00	1.00
7.	06123202	ICT-3202	Digital Signal Processing Sessional	0.00	3.00	1.00
8.	06123206	ICT-3206	Optical Fiber Communication Sessional	0.00	3.00	1.00
9.	06133210	ICT-3210	Artificial Intelligence Sessional	0.00	3.00	1.00
10.	06113200	ICT-3200	Viva-voce	0.00	0.00	1.00
					Total	**20.00**

Fourth Year First Semester

SN.	*Course Code (BNQF)*	*Course Code*	*Course Title*	*Class hours/week*		*Credit*
				Theory	*Lab*	
1.	06124101	ICT-4101	Wireless and Mobile Communication	3.00	0.00	3.00
2.	06134103	ICT-4103	Machine Learning	3.00	0.00	3.00
3.	06114105	ICT-4105	Research Methodology and Technical Writing	2.00	0.00	2.00
4.	06114215	ICT-4215	Research Project/Thesis	0.00	0.00	0.00
5.		Optional I		3.00	0.00	3.00
6.		Optional II		3.00	0.00	3.00
7.	06124102	ICT-4102	Wireless and Mobile Communication Sessional	0.00	3.00	1.00
8.	06134104	ICT-4104	Machine Learning Sessional	0.00	3.00	1.00
9.		Optional I Sessional		0.00	3.00	1.00
10.		Optional II Sessional		0.00	3.00	1.00
					Total	**18.00**

Optional Courses

	Course Code (BNQF)	*Course Code*	*Course Title*	*Class hours/week*		*Credit*
				Theory	**Lab**	
1.	06134107	ICT-4107	Big Data & Cloud Computing	3.00	0.00	3.00
2.	06124109	ICT-4109	Computer Vision	3.00	0.00	3.00
3.	06124111	ICT-4111	Microwave Engineering	3.00	0.00	3.00
4.	06124113	ICT-4113	Internet of Things (IOT)	3.00	0.00	3.00
5.	06134108	ICT-4108	Big Data & Cloud Computing Sessional	0.00	3.00	1.00
6.	06124110	ICT-4110	Computer Vision Sessional	0.00	3.00	1.00
7.	06124112	ICT-4112	Microwave Engineering Sessional	0.00	3.00	1.00
8.	06124114	ICT-4114	Internet of Things (IOT) Sessional	0.00	3.00	1.00

Fourth Year Second Semester

SN.	*Course Code (BNQF)*	*Course Code*	*Course Title*	*Class hours/week*		*Credit*
				Theory	*Lab*	
1.	06124201	ICT-4201	Cyber Security	3.00	0.00	3.00
2.	06124203	ICT-4203	Satellite Communication and Radar	3.00	0.00	3.00
3.	06114215	ICT-4215	Research Project/ Thesis	3.00	0.00	3.00
4.	06114000	ICT-4000	Internship/ Industrial Tour			1.00
5.		Optional I		3.00	0.00	3.00
6.		Optional II		3.00	0.00	3.00
7.	06124204	ICT-4204	Cyber Security Sessional	0.00	3.00	1.00
8.		Optional I Sessional		0.00	3.00	1.00
9.	06114200	ICT-4200	Viva-voce	0.00	0.00	1.00
					Total	**19.00**

Optional Courses

	Course Code (BNQF)	*Course Code*	*Course Title*	*Class hours/week*		*Credit*
				Theory	**Lab**	
1.	06134205	ICT-4205	Natural Language Processing (NLP)	3.00	0.00	3.00
2.	06124207	ICT-4207	Block Chain and Distributed Security	3.00	0.00	3.00
3.	06134209	ICT-4209	Data Science and Application	3.00	0.00	3.00
4.	06124211	ICT-4211	Human Machine Interaction	3.00	0.00	3.00
5.	06134213	ICT-4213	Robotics	3.00	0.00	3.00
6.	06134206	ICT-4206	Natural Language Processing (NLP)Sessional	0.00	3.00	1.00
7.	06124208	ICT-4208	Block Chain and Distributed Security Sessional	0.00	3.00	1.00
8.	06134210	ICT-4210	Data Science and Application Sessional	0.00	3.00	1.00
9.	06124212	ICT-4212	Human Machine Interaction Sessional	0.00	3.00	1.00
10.	06134214	ICT-4214	Robotics Sessional	0.00	3.00	1.00

Grand Total: **156 Credit**

Summary

Total Credit -156

Core Course (ICT)-118 Credit

GED Course -38 Credit (24.36% of total Credit)

	GED Course Summary				
	First Year First Semester				
Course Code (BNQF)	***Course Code***	***Course Title***	***Class hours/week***		***Credit***
			Theory	***Lab***	
05411101	MATH-1101	Differential and Integral Calculus	3.00	0.00	3.00
02311107	ENG-1107	Technical and Communicative English	2.00	0.00	2.00
07131109	EEE-1109	Basic Electrical Engineering	3.00	0.00	3.00
05331111	PHY-1111	Physics	3.00	0.00	3.00
02311108	ENG-1108	Technical and Communicative English Sessional	0.00	2.00	1.00
07131110	EEE-1110	Basic Electrical Engineering Sessional	0.00	3.00	1.00
	First Year Second Semester				
05411201	MATH-1201	Algebra of Matrix and Geometry	3.00	0.00	3.00
05421203	STAT-1203	Applied Statistics	3.00	0.00	3.00
07141205	EEE-1205	Electronic Device and Circuit	3.00	0.00	3.00
02221207	HUM-1207	Bangladesh Studies	2.00	0.00	2.00
07141206	EEE-1206	Electronic Device and Circuit Sessional	0.00	3.00	1.00
	Second Year First Semester				
05412101	MATH-2101	Differential Equation, Fourier Analysis and Laplace Transform	3.00	0.00	3.00
03112105	ECO-2105	Economics	3.00	0.00	3.00
06112109	MATH-2109	Numerical Analysis	3.00	0.00	3.00
04132111	MGT-2111	Entrepreneurship Management	3.00	0.00	3.00
06112110	MATH-2110	Numerical Analysis Sessional	0.00	3.00	1.00

BNQF Code: 05411101, Departmental Code: MATH-1101

Course Title: Differential and Integral Calculus

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** GED
Pre-requisites (if any**):** None

Rationale

Calculus is one of the most fundamental courses in mathematics which majorly contains two parts, one is differential calculus and other is integral calculus. Generally, the part of calculus concerned with functions, limits, successive differentiation, partial differentiation and finding tangent lines and rates of change is called differential calculus.

Integral calculus is a branch of calculus concerned with the theory and applications of integration. In Mathematics, integration is a method of adding or summing up the parts to find the whole. It is a reverse process of differentiation, where we reduce the functions into parts. Integral calculus is used for calculations involving arc length, pressure, area, center of mass, volume, and work.

Course Objectives

1. Differential Calculus for functions of one variable including a study of limits, continuity, derivatives of different classes of functions, maxima and minima, concavity, related rates and optimization problems. Students will be able to find the rate at which one quantity changes relative to another
2. Integral Calculus aims to provide a firm foundation in the concepts and techniques of integrations. It is primarily concerned with developing the students' understanding of the concepts of anti-derivatives and providing experience with its methods and applications. It is to emphasize a multi-representational approach to integral calculus, with concepts, results, and problems being expressed geometrically, numerically, analytically, and verbally
3. The overall goal is to grow interested and provide the kind of problem-solving experience that the students might find in a research or industrial setting.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Understand the concepts of derivatives and anti-derivatives with various types of functions.
CLO2 Evaluate limits, continuity, derivatives, limits in indeterminate form, partial derivatives, and the graph of the equation which follows function or inverse function.
CLO3 Learn basic properties of integration, evaluation of integration by successive reduction, Integration by parts, the method of substitution.
CLO4 Develop and apply definite integrals to evaluate area between two curves, volumes of solids of revolution, surface area, arc lengths utilizing different methods.
CLO5 Apply the application of differentiation and the method of integration to real-life problems with maxima and minima critical points and inflection points of functions.

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	**PLO**											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2		√										
CLO3	√											
CLO4		√										
CLO5		√										

Course Contents		Hours	CLOs
1.	**Differential Calculus:** Functions and their graphs; Domain and Range of functions; Limit; Continuity; Derivatives; Rules of differentiation of various functions; Successive differentiation; Increasing and decreasing functions; Maximum and minimum values of functions; Indeterminate forms; Partial differentiation: Partial differentiation for transformation of variables; Euler's rule on homogeneous functions, Tangent; Normal; Sub tangent and subnormal in Cartesian and polar coordinates.	**21 Hrs.**	CLO1,CLO2, & CLO5
2.	**Integral Calculus:** Definition of integration; Integration by the method of substitution; Integration by parts; Standard integrals; Integration by the method of successive reduction; Definite integrals; Definite integration as the limit of a sum; Properties of definite integrals and their applications; Fundamental theorem of integral calculus; Area under a plane curve in Cartesian and polar co-ordinates; Area of the region enclosed by two curves in Cartesian and polar co-ordinates.	**21 Hrs.**	CLO1, CLO3 CLO4 & CLO5

Assessment Strategy	Course Evaluation Process and Mark Distributions		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. Anton H., Calculus, Wiley, 2009.
2. Stewart J., Calculus, Cengage Learning, 2015.
3. Smith R. T., and Minton R. B., Calculus, McGraw-Hill, 2007.
4. Mohammad, Bhattacherjee and Latif, Differential and Integral Calculus, Gonith Prokashon, 2014.
5. Das B. C. and Mukharjee B. N., Differential Calculus, U. N. Dhur & Sons Pvt. Ltd., 1949.
6. Das B. C., and Mukharjee B. N., Integral Calculus, U. N. Dhur & Sons Pvt. Ltd., 1938.

BNQF Code: 06111103, Departmental Code: ICT-1103

Course Title: ICT Fundamental

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

This course covers the fundamentals of computer programming terminology, computer components, hardware, operating systems, number systems, system software, and popular application software are all covered in this course. This is a basic course that allows students to delve further into this wonderful machine (Computer).

Course Objectives

1. To introduce students with the basic terminology used in computer programming.
2. To write programs in C language, use different data types in a computer program, and design programs involving decision structures, loops and functions.
3. To design programs involving decision structures, loops and functions.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Analyze the basic parts of computer system, types of computer, history and generations of computers, number system and basic digital circuits.

CLO2 Distinguish about hardware, software and operating system.

CLO3 Classify the Computer networks.

CLO4 Formulate the simple computer programs.

CLO5 Understand the implication of modern technologies.

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2	√											
CLO3		√										
CLO4			√									
CLO5	√											

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Introduction and basic organization of computers, types of computer. History and generations of computers.	Lecture, Discussion	Class Test	CLO1
2.	Number systems and its conversions,	Lecture, Discussion	Class Test	CLO1
3.	Logic gates.	Lecture, Problem Solving	Assignment	CLO1
4.	Memory organizations, Input and output devices.	Lecture, Problem Solving	Exam	CLO1,CLO2

5.	Storage, processor, Operating system basics.	Lecture, Discussion Problem Solving	Class Test, Exam	CLO2,CLO3
6.	Application software, basic architecture of a computer. *Review and makeup class(if any)*	Lecture, Problem Solving	Exam	CLO3
7.	*Review and makeup class(if any) and Mid Term Exam 1 & Feedback*			
8.	Basics of networking.	Lecture, Discussion Problem Solving	Class Test, Exam	CLO4
9.	LAN, MAN, WAN, Topology, Switch, Router, IP Address, IoT, Basics of Blockchain, Robotics, 4IR.	Lecture, Discussion Problem Solving	Class Test	CLO4
10.	Programming language basics, general form of a simple program.	Lecture, Discussion	Exam	CLO5
11.	Variable, Identifiers, Operators.	Lecture, Discussion Problem Solving	Exam	CLO5
12.	Input and output operations. Statements used in branching and looping.	Lecture, Problem Solving	Exam	CLO5, CLO6
13.	Decision Making, Arrays. *Review and Makeup class(if any)*	Lecture, Problem Solving	Exam	CLO5, CLO6
14.	*Review and makeup class(if any) and Mid Term Exam 2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. Dr. M. Lutfur Rahman and Dr. M. Alamgir Hossain, “Computer Fundamentals”, 1st Ed., Systech Publications Ltd., 2013.
2. E.Balagurusamy, “Programming in ANSIC”, 6th Ed., Tata McGraw-Hill Publishing Company, 2016.
3. Pradeep K. Sinha, “Computer Fundamentals”, 6th Ed., BPB publications, 2004.

BNQF Code: 06131105, Departmental Code: ICT-1105

Course Title: Structured Programming

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

The purpose of this course is to deepen students' engagement with the principles of programming language written in C through the understanding of basic knowledge and skillful implementation. This is an introductory programming course designed to prepare the students with fundamental tools and techniques and to build up a rigorous footing in programming.

Course Objectives

1. To provide the understanding of programming principles
2. To use programming principles in problem solving by transferring the model-based problem into computer-based solution
3. To enhance communication social skills through group project

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Understand computing problems using programming concepts and learn the basic concept of ACM Problem solving techniques
CLO2 Describe fundamental programming elements including: variable, use of data types and data structures, decision structures, loop structures, pointer, string, console, file IO, and functions.
CLO3 Explain the problem requirements, interpret the problem, develop the algorithm to solve the problem and implement with the help of programming language.
CLO4 Discuss the knowledge of programming and problem interpreting in real file problems.

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2	√											
CLO3	√											
CLO4	√	√										

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Lesson 1: Importance of Programing & Problem Solving, Sample program of C, Basic Structure of C program, Programming style, Executing a 'C' program Lesson 2: Character set, C token, Keywords and Identifiers, Constants, Variables, Data Types, Declaration of variables, Assigning values to variables, Defining symbolic constant, Declaring a variable as constant	Lecture, Discussion	Class Test	CLO1, CLO2
2.	Lesson 3: Arithmetic operators, Relational operators, Logical operators, Inc. and Dec. operators, Conditional operators, Bitwise operators, Arithmetic Expressions, Evaluation of Expressions, Precedence of Arithmetic	Lecture, Discussion, Problem Solving	Class Test Exam	CLO1, CLO2

	operators Lesson 4**:** Reading a character, Writing a character, Formatted input, Formatted output			
3.	Lesson 5: Conditional statements (e.g., if/else, switch case) Lesson 6**:** Nested conditional structures Standard/structures, programming practices for decision structures.	Lecture, Discussion, Problem Solving	Class Test Exam	CLO1, CLO2
4.	Lesson 7: Why should we use the loops?, Loop control variables, initialization, test and modifications (e.g. while, do-while & for loop) Lesson 8: Nested loop structures, Standard/structures programming practice for loop structures	Lecture, Discussion, Problem Solving	Assignment Exam	CLO1, CLO2
5.	Lesson 9: Use of Array, Advantage of using Array, One-dimensional Array, Declaration of 1-D array, Initialization of 1-D array Lesson 10: Two Dimensional array, Initialization of 2-D array , Multi- dimensional array	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1, CLO2
6.	Lesson 11: Pointer Expressions, Pointer Increments and scale factor, Pointers and array, Array of pointers, Pointer as Function Arguments, Functions Returning pointers, Pointers to Functions, Pointers and structures Lesson 12: Pointer Expressions, Pointer Increments and scale factor, Pointers and array, Array of pointers, Pointer as Function Arguments, Functions Returning pointers, Pointers to Functions, Pointers and structures	Lecture, Problem Solving	Exam	CLO1, CLO2
7.	*Review and makeup class(if any) and Mid Term Exam 1 & Feedback*			
8.	Lesson 13: Introduction to function, Need for user-defined function, A multi-function program, Elements of user defined function, Definition of function, Return values and their types, Function calls, Function Declaration, Category of function Lesson 14: No arguments and no return values, Arguments but no return values, Arguments with return values, No Arguments but return a values, Functions that return multiple values, Nesting of functions, Recursion, Passing arrays to functions, Passing strings to functions, The scope, visibility and lifetime of variables	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1, CLO2, CLO3
9.	Lesson 15: Introduction to String, Declaring and Initializing string variable, Reading string from terminal Lesson 16: Arithmetic operations and characters, Putting strings together, Comparison of two strings, String handling functions	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1, CLO2
10.	Lesson 17: Introduction to structure, Defining a structure, Declaring structure variables, Accessing structure members, Structure initialization Lesson 18: Copying and Comparing structure variables, Operations on individual members, Arrays of structures, Structure and function	Lecture, Discussion	Class Test, Exam	CLO1, CLO2, CLO4
11.	Lesson 19: Create, read, write and update files, Copying a File, Character Input vs. Line Input Lesson 20: Dynamic Memory Allocation, Allocating a block of Memory: Malloc, Releasing the used space:Free	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1, CLO2
12.	Lesson 21: Preprocessor – why?, include: how to make use of a header file, define: simple and parameterized macros,	Lecture, Problem Solving	Exam	CLO1, CLO2

	undef directive, predefined preprocessor symbols, macro - operators: and , conditional compilation: if and ifdef directives			
13.	Review and Exercises	Lecture, Problem Solving	Exam	
14.	*Review and makeup class(if any) and Mid Term Exam 2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. E Balagurusamy, Programming in ANSI C.
2. Dennis Ritchie, The C programming language. Prentice Hall, 1988.
3. Paul Deitel Harvey M. Deitel, C: How to Program, 6/e, Deitel & Associates, Inc
4. Herbert Shieldt , C: The Complete Reference
5. Stephen G. Kochan , Programming in C
6. Yashavant Kanetkar, Let Us C , 7/e
7. Herbert Shieldt, Teach Yourself C
8. R.G. Dromey, How to solve it using Computer, Prentice Hall, 1985
9. W W Norton, C Programming- A Modern Approach, 2nd Edition, 2008

BNQF Code: 02311107, Departmental Code: ENG-1107
Course Title: Technical and Communicative English

Credit Hr.: 2.00, **Contact Hr.:** 2.00, **Course Type:** GED
Pre-requisites (if any**):** None

Rationale

This course is designed to enable students to develop their competence in reading writing, speaking, listening and grammar for academic purposes. The students will be encouraged to acquire skills and strategies for using language appropriately and effectively in various situations.

Course Objectives

1. To teach students the tools for writing technical error free English.
2. To grow effective and fast reading skill among the students.
3. To enable to communicate confidently and competently in English language in all spheres.
4. To develop writing competence of scientific reports, journal etc.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Communicate in English in their academic life and daily life.
CLO2 Use different grammatical aspects in English speaking and writing.
CLO3 Listen, speak, read and write Basic English.
CLO4 Present and prepare small writing for written communication.

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1										√		
CLO2		√										
CLO3	√											
CLO4		√										

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Lesson 1:Overview of Basic English Communication. Lesson 2: Basic Reading, part-1 and Basic Grammar Part-1, Articles, [Text Book-1 and 4]	Lecture, Discussion	Class Test	CLO2, CLO3, CLO4
2.	Lesson 1: Listening-part-1 and speaking Part-1Greeting, Answering to Greeting, Small Talks. [Text Book- 4] [Cambridge IELTS, Book-1, Test-1] Lesson 2: Basic Grammar, Articles, Part-2, Listening-part-2 and speaking, Agreeing & Disagreeing Part-2. [Text Book-1 and 3] & [Cambridge IELTS, Book-1, Test-2]	Lecture, Discussion	Class Test Exam	CLO1, CLO2, CLO3, CLO4
3.	Lesson 1: Basic Grammar, Use of Prepositions, Part-3, Listening-part-3 and speaking Part-3.	Lecture, Discussion,	Class Test Exam	CLO2, CLO3,

	[Text Book-1 and 3] [Cambridge IELTS, Book-1, Test-3] Lesson 2: Basic Grammar, Tenses, Part-4, Listening-part-4 and speaking Part-4. [Text Book-1 and 4] [Cambridge IELTS, Book-1, Test-4]			CLO4
4.	Lesson 1: Reading Comprehension-1, and Paragraph writing, Types, part-1 [Text Book-1 and 3] Lesson 2: Reading Comprehension-2, and Paragraph writing, Structure, part-2 [Text Book-1 and 3]	Lecture, Discussion,	Presentation 1: Topics will be provided as Individual or Group	CLO1, CLO2, CLO3, CLO4
5.	Lesson 1: Reading Comprehension-3, and Paragraph writing, Writing process, part-3 [Text Book-1 and 3] Lesson 2: Reading Comprehension-4, and Paragraph writing, Practical Writing, part-4 [Text Book-1 and 3]	Lecture, Discussion	Class Test, Exam	CLO1, CLO2, CLO3, CLO4
6.	Lesson 1: Reading Comprehension-5, and Paragraph writing, Practical Writing, part-5 [Text Book-1 and 3] Lesson 2: Reading Comprehension-6, and Paragraph writing, Practical Writing, part-6 [Text Book-3 and 4]	Lecture, Discussion	Exam	CLO1, CLO2, CLO3, CLO4
7.	*Review and makeup class(if any) and Mid Term Exam 1 & Feedback*			
8.	Introduction to function, Need for user-defined function, Lesson 1: Basic Grammar, Right form of Verbs, Part-5, Listening-part-5 and speaking Part-5. [Text Book-1 and 4] [Cambridge IELTS, Book-2, Test-1] Lesson 2: Basic Grammar, Practice of Right form of Verbs, Part-6, Listening-part-6 and speaking Part-6. [Cambridge IELTS, Book-2, Test-2]	Lecture, Discussion Problem Solving	Assignment	CLO1, CLO2, CLO3, CLO4
9.	Lesson 1: Basic Grammar, Linking Words, Part-7, Listening-part-7 and speaking Part-7. [Text Book-1 and 4] [Cambridge IELTS, Book-2, Test-3] Lesson 2: Basic Grammar, Conditional Sentences, Part-8, Listening-part-8 and speaking Part-8. [Text Book-1 and 4] [Cambridge IELTS, Book-2, Test-4]	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1, CLO2, CLO3, CLO4
10.	Lesson 1: Reading Comprehension, Q/A, part-6, and Paragraph writing, part-6 [Text Book-3 and 4] Lesson 2: Reading Comprehension, part-7, Q/A , and Paragraph writing, part-7 [Text Book-1 and 3]	Lecture, Discussion	Class Test, Exam	CLO1, CLO2, CLO3, CLO4
11.	Lesson 1: Reading Comprehension, Summary Writing, pat-8, and Paragraph writing, part-8 [Text Book-1 and 3]	Lecture, Discussion	Class Test, Exam	CLO1, CLO2, CLO3, CLO4

	Lesson 2: Reading Comprehension-9, Q/A, and Paragraph writing, part-9 Text Book-1 and 3]			
12.	Lesson 1: Reading Comprehension-10, Q/A and Summary writing and Paragraph writing, part-10 [Text Book-1 and 3] Lesson 2: Basic Grammar Part-9, Conditional Sentences, Listening-part-9 and speaking Part-9. [Text Book-1, 3 and 4] [Cambridge IELTS, Book-3, Test-1]	Lecture, Discussion	Assignment	CLO1, CLO2, CLO3, CLO4
13.	Lesson 1: Review class on topic discussed in Week-8, Week-9, Week-10 Lesson 2: Review class on topic discussed in Week-11, Week-12	Lecture, Discussion	Exam	CLO5, CLO6
14.	*Review and makeup class(if any) and Mid Term Exam 2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. A Basic English Grammar: Exercises-John Eastwood.
2. Grammar Practice Activities for Intermediate Students of English-Leo Jones.
3. Guided Paragraph Writing-T C Jupp & John Milne
4. Cambridge IELTS
5. Essential English Grammar-Raymond Murphy
6. Common Mistakes in English-T F Fitikides

BNQF Code: 07131109, Departmental Code: EEE-1109

Course Title: Basic Electrical Engineering

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** GED
Pre-requisites (if any**):** None

Rationale

This subject will assist the students in understanding the theory, concepts and working principles of basic electrical components and circuits used in electrical systems along with their applications. The knowledge acquired by student will help them to design, test, analyze and troubleshoot electrical systems and installations.

Course Objectives

1. Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
2. To explain the working principle, construction, applications different active and passive elements in a circuit.
3. Provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.
4. Highlight the importance of transformers in transmission and distribution of electric power.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Predict the behavior of any electrical and magnetic circuits.

CLO2 Formulate and solve complex AC, Dc circuits.

CLO3 Identify the type of electrical machine used for that particular application.

CLO4 Realize the requirement of transformers in transmission and distribution of electric power and other applications.

CLO5 Function on multi-disciplinary teams.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2		√										
CLO3						√						
CLO4		√										
CLO5									√			

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Resistors, Inductors and Capacitors in series and parallel; Resistance and Ohm's law; Capacitance and Dielectrics, Classification of circuits.	Lecture, Discussion	Class Test	CLO1
2.	Transient response in capacitive networks; Charging and discharging phases; R-L transients;	Lecture, Discussion	Class Test	CLO1
3.	Storage cycle, Decay phase; Faraday's experiment;	Lecture, Discussion	Class Test	CLO1, CLO2
4.	Source Conversion; Important terms of circuit analysis; Branch current analysis, Mesh and Nodal analysis; Star-delta and delta-star conversion.	Lecture, Discussion	Class Test	CLO1, CLO2
5.	Different types of power sources, EMF, Difference between	Lecture, Discussion	Assignment	CLO3

	EMF and potential difference, Kirchhoff's laws,			
6.	Superposition theorem, Thevenin's Theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Millman's Theorem,.	Lecture, Discussion Problem Solving	Exam	CLO2, CLO3
7.&8.	***Mid Term Exam***			CLO1, CLO2, CLO3
9.	Generation of alternating voltage & currents; Sine wave; General format of sinusoidal voltage and currents; Phase & algebraic representation of sinusoids; Average &MS (effective) values;	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1
10.	Response of basic R, L, C elements to a sinusoidal voltage & currents; Frequency response of basic elements; Resonance;	Lecture, Discussion Problem Solving	Class Test	CLO1 CLO2
11.	Average power & power factor; Complex numbers; Rectangular & polar form Active & reactive power;	Lecture, Discussion	Exam	CLO2 CLO3
12.	Series & parallel resonance circuit; Qualify factor; Selectivity.	Lecture, Discussion Problem Solving	Assessment	CLO3
13	Working principal of transformer, E.M.F. equations, Voltage transformation ratio-former equivalent circuit;	Lecture, Discussion Problem Solving	Assessment	CLO4
14.	Transformer on no load and on load; Phasor diagram; Transformer rating; Losses and efficiency, Team work. **Review and Makeup class (if any)**	Lecture, Discussion Problem Solving	Assessment	CLO4 CLO5

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. R.L. Boylestad, Introductory Circuit Analysis.
2. R.M. Kerchner, G.F. Corcoran, Alternating Current Circuits.
3. J. Nagarath and D.P. Kothari, Electric Machines.
4. F. Puschstein, T. C. Loyd, A. G. Conrad, Alternating Current Machines.
5. J.A.Edminister,Schaum's outline series: Theory & Problems of Electric circuits.

BNQF Code: 05331111, Departmental Code: PHY-1111

Course Title: Physics

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** GED
Pre-requisites (if any**):** None

Rationale

The goal of physics is to understand how things work from first principles and apply core ideas in science & technology. Students who study physics can get a broad perspective to any problem. It helps to learn how to consider any problem by bringing the innovative thinking in preparing solution. This subject boost student's analytical skills to analyze complex problems and gives them a strong quantitative background that can be applied in any technical field.

Course Objectives

1. Assess the role of science, and in particular, physics, in helping us to better understand the complex, technological society of which we are a part
2. Overview and understanding of basic physics, with moderate use of mathematical formalism.
3. To enhance communication social skills through group project

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Know the basic of physics and their utilization for core engineering in the various aspect of self and professional development
CLO2 Explain for basic physical formula of physics in some cases
CLO3 Apply their knowledge in practical field in some case of daily life problem solution

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2	√	√										
CLO3		√										

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Fundamentals of Physics, Basic concepts of Mechanics One & Two dimensional motion, Projectile motion	Lecture, Discussion	Class Test	CLO1, CLO3
2.	Explanation of two-dimensional motion, Force & Frictional forces Explanation of frictional force	Lecture, Discussion,	Class Test, Assignment, Exam	CLO2, CLO3
3.	Work, energy and Conservation of momentum, Work-energy theorem. Rotation of rigid bodies, Angular momentum, Moment of inertia, Torque.	Lecture, Discussion, Problem Solving	Class Test Exam	CLO1, CLO3
4.	Explanation regarding rigid body rotation	Lecture, Discussion,	Class Test	CLO1,

	Center of Gravity and center of mass, Kepler's law of planetary motion;		Exam	CLO2
5.	Simple harmonic motion, Spring – mass system, Force constant, , Phase, Period, frequency, and angular frequency Differential equation of simple harmonic oscillator. Total energy of simple harmonic oscillator	Lecture, Discussion	Exam	CLO1, CLO2
6.	Combination and composition of simple harmonic motions, Damped harmonic oscillations and Forced harmonic oscillation;	Lecture, Discussion	Exam	CLO2
7.	*Review and makeup class(if any) and Mid Term Exam 1 & Feedback*			
8.	Wave motion, Transverse and longitudinal waves, Traveling wave and standing wave Wave velocity and particle velocity, Differential equation of progressive wave of variables	Lecture, Discussion	Class Test, Exam	CLO1
9.	Power and intensity of a wave, Energy of progressive and stationary waves, Group velocity and phase velocity and Doppler Effect Electric charge, Coulomb's Law, Application of Coulomb's law, Electric field	Lecture, Discussion	Class Test, Exam	CLO1, CLO3
10.	Calculation of electric field, a dipole in an electric field, Electric flux, Gauss' law, Electric potential and Electric potential energy; Energy density, Dielectrics, Application	Lecture, Discussion	Class Test, Assignment, Exam	CLO1, CLO2, CLO3
11.	Capacitor and Capacitance, Combination of capacitors, Energy stored in a capacitor, , Current Electricity, Electric current. Ohm's Law, Resistance and Conductance, Application	Lecture, Discussion	Class Test, Exam	CLO1, CLO2
12.	Magnetic field, Force on a moving charge and current carrying conductors in a magnetic field, Motion of a point charge in a magnetic field, Hall effect, Biot-Savart law, Ampere's law, Faraday's law, Lenz's law,	Lecture, Discussion	Class Test, Exam	CLO1, CLO2
13.	Self- inductance and mutual inductance, Energy stored in a magnetic field Alternating current & Direct current	Lecture, Discussion	Exam	CLO1, CLO2, CLO3
14.	*Review and makeup class(if any) and Mid Term Exam 2 & Feedback*			

<table>
<tr><th>Assessment Strategy</th><th colspan="3">Course Evaluation Process and Mark Distributions</th></tr>
<tr><td rowspan="7">Exam Continuous Assessment:
Attendance, Class Test, Assignment, Presentation
Summative:
Mid Semester Exam and Final Semester Exam</td><td>SL</td><td>Category</td><td>Mark%</td></tr>
<tr><td>1.</td><td>Attendance</td><td>5%</td></tr>
<tr><td>2.</td><td>Class Test</td><td>5%</td></tr>
<tr><td>3.</td><td>Assignment</td><td>5%</td></tr>
<tr><td>4.</td><td>Presentation</td><td>5%</td></tr>
<tr><td>5.</td><td>Mid Semester Exam</td><td>20%</td></tr>
<tr><td rowspan="2">Make-up Procedures</td><td>6.</td><td>Final Semester Exam</td><td>60%</td></tr>
<tr><td rowspan="4">Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td colspan="2">Total:</td><td>100%</td></tr>
</table>

Learning Materials

1. Rafiqullah and Roy, Concept of electricity and Magnetism.
2. D.K. Cheng, Fields and waves electromagnetism.
3. Whimmery and V. Duger, Fields and waves.
4. Jankin and White, Fundamental of optics

BNQF Code: 06131106, Departmental Code: ICT-1106

Course Title: Structured Programming Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

The purpose of this course is to deepen students' engagement with the principles of programming language written in C through the understanding of basic knowledge and skillful implementation. This is an introductory programming course designed to prepare the students with fundamental tools and techniques and to build up a rigorous footing in programming.

Course Objectives

1. To provide the understanding of programming principles
2. To use programming principles in problem solving by transferring the model-based problem into computer-based solution
3. To enhance communication social skills through group project

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Understand computing problems using programming concepts and learn the basic concept of ACM Problem solving techniques.
CLO2 Describe fundamental programming elements including: variable, use of data types and data structures, decision structures, loop structures, pointer, string, console, file IO, and functions.
CLO3 Explain the problem requirements, interpret the problem, develop the algorithm to solve the problem and implement with the help of programming language.
CLO4 Discuss the knowledge of programming and problem interpreting in real file problems

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1					√							
CLO2	√											
CLO3		√										
CLO4		√										√

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Working with basic structure of C program, Problem solving from online judges	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
2.	Working with Operator and Expression, Exercise based on discussion, Problem solving in the lab	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
3.	Working with Conditional statements (e.g., if/else, switch case), Exercise based on discussion, Problem solving in the lab	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
4.	Working with Nested conditional structures, Exercise based on discussion, Lab Performance Test, Problem	Lecture, Discussion, Problem Solving	Assignment,	CLO1, CLO2

	solving in the lab		Lab Performance	
5.	Working with Loop (e.g., while loop, do-while, for loop), Exercise based on discussion, Problem solving in the lab	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
6.	Working with Array, Exercise based on discussion, Problem solving in the lab	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
7.	*Review and makeup class(if any) and Lab Test Exam 1 & Feedback*			
8.	Working with String, Exercise based on discussion	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2, CLO3
9.	Working with Function, Exercise based on discussion, Problem solving in the lab	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
10.	Working with Pointer & Structure, Exercise based on discussion, Problem solving in the lab	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2, CLO4
11.	Working with Structure, Exercise based on discussion, Problem solving in the lab	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
12.	Working with File and Dynamic Memory, Exercise based on discussion, Problem solving in the lab	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2, CLO4
13.	Review and Exercises	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	
14.	*Review and makeup class(if any) and Lab Test Exam 2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Lab Test Exam and Final Laboratory Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Lab Performance	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Lab Test Exam	20%
Make-up Procedures	6.	Final Laboratory Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. E Balagurusamy, Programming in ANSI C.
2. Dennis Ritchie, The C programming language. Prentice Hall, 1988.
3. Paul Deitel Harvey M. Deitel, C: How to Program, 6/e, Deitel & Associates, Inc
4. Herbert Shieldt , C: The Complete Reference
5. Stephen G. Kochan , Programming in C
6. Yashavant Kanetkar, Let Us C , 7/e
7. Herbert Shieldt, Teach Yourself C
8. R.G. Dromey, How to solve it using Computer, Prentice Hall, 1985
9. W W Norton, C Programming- A Modern Approach, 2nd Edition, 2008

BNQF Code: 02311108, Departmental Code: ENG-1108
Course Title: Technical and Communicative English Sessional
Credit Hr.: 1.00, Contact Hr.: 2.00, Course Type: GED
Pre-requisites (if any): None

Rationale
This course is designed to enable students to develop their competence in reading writing, speaking, listening, and grammar for academic and professional purposes. The students will be encouraged to acquire skills and strategies for using language appropriately and effectively in various situations.

Course Objectives:
1. To teach students the tools for writing technical error-free English.
2. To grow effective and fast reading skills among the students.
3. To enable to communicate confidently and competently in English language in all spheres.
4. To develop writing competence in scientific reports, journals, etc.

Course Learning Outcomes (CLO):
After completing the course, students will be able to:
CLO1 Communicate in English in their academic life and daily life.
CLO2 Use different grammatical aspects in English speaking and writing.
CLO3 Listen, speak, read, and write using Basic English rules.
CLO4 Create concise written content for effective communication.

Mapping Course Learning Outcomes (CLOs) with PLOs

CLO	PLO										
PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CLO 1									√		√
CLO 2								√	√		
CLO 3								√	√		√
CLO 4								√	√		√

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	C LO
1	**Lesson 1**: Overview of Basic English Communication. Lesson 2: Basic English Grammar Part-1: Articles, Regular and irregular verbs [Text Book-1 and 2]	Lecture, Discussion	Class test	CLO3
	Lesson 2: Basic Grammar, Verb Tenses Present and Past Tense: Simple and Progressive [Text Book 2 and 6]	Do	Do	CLO 2, 3
	Sessional 1: Listening to understand English varieties and standard pronunciation [Cambridge IELTS Book 1, Listening Test 1]	Audio-visual presentation, projection and display	Listening test (Lab)	CLO 1, 3
2	**Lesson 3:** Basic Grammar, Perfect and Progressive Tenses [Text Book 2 and 6]	Lecture, Discussion, slide show	Class test	CLO 1,2, 3
	Lesson 4: Basic Grammar: Subject-verb Agreement-1 [Text Book 2, 3 and 6]	Do	Do	CLO2, 3

	Sessional 2: Listening practice to identify and understand familiar words and basic phrases in various situations. [Cambridge IELTS Book 2, Listening Test 1]	Audio-visual presentation, projection and display	Listening test (Lab)	CLO 1, 3
3	**Lesson 5:** Reading Passage: Skimming and scanning, extensive and intensive reading, comprehending, and extracting main ideas.	Using reading materials, discussion	Class test	CLO3
	Lesson 6: Reading: Vocabulary development, writing summaries of the text.	Do	Do	CLO2, 3
	Sessional 3: Listening practice to understand common vocabulary and expressions in short, clear dialogues. Observing simple talks, introductions, information, and announcements. [Cambridge IELTS Book 3, Listening Test 1]	Audio-visual presentation, projection and display	Listening test (Lab)	CLO 3
4	**Lesson 7:** Reading Comprehension-1 Vocabulary development, interacting with the text [Cambridge IELTS, Book 1, Test 1]	Using reading materials	Class test	CLO 3
	Lesson 8: Reading Comprehension-2 Understanding the meaning of the text [Cambridge IELTS Book 2, Reading test 1]	Do	Do	CLO 3
	Sessional 4: Listening practice to understand the main points of a speech about everyday or professional topics. Situations include phone calls, meetings, and interviews. [Cambridge IELTS Book 2, Listening Test 2]	Audio-visual presentation, projection and display	Listening test (Lab)	CLO 3
5	**Lesson 9:** Basic Grammar, Subject-verb Agreement-2	Lecture, discussion	Class test	CLO 1, 2, 3
	Lesson 10: Basic Grammar, Application of right form of Verbs-1	Do	Do	CLO 2, 3
	Sessional 5: Introduction to speaking, ice-breaking, controlling nervousness, reaching the audience	Using cue cards	Speaking test on cue card topics or role-playing	CLO 1, 2, 3
6	**Lesson 11:** Basic Grammar, Application of right form of Verbs-2	Lecture, discussion	Class test	CLO 2, 3
	Lesson 12: Basic Grammar, Application of right form of Verbs-3	Do	Do	CLO 2, 3
	Sessional 6: Greetings, agreeing, disagreeing, small talks in different situations-1	Using cue cards	Speaking test on cue card topics or role-playing	CLO 2, 3
7	**Lesson 13:** Basic Grammar, Linking Words, Part-1	Lecture, discussion	Class test	CLO 2, 3
	Lesson 14: Basic Grammar, Linking Words, Part-2	Do	Do	CLO 2, 3
	Sessional 7: Greetings, agreeing, disagreeing, small talks in different situations-2	Using cue cards, IELTS speaking	Speaking test on cue card topics or	CLO 2, 3

		materials	role-playing	
8	**Lesson 15:** Basics of writing, Paragraph writing strategies [Test Book 4]	Lecture, discussion, slide show	Class test	CLO 2, 3
	Lesson 16: Developing a good paragraph-Burger model: topic sentence, supporting ideas and conclusion	Do	Do	CLO 2, 3
	Sessional 8: Speaking: Practicing role-playing tasks-1	Using cue cards, IELTS speaking materials	Speaking test on cue card topics or role-playing	CLO 2, 3
9	**Lesson 17:** : Practicing freewriting and organization of concepts	Lecture, discussion, slide show	Assignment	CLO 2, 3, 4
	Lesson 18: Writing formal/official letters-1	Do	Class test	CLO 2, 3, 4
	Sessional 9: Speaking: Practicing role-playing tasks-2	Using cue cards, IELTS speaking materials	Speaking test on cue card topics or role-playing	CLO 2, 3
10	**Lesson 19:** CV writing	Lecture, discussion, slide show	Assignment	CLO 2, 3,4
	Lesson 20: Writing Job/ Cover Letter	Do	Class test	CLO 1, 2, 3, 4
	Sessional 10: Speaking: Practicing proper introduction, conclusion, and outlining of the speech, developing supporting ideas and visual aids.	IELTS speaking materials, displaying sample answers	Do	CLO 1, 2, 3
11	**Lesson 21:** Basic Grammar, Conditional Sentences-1	Lecture, discussion	Class test	CLO 1, 2, 3
	Lesson 22: Basic Grammar, Conditional Sentences-2	Do	Do	CLO 1, 2, 3
	Sessional 11: Speaking test-1	Cue cards, role playing	Speaking test on cue card topics or role-playing/ presentation	CLO 1, 2, 3
12	**Lesson 23:** Basic Grammar, Conditional Sentences-3	Lecture, discussion	Class test	CLO 1, 2, 3
	Lesson 24: Basic Grammar, Conditional Sentences-4	Do	Do	CLO 1, 2, 3
	Sessional 12: Speaking test-2	Cue cards, role playing	Speaking test on cue card topics or role-playing/ presentation	CLO 2, 3
13	**Lesson 25:** Reflective writing-1	Lecture, discussion, displaying samples	Assignment	CLO, 2, 3,4
	Lesson 26: Reflective writing-2	Do	Do	CLO3 2, 3, 4
	Sessional 13: Speaking test-3	Cue cards, role playing	Speaking test on cue card topics or role-playing/ presentation	CLO3
14	**Lesson 27:** Review class-1			CLO3
	Lesson 28: Review class-2			CLO3
	Sessional 14: Overview			CLO3

BNQF Code: 07131110, Departmental Code: EEE-1110
Course Title: Basic Electrical Engineering Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** GED
Pre-requisites (if any**):** None

Rationale

This subject will assist the students in understanding the theory, concepts and working principles of basic electrical components and circuits used in electrical systems along with their applications. The knowledge acquired by student will help them to design, test, analyze and troubleshoot electrical systems and installations.

Course Objectives

1. Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
2. To explain the working principle, construction, applications different active and passive elements in a circuit.
3. Provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.
4. Highlight the importance of transformers in transmission and distribution of electric power.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Predict the behavior of any electrical and magnetic circuits.

CLO2 Formulate and solve complex AC, Dc circuits.

CLO3 Identify the type of electrical machine used for that particular application.

CLO4 Realize the requirement of transformers in transmission and distribution of electric power and other applications.

CLO5 Function on multi-disciplinary teams.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2		√										
CLO3						√						
CLO4		√										
CLO5									√			

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Introduction to different elements of Electrical circuits Lab	Lecture, Discussion	Assignment, Lab Performance	CLO1
2.	Verification of Ohm's Law	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1
3.	Verification of Kirchhoff's Voltage Law (KVL) & Voltage divider rule (VDR).	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1
4.	Verification of Kirchhoff's Current Law (KCL) & Current divider rule (CDR)	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1

5.	Verification of Superposition Theorem	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO2
6.	Verification of Thevenin's Theorem	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO2
7.	*Review and makeup class(if any) and Lab Test Exam 1 & Feedback*			
8.	Verification of Millman's Theorem	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO2
9.	Verification of Maximum Power Transfer Theorem	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO2
10.	Verification of R, L, C circuit	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO2
11.	Verification of series and parallel resonant circuit	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO3
12	Review and practice Class	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2, CLO3
13.	Group Project Presentation	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO2
14.	*Review and makeup class(if any) and Lab Test Exam 2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Lab Test Exam and Final Laboratory Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Lab Performance	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Lab Test Exam	20%
Make-up Procedures	6.	Final Laboratory Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials:

1. *R.L. Boylestad, Introductory Circuit Analysis.*
2. *R.M. Kerchner, G.F. Corcoran, Alternating Current Circuits.*
3. *J. Nagarath and D.P. Kothari, Electric Machines.*
4. *F. Puschstein, T. C. Loyd, A. G. Conrad, Alternating Current Machines.*
5. *J.A.Edminister,Schaum's outline series: Theory & Problems of Electric circuits.*

BNQF Code: 05411201, Departmental Code: MATH-1201

Course Title: Algebra of Matrix and Geometry

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** GED
Pre-requisites (if any**):** None

Rationale

Algebra of Matrix and Geometry are the foundations of mathematics courses. Understanding this course will precede everyone to learn other areas of mathematics. After completing this course, students will get understanding of fundamental concepts, properties, determinant of different type of matrix with rank, operation and applications of matrices and Characteristics equation. The geometrical problem can be solved by algebra, and the algebraic problem can be solved by geometry. So geometrical conception is essential for mathematics students.

Course Objectives

1. To provide the understanding of fundamental concepts of matrix
2. The students will be competent to solve systems of linear equations and apply these techniques to real-world problems and able to develop a comprehensive understanding of the concepts of two-dimensional geometry.
3. To perform matrix algebra, compute determinants and know their properties.
4. To learn basis, rank, nullity, and finding and using the eigenvalues and eigenvectors of a matrix to apply problems.
5. To learn about axes, translation and rotation of axes, conics, and conic sections for two-dimensional functions.
6. To enhance with a deeper understanding of relationships in spaces as well as in the plane.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Define different types of matrices and determinants. Perform basic operations with matrices and find the transpose and inverse of a matrix. Row-reduce a matrix to either row-echelon or reduced row-echelon form
CLO2 Use matrix operations to solve systems of equations and be able to determine the nature of the solutions. Understand some applications of systems of linear equations.
CLO3 Calculate eigenvalues and their corresponding eigenspaces with their applications.
CLO4 Understand co-ordinate and its translation and rotation system. Identification of conic.
CLO5 Identification the equation of straight lines, circle and conic and their properties.
CLO6 Sketch graphs and discuss relevant features of lines, circles and conic sections.

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2		√										
CLO3	√											
CLO4	√											
CLO5	√											
CLO6		√										

Course Contents		Hours	CLOs
1.	**Algebra of Matrices:** Matrices and their properties; Special types of matrices; Laws of Matrix Algebra; Determinants and its properties; Expansion and evaluation of determinants; Cramer's rule, Adjoin and inverse of a square matrix, Rank of a matrix, Matrix operations, Elementary row or column operations, Echelon forms of matrices; Introduction to system of linear equations; Solutions of the system of linear equations; Application of matrices and determinants for solving the system of linear equations.	**15 Hrs.**	CLO1 & CLO2
2.	**Characteristic Equation**: Eigenvalues and Eigenvectors; Matrix polynomial; Characteristic equation; Cayley-Hamilton theorem; Diagonalization of matrices; Applications.	**6 Hrs.**	CLO3
3.	**Co-ordinate systems:** Cartesian co-ordinates, Polar co-ordinates, Parameters, Standard Equations in different co-ordinates systems and their parametric representations, Transformation of co-ordinates.	**7 Hrs.**	CLO4 &CLO6
4	**Pair of straight lines:** Condition for a general equation of 2nd degree in two variables to represent pair of straight lines, Properties of pair of straight lines.	**6 Hrs.**	CLO5 &CLO6
5	**System of circles:** Circles and system of circles, General properties, orthogonality of two circles, limiting circle, radical axis, co-axial circles.	**4 Hrs.**	CLO5 &CLO6
6	**Conics:** The general equation of 2nd degree in two variables and reduction to standard forms, identification of conics; Parabola, Ellipse and Hyperbola: Derivation of standard forms and properties.	**4 Hrs.**	CLO5 &CLO6

Assessment Strategy	Course Evaluation Process and Mark Distributions		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. Anton H. and Rorres C., Elementary Linear Algebra: Applications Version, John Wiley & Sons, 2013.
2. Strang G., Linear Algebra and its Applications, Belmont, CA: Thomson, Brooks/Cole, 2006.
3. Thomas Jr. B. G., and Finney L. R., Calculus with Analytic Geometry, Addison and Wesley, 1986.
4. Loney S., Analytic Geometry, University of Michigan Libra, 1899.
5. Kar J. M., Analytic Geometry, Gurudas College Call, 1956.

BNQF Code: 05421203, Departmental Code: STAT-1203

Course Title: Applied Statistics

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** GED
Pre-requisites (if any**):** None

Rationale

Statistics is the science that deals with the collection, description, analysis, interpretation, and presentation of data. Statistics can be used to describe a particular data set (termed descriptive statistics) as well as to draw conclusions about the population from a particular data set (termed inferential statistics). In real life, statistical methods can apply to solve different problems and help to make an effective decision that affect our daily lives. Statistical methods are used in development of planning, commerce, industry, business, formation of development policy, agricultural sector, social science etc. By studying this course, students will learn the fundamental knowledge about statistics and their applications.

Course Objectives

1. Identify shape of a distribution of data – right skew, left skew, or symmetric) when presented with a histogram.
2. Given a variable of interest, identify whether the variable is categorical (binary, ordinal, nominal) or quantitative (discrete, continuous).
3. From a numerical description of a variable, predict what shape the histogram would most likely take.
4. Explain how mean and median are related for different distribution shapes (right skew, left skew, and symmetric).
5. Describe how outliers affect various numerical summaries (mean, median, range, and standard deviation).
6. Identify from a probability scenario events that are simple, complementary, mutually exclusive, and independent.
7. Explain the difference between events that are mutually exclusive and independent.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Achieve a sound understanding of the theoretical and practical knowledge of statistics.
CLO2 Impart them with fundamental knowledge about descriptive statistics and their applications.
CLO3 Apply appropriate statistical tools (Regression, data mining, and probability) for making decision.
CLO4 Able to apply their statistical knowledge and skills throughout their future studies.

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	**PLO**											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2	√											
CLO3					√							
CLO4			√									

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy				
Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Lesson 1: Introduction Meaning and Definition of Statistics; Types of statistics; Characteristics; Why we study Statistics; Scopes and applications of statistics in Engineering; Limitations and misuses of statistics; Population and sample; Parameter and statistic Lesson 2: Collection of Data Meaning of data, types of data; Sources of statistical data; Data collection tools; Variable and types of variable; Level of measurement.	Lecture, Discussion	Class Test, Exam	CLO1
2.	Lesson 3: Constructing frequency distribution and relative frequency distribution: Qualitative and quantitative data Lesson 4**:** Cumulative frequency distribution; Graphic presentation of a frequency distribution with merits and demerits.	Lecture, Discussion, Problem Solving	Class Test, Exam	CLO1, CLO4
3.	Lesson 5: Measures of Central Tendency Ungrouped data: Arithmetic Mean, Geometric Mean, Harmonic Mean, Weighted Mean, Median and Mode with uses, advantages and limitations Lesson 6: Grouped Data Arithmetic Mean, Median and Mode with uses, advantages and limitations	Lecture, Discussion, Problem Solving	Class Test, Assignment, Exam	CLO1, CLO2, CLO4
4.	Lesson 7: Measures of Location Quartile, Percentile and Decile Lesson 8: Mathematical Problems	Lecture, Discussion, Problem Solving	Class Test, Exam	CLO1, CLO2, CLO4
5.	Lesson 9: Measures of Dispersion Meaning of dispersion; measures of dispersion; absolute measures of dispersion, Lesson 10: Relative measures of dispersion; Application of different measures of dispersion.	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1, CLO2
6.	Lesson 11: Skewness Concept of Skewnessn and their measures. Lesson 12: Kurtosis Concept of kurtosis and their measures.	Lecture, Problem Solving	Exam	CLO1, CLO2, CLO4
7.	*Review and makeup class(if any) and Mid Term Exam 1 & Feedback*			
8.	Lesson 13: Correlation Bi-variate data, scattered diagram, simple correlation, calculation of correlation coefficient Lesson 14: Regression Simple regression, Multiple regression with examples, related math	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1, CLO3, CLO4
9.	Lesson 15: Coefficient of determination; Forecast the future value using regression equation, Calculate and interpret the confidence and prediction intervals Lesson 16: Probability Sample Space, Tree diagram, Define probability	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1, CLO3, CLO4

	Laws of probability, Additional rules, multiplication rules			
10.	Lesson 17: Laws of probability, Additional rules, multiplication rules Lesson 18: Marginal probability, Joint probability, Conditional probability and Bayesian Probability	Lecture, Discussion	Class Test, Exam	CLO1, CLO3, CLO4
11.	Lesson 19 and 20 : Probability Distributions Basic idea of Probability Distribution, Binomial distribution and Poisson distribution with math	Lecture, Discussion Problem Solving	Class Test, Assignment, Exam	CLO1, CLO3, CLO4
12.	Lesson 21: Presentation Lesson 22: Test of Hypothesis Define Hypothesis, basic concepts of Hypothesis.	Lecture, Discussion	Exam	CLO1
13.	Lesson 23 and 24 : Mean test with related math	Lecture, Problem Solving	Exam	CLO1, CLO3, CLO4
14.	*Review and makeup class(if any) and Mid Term Exam 2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. M. Nurul Islam, *Introduction to Statistics and Probability*, Book World.
2. Lind, D. A., Marchal, W. G. and Mason, R. D.,*Statistical Techniques in Business and Economics*
3. Md. Siddiqur Rahman, Statistics and Probability: An Introductory Analysis.
4. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics
5. R.N. Shill & S.C. Debnath, An introduction to the theory of Statistics
6. Murry R. Spiegel, Theory and problems of Statistics
7. J.N. Kapoor & H.C. Saxena, Mathematical Statistics

BNQF Code: 07141205, Departmental Code: EEE-1205

Course Title: Electronic Device and Circuit

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** GED
Pre-requisites (if any**):** None

Rationale

This course is designed to give knowledge about basic electronic devices i.e. various Unipolar & bipolar devices, oscillators, power supplies, amplifiers, Op-Amps, pnpn devices and their workings. It is targeted to provide a basic foundation for technology areas like communication systems, industrial electronics as well as instrumentation, control systems and electronic circuit design.

Course Objectives

1. Acquire a basic knowledge in solid state electronics including diodes, MOSFET, BJT, and operational amplifier.
2. Develop the ability to analyze and design analog electronic circuits using discrete components.
3. Observe the amplitude and frequency responses of common amplification circuit
4. Design, construct, and take measurement of various analog circuits to compare experimental results in the laboratory with theoretical analysis.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Memorize basic knowledge of electronics devices those are the basic building blocks of electronic circuits.
CLO2 Describe knowledge and skills in illustrating electronic circuits using basic electronics devices.
CLO3 Explain complex networks of resistors, inductors, capacitors, diodes, transistors and op-amp subject to both direct (non-time-varying) and alternating voltages and currents.

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2		√										
CLO3	√	√										

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Semiconductor, Bonds in Semiconductors, Commonly used Semiconductors, Energy Band Description, Effect of Temperature, Intrinsic and Extrinsic Semiconductor	Lecture, Discussion	Class Test	CLO1
2.	N-type and P-type semiconductor, majority and minority carrier, PN junction, properties of pn junction	Lecture, Discussion	Class Test	CLO1
3.	Biasing a pn junction, volt-ampere characteristics of pn junction, important terms, limitation in the operation of pn junction	Lecture, Discussion, Problem Solving	Assignment Exam	CLO1
4.	Semiconductor diode, Crystal diode as a rectifier, resistance of crystal diodes, Equivalent circuit of crystal diode, half wave rectifier, output frequency and efficiency of half wave rectifier, mathematical problems.	Lecture, Discussion, Problem Solving	Class Test, Exam	CLO1, CLO2

5.	Full wave rectifier, Centre-tap full wave rectifier, Full wave bridge rectifier, output frequency and efficiency of full wave rectifier, mathematical problems.	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1, CLO2
6.	Mathematical problems, ripple factor, comparison of rectifier circuits, filter circuits, types of filer circuits	Lecture, Discussion Problem Solving	Exam	CLO1, CLO2
7.	Voltage stabilization, Zener diode, Equivalent circuit, Zener diode as a voltage stabilizer, mathematical problems.	Lecture, Discussion Problem Solving	Exam	CLO1, CLO2
	Review and makeup class(if any) and Mid Term Exam 1 & Feedback			
8.	Transistor, naming of transistor terminals, important facts about transistor, transistor action, transistor symbol, transistor as an amplifier mathematical problems	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1, CLO2
9.	Transistor connection, common base connection, Mathematical problems, V-I characteristics of CB connection	Lecture, Discussion Problem Solving	Class Test	CLO1, CLO2
10.	Common Emitter connection, Mathematical problems, V-I characteristics of CE connection	Lecture, Discussion Problem Solving	Exam	CLO1, CLO2
11.	Common collector connection, V-I characteristics of CC connection, comparison of transistor connection	Lecture, Discussion Problem Solving	Exam	CLO1
12.	Field Effect Transistors(FET), Types of FET, JEFT, Principle and Working of JFET, Schematic symbol of JFET, Importance of JFET, Difference between BJT and JFET, MOSFET, Review and practices	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1
13.	Introduction of OP-AMP, OP-AMP symbol, Polarity convention, Ideal OP-AMP characteristics, Virtual grounds and summing points, OP-AMP applications	Lecture, Discussion Problem Solving	Exam	CLO3
14.	*Review and makeup class(if any) and Mid Term Exam 2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. Principles of Electronics: V. K. Mehta
2. Electronic Devices and Circuit Theory, Robert L. Boylestad
3. Electrical Technology: Electrical Devices and Circuits, B. L. Theraja and A.K. Theraja.

BNQF Code: 02221207, Departmental Code: HUM-1207

Course Title: Bangladesh Studies

Credit Hr.: 2.00, **Contact Hr.:** 2.00, **Course Type:** GED
Pre-requisites (if any**):** None

Rationale

This course has been designed to help the students in obtaining comprehensive idea about the history, culture and heritage of Bangladesh. It will introduce students to the economy, society, politics, diplomacy and foreign policy of Bangladesh. Students will learn about the challenges and potentials of Bangladesh in shaping its peaceful and sustainable future. Students learn about roles and contribution of Bangladesh in the regional and international bodies.

Course Objectives

1. Introduce students with rich history, culture and heritage of Bangladesh.
2. To providing them in-depth knowledge on the major political events that shaped Bangladesh as an independent sovereign state.
3. Improve their understanding on political, economic and social development of Bangladesh.
4. Help them think critically and comprehensively about foreign policy of Bangladesh, its relationship with other countries and its important roles in the international organizations like UN, Commonwealth and SAARC etc.
5. Increase understanding on the challenges and potentials of Bangladesh in shaping its peaceful and sustainable future

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Conduct SWOT (strengths, weaknesses, opportunities and threats) analysis on the geography, demography, society, culture, government and politics of Bangladesh.
CLO2 Critically analyze the national and international factors behind the socio-economic development of Bangladesh and design solutions to meet specific development needs.
CLO3 Debate on the historical and legal framework of ethics and normative issues affecting contemporary Bangladesh through questioning popular perceptions and evaluate them against empirical evidence.
CLO4 Explain the diverse nature of prevailing environmental concerns through qualitative and quantitative analysis and design solution for sustainable development.
CLO5 Develop rational and practical solutions both individually and collectively through a sense of ownership for the country and communicate those innovative solutions to meet the critical challenges of contemporary Bangladesh.

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2		√										
CLO3										√		
CLO4							√					
CLO5			√									

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy				
Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Lesson 1: Introduction to course, Course Approach, Course Methodology, Marks Distribution, Assessment and Evaluation Lesson 2: Importance and application of the course, sharing expectations and outcomes, Motivation, and Self-development.	Lecture, Discussion	Class Test	
2.	Lesson 1: Bangladesh-At a Glance Geographical Traits e.g. Location, Border & Boundary, Topography, Rivers, Mineral and Natural Resources, Climate; Demographical Traits e.g. Population of Bangladesh, Labor Force, Demographic Dividend Lesson 2: Bangladesh-At a Glance Social Traits e.g. Society, Social Stratification; Cultural Traits e.g. Identity, Tradition, Festivals, Cultural Challenges; Government; Organs of Government; Sovereignty	Lecture, Discussion	Class Test Exam	CLO1
3.	Lesson 1: Origin of the name of Bangladesh; Development trend of the name of Bangladesh Lesson 2: Origin and Identity of the people of Bangladesh ; Origin of Man; Origin and Identity of Banagalees, Reasons of arrival of Various Races in this region	Lecture, Discussion	Class Test Exam	CLO3
4.	Lesson 1: Bangladesh in International Affairs Foreign Policy, Bangladesh Foreign Policy: Principles, Objectives and Determinants Lesson 2: Bangladesh in International Affairs Bangladesh Foreign Policy: Policy Making Body, Foreign policy achievements and challenges	Lecture, Discussion	Assignment, Class Test, Exam	CLO2
5.	Lesson 1: The Constitution of Bangladesh Concept, Types, Essentials of a Good Constitution, Bangladesh Constitution: Making Process, Basic Facts and Figures and Features. Lesson 2: The Constitution of Bangladesh Bangladesh Constitution: Fundamental Principles, Fundamental Rights, Amendments of Bangladesh Constitution	Lecture, Discussion	Class Test, Exam	CLO1, CLO3
6.	Lesson 1: Presentation Presentation will be taken on selected topics that are related with the course content as a group or individual Lesson 2: Presentation Presentation will be taken on selected topics that are related with the course content as a group or individual	Lecture, Discussion	Exam	CLO5
7.	*Review and makeup class(if any) and Mid Term Exam 1 & Feedback*			
8.	Lesson 1: Economic Profile of Bangladesh Nature of the economy; Development Approaches; Development Strategies e.g. Vision 2021, SDGs; Concepts: Gig Economy, Blue Economy; National Budget and Functions of ECNEC. Lesson 2: Economic Profile of Bangladesh: A Promising Country Economic Development Trends, Bottomless Basket to Emerging	Lecture, Discussion	Class Test, Assignment, Exam	CLO1, CLO2

	Tiger; Challenges of the Economy			
9.	Lesson 1: Urbanization in Bangladesh Concepts e.g. Urbanization and Migration; Trend of Urbanization: Bangladesh and International Perspective; Impact, Problems of Urbanization in Bangladesh Lesson 2: Rural Development in Bangladesh Rural Development; Indicators of Rural Development; BARD: Cumilla Model; Local Government and Role of NGOs in rural Development	Lecture, Discussion	Class Test, Exam	CLO2
10.	Lesson 1: Environmental Degradation and Climate Change: Bangladesh Perspective Concepts e.g. Environment, Ecosystem, Climate Change and Environmental Degradation; Factors of Environmental Degradation; Impact of Climate Change Lesson 2: Environmental Degradation and Climate Change: Bangladesh Perspective Common Environmental Problems in Bangladesh; Initiatives for environmental protection: Bangladesh and International	Lecture, Discussion	Class Test, Exam	CLO4
11.	Lesson 1: Industrial Sector in Bangladesh Industrial Growth Trend: Major Industries in Bangladesh; Contribution of Industry in GDP Lesson 2: ICT Industry ICT Industry; Development of ICT Industry, Govt. Initiatives; Problems of ICT Industry and Prospects of ICT Industry	Lecture, Discussion	Class Test, Exam	CLO2, CLO5
12.	Lesson 1: Presentation Presentation will be taken on selected topics that are related with the course content as a group or individual Lesson 2: Presentation Presentation will be taken on selected topics that are related with the course content as a group or individual	Presentation	Presentation	CLO2, CLO3
13.	Lesson 1: Review class on topic discussed in Week-8, Week-9, Week-10 Lesson 2: Review class on topic discussed in Week-11, Week-12	Lecture, Discussion	Exam	CLO2, CLO3, CLO4, CLO5
14.	*Review and makeup class(if any) and Mid Term Exam 2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. Bangladesh Politics: Problems and Issues , Rownak Jahan
2. Constitutional Development in Bangladesh , Dilara Chowdhury
3. Government & Politics of Pakistan , Dr. M. A. Chowdhury
4. Ausamapta Atmajiboni (The Unfinished Memoirs), Sheikh Mujibur Rahman, The University Press Limited, 2012.
5. Banglapeadia, National Encyclopedia of Bangladesh. Volume-1 to 10, Asiatic Society of Bangladesh, March, 2003.
6. Bangladesh, On the Threshold of the Twenty-first Century; Edited by-A.M. Chowdhury & Fakrul Alam, Asiatic Society of Bangladesh, 2002.
7. Socio-Economic Condition in Bangladesh, Chowdhury Tamzid Ahmed, Tapan Prakashon, Dhaka.
8. The Face of Urbanization and Urban Poverty in Bangladesh, Pranab Kumar Panday, 2020 Palgrave Macmillan
9. The Constitution of the People's Republic of Bangladesh, Ministry of Law, Justice and Parliamentary Affairs, Bangladesh.
10. A History of Bangladesh, Willem van Schendel, Cambridge University Press, UK.

BNQF Code: 06111209, Departmental Code: ICT-1209

Course Title: Discrete Mathematics

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

Discrete methods underlie the areas of data structures, computational complexity and the analysis of algorithms. Recent advances in technology - particularly in applications of
Computing - have enhanced the importance of discrete mathematics as a basis for understanding the foundations of computing and for further studies in computer analysis.

Course Objectives

1. To introduce students to language and methods of the area of Discrete Mathematics.
2. The focus of the module is on basic mathematical concepts in discrete mathematics and on applications of discrete mathematics in algorithms and data structures.
3. To show students how discrete mathematics can be used in modern computer science.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Understand the notion of mathematical thinking, mathematical proofs, and algorithmic thinking, and be able to apply them in problem solving.
CLO2 Understand the basics of discrete probability and number theory, and be able to apply the methods from these subjects in problem solving.
CLO3 Be able to use effectively algebraic techniques to analyze basic discrete structures and algorithms.
CLO4 Understand asymptotic notation, its significance, and be able to use it to analyze asymptotic performance for some basic algorithmic examples.
CLO5 Understand some basic properties of graphs and related discrete structures, and be able to relate these to practical examples.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2	√											
CLO3		√										
CLO4		√										
CLO5	√											

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Set theory – Definitions and Set Identities, Venn Diagrams, Operations of Sets;	Lecture, Discussion	Class Test	CLO1
2.	Definition of Relation, Inverse Relation, Composition, Types of Relations, Closure Properties, Equivalence	Lecture, Discussion	Class Test	CLO2

	Relations, Partial Ordering;			
3.	Functions– Functions as Relations, Composition of function, One-to-One, Onto, and Inverse function.	Lecture, Discussion	Class Test	CLO1, CLO2
4.	Propositions and Compound Propositions, Basic Logical Operations, Propositions and Truth Tables, Tautologies and Contradictions, Logical Equivalence	Lecture, Discussion	Class Test	CLO1, CLO2, CLO4
5.	Predicate and Quantifiers, Interpretations of predicate logic, Predicate calculus.	Lecture, Discussion	Assignment	CLO2
6.	Basic Counting principle, Permutation, Combination, Pigeonhole Principle, Inclusion-Exclusion principle	Lecture, Discussion Problem Solving	Exam	CLO2, CLO3
7.&8.	***Mid Term Exam***			CLO1, CLO2, CLO3, CLO4
9.	Graphs and Multigraph, Subgraphs, Isomorphic Graphs and Homeomorphic Graphs, Paths and Connectivity, Labeled and Weighted Graphs,	Lecture, Discussion Problem Solving	Class Test, Exam	CLO3
10.	Tree Graphs, Planar Graphs, Graph Coloring, Hamiltonian Graph, Euler Graphs, BFS, DFS. Dijkstra's Algorithm, Checking whether a graph is Euler graph.	Lecture, Discussion Problem Solving	Class Test	CLO4
11.	Definition of Formal Language, Words and Sub words, Languages – Operations on Languages, Regular Expressions and Regular Languages,	Lecture, Discussion	Exam	CLO4
12.	Finite State Automata – Pumping and Kleene Theorem, Phrase-structure Grammars – Types of Grammars, Derivation Tree, Backus-Naur form.	Lecture, Discussion Problem Solving	Assessment	CLO5, CLO2
13	Order Sets, Lattices as Partially Ordered Sets and Their Properties, Lattices and Algebraic Systems,	Lecture, Discussion Problem Solving	Assessment	CLO5
14.	Sub Lattices, Complimented, Bounded and Distributive Lattices, Direct Products and Homomorphism.**Review and Makeup class (if any)**	Lecture, Discussion Problem Solving	Assessment	CLO5
15.&16.	***Final Term Exam & Feedback***			CLO2 CLO3, CLO4, CLO5

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:**	SL	Category	Mark%

Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. Seymour Lipschutz& Marc Laris Lipson, Theory and Problems of Discrete Math.
2. Kenneth H.Rosen, Discrete Mathematics and its Applications.
3. Olympia Nicodemi, Discrete Mathematics.
4. Knuth, Concrete Mathematics.
5. Donald F. Stanat& David F. McAllister, Discrete Mathematics in Computer Science.

BNQF Code: 06131211, Departmental Code: ICT-1211

Course Title: Data Structures

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

Data structure is a logical mathematical model of storing & organizing data in a particular way in a computer. This course introduces fundamental data structures and explains abstract data types and their representations based on arrays, pointers and Link list. It also discusses the advantages and disadvantages of the different types of representations of data types. It introduces algorithms for efficient searching, insertion and deletion using data structures stored in internal memory.

Course Objectives

1. To introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms.
2. To develop effective software engineering practice, emphasizing such principles as decomposition, procedural abstraction, and software reuse.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Describe basic data structures like array, linked list, stack, queue, tree and graph.
CLO2 Explain programming techniques to develop data structures: array, linked list, stack, queue, tree and graph.
CLO3 Apply the knowledge of data structures in problem solving

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2		√										
CLO3	√	√										

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Lesson-1: Introduction and importance of Data Structure in computing; Applications; Review discussion on recursion. Lesson-2: Review discussion on pointer, structure, self-referential structure; dynamic memory allocation	Lecture, Discussion	Class Test	Background Preparation week
2.	Lesson-3: Review of Wk 1, Computational Complexity and exercises; Lesson-4: Self-referential structure application for link list; Exercise on visualization of data node; Course Project Team and discussion on presentation and deliverables	Lecture, Discussion	Class Test	CLO1, CLO3
3.	Lesson-5: Link-List and operations on link list Lesson-6: Review and Link-List and operations on link list	Lecture, Discussion, Problem Solving	Assignment	CLO1, CLO2

4.	Lesson-7: Link-list application and case study mini project Lesson-8: Discussion on Stack data structure and implementation of stack using array and link list	Lecture, Discussion, Problem Solving	Exam	CLO1, CLO2
5.	Lesson-9: Processing of expression: in-order, pre-order and post-order; Application of stack in processing expressions Lesson-10: Discussion on Queue data structure and implementation of Queue using array and link-list	Lecture, Discussion Problem Solving	Class Test, Assignment, Exam	CLO1, CLO2
6.	Lesson 11: Discussion on Queue and applications; Exercise for expression processing Lesson 12: Review discussion for Mid Exam; Exercises on link-list and stack	Lecture, Discussion, Problem Solving	Exam	CLO1, CLO2, CLO3
7.	*Review and makeup class(if any) and Mid Term Exam 1 & Feedback*			
8.	Lesson 13: Discussion on Tree data structure: terminology, array to tree and tree to array; different form of trees; tree implementation using array and link-list; tree applications Lesson 14: Tree traversals and applications, Binary Search Tree and operations on BST, BST Applications	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1, CLO2
9.	Lesson 15: Discussion on Heap data structure and applications of Heap; Operations on Heap Lesson 16: Review discussion on BST and Heap; Discussion on Hashing; Exercise on BST and Heap	Lecture, Discussion Problem Solving	Class Test, Assignment, Exam	CLO1, CLO2
10.	Lesson 17: Discussion on Graph data structure and applications of graph, Graph representations, Graph Implementation Lesson 18: Discussion on Traversal of Graph; Graph Applications	Lecture, Discussion, Problem Solving	Class Test, Assignment, Exam	CLO1, CLO2
11.	Lesson 19: Review exercises on Tree, BST, Heap and Graph Lesson 20: Review exercises on Tree, BST, Heap and Graph	Lecture, Problem Solving	Exam	CLO1, CLO2
12.	Lesson 21: Review exercises on Tree, BST, Heap and Graph Lesson 22: Review exercises on Tree, BST, Heap and Graph	Lecture, Problem Solving	Exam	CLO1, CLO3
13.	Lesson 23: Review class on topics discussed of Wk 8, Wk 9 and Wk 10 for preparing for the final exam Lesson 24: Review class on topics discussed of Wk 8, Wk 9 and Wk 10 for preparing for the final exam	Lecture, Problem Solving	Exam	CLO1, CLO2, CLO3
14.	*Review and makeup class(if any) and Mid Term Exam 2 & Feedback*			

Assessment Strategy	Course Evaluation Process and Mark Distributions		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. S. Lipschetz, Data Structure
2. Mark Allen Weiss , Data Structures and Algorithm Analysis in C
3. Horowitz E and Sahni S Galgotia, Fundamentals of Data Structures.
4. Niklauswirth, Algorithms and Data Structures.
5. Y. Langsam, Augenstein, A. M. Tanenbaum , Data Structures using C and C++
6. Granville Barnett, Data Structures and Algorithms
7. Dinesh P. Mehta and Sratаj Shani, Handbook of Data Structures and Applications

BNQF Code: 07141206, Departmental Code: EEE-1206

Course Title: Electronic Device and Circuit Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core

Pre-requisites (if any**):** None

Rationale

This course is designed to give knowledge about basic electronic devices i.e. various Unipolar & bipolar devices, oscillators, power supplies, amplifiers, Op-Amps, PN devices and their workings. It is targeted to provide a basic foundation for technology areas like communication systems, industrial electronics as well as instrumentation, control systems and electronic circuit design.

Course Objectives

1. Acquire a basic knowledge in solid state electronics including diodes, MOSFET, BJT, and operational amplifier.
2. Develop the ability to analyze and design analog electronic circuits using discrete components.
3. Observe the amplitude and frequency responses of common amplification circuit
4. Design, construct, and take measurement of various analog circuits to compare experimental results in the laboratory with theoretical analysis.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Memorize basic knowledge of electronics devices those are the basic building blocks of electronic circuits.
CLO2 Describe knowledge and skills in illustrating electronic circuits using basic electronics devices.
CLO3 Explain complex networks of resistors, inductors, capacitors, diodes, transistors and op-amp subject to both direct (non-time-varying) and alternating voltages and currents.

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1					√							
CLO2				√								
CLO3					√							

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Study of the following Instruments **(a)** Cathode Ray Oscilloscope **(b)** Function generator **(c)**The Multimeter Structure **(d)** Regulated power supply	Lecture, Discussion	Assignment, Lab Performance	CLO1
2.	To obtain V-I characteristics of PN junction diode	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
3.	To implement Half-wave Diode rectifier and investigation the output.	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
4.	To implement Full-wave Diode Rectifier and investigation the output.	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2

5.	To investigate the V-I characteristics of Zener Diode..	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
6.	*Review and makeup class(if any) and Lab Test Exam 1 & Feedback*			
7.	Designing and implementing different types of diode circuits and investigation the output.	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
8.	To plot and study the input and output characteristics of BJT in Common Emitter Configuration.	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
9.	To implement and Study of BJT biasing circuit	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
10.	Review and practice Class	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	
11	*Review and makeup class(if any) and Lab Test Exam 2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Lab Test Exam and Final Laboratory Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Lab Performance	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Lab Test Exam	20%
Make-up Procedures	6.	Final Laboratory Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. Principles of Electronics: V. K. Mehta
2. Electronic Devices and Circuit Theory, Robert L. Boylestad
3. Electrical Technology: Electrical Devices and Circuits, B. L. Theraja and A.K. Theraja.

BNQF Code: 06131212, Departmental Code: ICT-1212

Course Title: Data Structures Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

Data structure is a logical mathematical model of storing & organizing data in a particular way in a computer. This course introduces fundamental data structures and explains abstract data types and their representations based on arrays, pointers and Link list. It also discusses the advantages and disadvantages of the different types of representations of data types. It introduces algorithms for efficient searching, insertion and deletion using data structures stored in internal memory.

Course Objectives

1. To introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms.
2. To develop effective software engineering practice, emphasizing such principles as decomposition, procedural abstraction, and software reuse.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Describe basic data structures like array, linked list, stack, queue, tree and graph.
CLO2 Explain programming techniques to develop data structures: array, linked list, stack, queue, tree and graph.
CLO3 Apply the knowledge of data structures in problem solving

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2		√			√							
CLO3												√

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Working with recursive function, pointer, structure and self-referential structure	Lecture, Discussion	Class Test	Background Preparation week
2.	Working with self-referential structure; Working on project planning in a team	Lecture, Discussion	Assignment, Lab Performance	CLO1, CLO3
3.	Implement link list and operations on link list	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
4.	Working with Link-List application on a mini-project to learn to apply link-list in a real-world situation	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
5.	Processing of expression using Stack and evaluation using Stack.	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2

6.	Working with Queue and applications.	Lecture, Discussion, Problem Solving	Assignment, Lab Performance, Project Concept Presentation by Team Lead	CLO1, CLO2, CLO3
7.	*Review and makeup class(if any) and Lab Test Exam1 & Feedback*			
8.	Working with Tree and BST with applications of tree	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
9.	Working with Heap and operations on Heap	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
10.	Working with Graph data structure and traversal of graph	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2
11.	Working with Graph applications	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO3
12.	Course Project presentation by the Team Lead	Course Project presentation	Course Project presentation	Project Implementation Presentation by Team
13.	Review on topics discussed of Wk 8, Wk 9 ,Wk 10 and wk 11	Lecture, Discussion, Problem Solving	Assignment, Lab Performance	CLO1, CLO2, CLO3
14.	*Review and makeup class(if any) and Lab Test Exam2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Lab Test Exam and Final Laboratory Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Lab Performance	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Lab Test Exam	20%
Make-up Procedures	6.	Final Laboratory Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. S. Lipschetz, Data Structure
2. Mark Allen Weiss , Data Structures and Algorithm Analysis in C
3. Horowitz E and Sahni S Galgotia, Fundamentals of Data Structures.
4. Niklauswirth, Algorithms and Data Structures.
5. Y. Langsam, Augenstein, A. M. Tanenbaum , Data Structures using C and C++
6. Granville Barnett, Data Structures and Algorithms
7. Dinesh P. Mehta and Srataj Shani, Handbook of Data Structures and Applications

BNQF Code: 05412101, Departmental Code: MATH-2101

Course Title: Differential Equation, Fourier analysis and Laplace Transform

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** GED
Pre-requisites (if any**):** None

Rationale

This course is designed to provide the fundamental concept of **Differential Equation, Fourier Analysis and Laplace Transform.** Through this course, students will develop a deep understanding of ODEs, their classifications, and solution methods, . The course emphasizes the mathematical modelling of real-world problems, allowing students to apply ODEs to various fields such as engineering, physics, and biology.

Course Objectives

1. It is an excellent introductory course of Differential equation, the Fourier series, Fourier transforms and Laplace transforms. Any periodic function can be expressed in terms of Fourier series, and using it we can solve both the 2nd order ordinary and partial differential equations such as one-dimensional heat and wave equations as well as two-dimensional Laplace equations. Also, the Laplace and Fourier transform methods are very powerful mathematical techniques for solving ordinary and partial differential equations and also initial and boundary value problems of differential equations arising in Mathematics, Physics and Engineering fields.

Course Learning Outcomes (CLO)

On satisfying the requirements and successful completion of this course, students will have the knowledge and skills to-

CLO1	Understand the fundamental concepts of differential equations, including order, degree, linearity, homogeneity, existence and uniqueness theorem.
CLO2	Apply various solution techniques to solve different kinds of differential equations, both with and without initial conditions, Boundary condition and draw the solutions curves graphically using direction fields.
CLO3	Identify and categorize first-order differential equations as separable, homogeneous, linear, exact, Bernoulli's, Riccati, and Clairaut's equations. Apply suitable methods to solve these equations effectively.
CLO4	Analyze real-world problems from various disciplines, such as Biology, Chemistry, Economics, Engineering, and Physics, by formulating and solving first and second-order differential equations, demonstrating the ability to model and interpret real-world phenomena mathematically.
CLO5	Introduce the concept of the Fourier series, Fourier transforms and discuss its different properties.
CLO6	Apply the Fourier series and Fourier transforms to solve both the second order ordinary and partial differential equations.
CLO7	Introduce the concept of Laplace transforms and discuss its different properties.
CLO8	Apply the method of Laplace transform to solve both the ordinary and partial differential equations that arise in the science and engineering field.
CLO9	Analyze real-world problems from various disciplines, such as Biology, Chemistry, Economics, Engineering, and Physics, by formulating and solving first and second-order differential equations, demonstrating the ability to model and interpret real-world phenomena mathematically.

Mapping Course Learning Outcomes (CLOs) with the PLOs												
CLO	**PLO**											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2		√										
CLO3				√								
CLO4				√								
CLO5	√											
CLO6			√									
CLO7	√											
CLO8		√										
CLO9			√									

Course Contents		Hours	CLOs
1.	**Differential Equations:** Differential equations and their solutions; Classification of differential equations; Initial value problems; Boundary value problems; Solution of first order differential equations; Solution of higher-order differential equations; Partial differential equations (PDEs) and their mathematical formulations; Complete integral and General solutions of PDEs; Lagrange's method, and Charpit's method for finding complete integrals of PDEs; Boundary value problems related to linear PDEs.	**18 Hrs.**	CLO1,CLO2, CLO3 & CLO4
2.	**Fourier Analysis:** Fourier series, Convergence of Fourier Series, Fourier analysis; Fourier Integral; Fourier transforms and their uses in solving boundary value problems of wave equations.	**12 Hrs.**	CLO5, CLO6 & CLO9
3	**Laplace Transform:** Definition; Laplace transforms of some elementary functions; Sufficient conditions for existence of Laplace transforms; Inverse Laplace transforms; Laplace transforms of derivatives. The unit step function; Periodic function; Some special theorems on Laplace transforms; Partial fraction; Solutions of differential equations by Laplace transforms.	**12Hs**	CLO7, CLO8 & CLO9

Assessment Strategy	Course Evaluation Process and Mark Distributions		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

Recommended Readings:	
i.	**Spiegel M. R.,** Laplace Transforms, *Schaum's Outline Series, McGraw Hill,* 1965.
ii.	**Churchill R. V., and Brown J. W.**, Fourier Series and Boundary value problems, *McGraw Hill,* 1941.
iii.	**Zill D. G.,** A first Course in Differential Equations with Modeling Applications, *Cengage Learning,* 2012.
Supplementary Readings:	
i.	**Kreyszig E.,** Advanced Engineering Mathematics, *Wiley,* 2011.
Ii	**Boyce, W. E., DiPrima R. C., and Meade D. B.,** Elementary Differential Equations and Boundary Value Problems, *John Wiley & Sons*, 2021

BNQF Code: 06132103, Departmental Code: ICT-2103

Course Title: Object Oriented Programming

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** Structured Programming

Rationale

Object Oriented Programming (OOP) is an important programming language to learn because of its compact syntax and ability to interact with hardware directly. Because compiled OOP interacts directly with the hardware it is running on, OOP is a good choice for programmers that are writing drivers for custom hardware. In addition, due its high-performance OOP is also a good choice for programming games that utilize fast-paced 3D graphics. Finally, this course provides another example of how object-oriented programming has been realized, and this presents an excellent opportunity for comparing and contrasting languages such as Java, C++. OOP is used frequently in areas such as game development, hardware manufacturing, embedded systems, and for military applications.

Course Objectives

The objectives of this course are as follows.

1. To learn how to implement copy constructors and class member functions.
2. To understand the concept of data abstraction and encapsulation.
3. To learn how to overload functions and operators in OOP.
4. To learn how containment and inheritance promote code reuse in OOP.
5. To learn how inheritance and virtual functions implement dynamic binding with polymorphism.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Explain how an existing OOP program works.

CLO2 Discover errors in a program and describe how to fix them.

CLO3 Critique a program and describe ways to improve it.

CLO4 Analyze a problem and construct a program that solves it.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1				√								
CLO2				√								
CLO3			√									
CLO4			√									

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Introduction to OOP, Basic structure OOP programs, Variables, constants, operators and expressions, data types, Program control statements	Lecture, Discussion		CLO1
2.	Recursion, Arrays and strings, pointers, Advanced data types, access modifiers, pointer to function dynamic memory allocation, User defined data types, advanced operators	Lecture, Discussion Problem Solving		CLO1

3.	Objects, Classes, Inline functions, friend functions, passing object to functions, arrays of objects	Lecture, Discussion Problem Solving		CLO1, CLO2
4.	References, Dynamic allocation using new and delete, Static class members, virtual functions.	Lecture, Discussion Problem Solving		CLO1, CLO2
5.	Parameterized constructors, multiple constructors in class, copy constructors, destructors, Function and operator overloading, overloading constructor functions, Rules for overloading operators, Overriding	Lecture, Discussion Problem Solving		CLO1, CLO3, CLO4
6.	Single Inheritance, Multiple Inheritance, multilevel Inheritance, Hierarchical Inheritance. Defining a package and finding classpath; Access Protection – Default, Public, Private, Protected; Importing Packages; Defining Interfaces and implementing it, Nested Interfaces, Interface Methods.	Lecture, Discussion Problem Solving		CLO1, CLO3, CLO4
7.&8.	***Mid Term Exam***			
9.	When to Use Exception Handling; Exception Hierarchy; Uncaught Exceptions; Using try and catch block; throw and throws statements; Multiple catch Clauses.	Lecture, Discussion Problem Solving		CLO3
10.	I/O class library, I/O streams, creating insertors and extractors, formatting I/O, file I/O, the message-based philosophy, using OOP memory model, Using VROOMM overlay technology, using command line compiler, compiling multiple file program. STL container classes, STL algorithms.	Lecture, Discussion Problem Solving		CLO3, CLO4
11.	Life Cycle of a Thread; Thread Class and Runnable Interface; Thread Priorities; Synchronization; Deadlock; Using Multithreading.	Lecture, Discussion		CLO3
12.	What are Generics? Generic Classes; Generic Interfaces; Applet Basics; Lambda Expressions Fundamentals, Functional Interfaces, Block Lambda Expressions, Lambda Exceptions; Life Cycle of Applet; Applet Display Methods; Adapter and Inner Classes.	Lecture, Discussion Problem Solving		CLO3, CLO4
13	Creating graphical user interfaces with AWT, Managing graphics objects with GUI layout managers, Event handling of various components.	Lecture, Discussion Problem Solving		CLO3, CLO4
14.	Socket basics, Socket-based network concepts, Client server basics, Client server algorithm, Socket for client, Socket for server.	Lecture, Discussion Problem Solving		CLO3, CLO4
15. 16.	***Makeup classes and Final Term Exam***			CLO3, CLO4

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	5%
	2.	Mid Term	
		a. Class Test:	5%
		b. Assignment/Presentation:	5%
		c. Exam	30%
Make-up Procedures	3.	Final Term	
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam		a. Class Test	5%
		b. Assignment/ Presentation:	5%
		c. Exam	40%
	Total:		100%

Learning Materials

1. Balagurusamy, “Object-Oriented Programming with C++”
2. Herbert Schildt, “Teach yourself C++”
3. Robert Lafore, “Object Oriented Programming in C++”
4. Irvine, “C++ Object Oriented Programming”
5. Deitel&Deitel, Java How to Program
6. P. Naughton and H. Schildt, *The Complete Reference Java 2*,
7. E. Balagurusamy , Programming with Java
8. SAMS publications, Teach Yourself Java-2 in 21 days
9. A primer, E Balagurusamy, Programming with Java.

BNQF Code: 03112105, Departmental Code: ECO-2105

Course Title: Economics

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** GED
Pre-requisites (if any**):** None

Rationale

Understanding principles of economics has immense importance for scientifically solving the problems of resource allocation. By conducting this course, students will be acquainted with a thorough grounding in the basic principles of economics and an exposure to arrange of applications of the theory in real world problems.

Course Objectives

1. The primary objective of the course is to acquaint students with the basic concepts of microeconomics and macroeconomics. This course analyzes various economic policies and how they affect economic fluctuations and foster economic growth and development.

Course Learning Outcomes (CLO)

On satisfying the requirements and successful completion of this course, students will have the knowledge and skills to-

CLO1	Explain the key ideas that define the economic way of thinking as mathematician and policy advisers.
CLO2	Understand to a range of micro and macroeconomic issues.
CLO3	Recognize the functions of money, central bank and commercial bank
CLO4	Demonstrate substantial knowledge on fundamental economic question of allocating scarce resources, principles of demand, supply, market price and quantity determination.
CLO5	Construct the knowledge of how consumers make choices and understand the production theory and firm behavior.
CLO6	Use the measurement of macroeconomic aggregates, recent trends in macroeconomic variables and issues in macroeconomic policy.
CLO7	Utilize general knowledge and understanding of Bangladesh economy.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)												
CLOs/ PLOs	PLO1	PL02	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1			√									
CLO2	√											
CLO3									√			
CLO4						√						
CLO5		√										
CLO6												√
CLO7												√

Detail Course Plan with Teaching-Learning and Assessment Strategy				
Week	**Topic**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLOs**
1.	Definition and scope of economics, Basic concepts & tools used in economics, Economic problems, Scarcity and Resources.	Lecturing and Student activity	Quiz/Homework (Formative) and Midterm (Summative)	CLO 1
2.	Concept of demand and supply, Law of demand and supply, Determinants of demand and supply.	Lecturing and Group discussion	Final exam (Summative)	CLO2
3.	Demand and supply functions, equations, schedules and curves, Market equilibrium, Price, income, cross and supply elasticity.	Lecturing and Visual presentation	Assignment and Presentations (Formative) Midterm and Final exam (Summative)	CLO2 CLO4
4.	Utility analysis, Paradox of value, Law of diminishing marginal utility, Indifference curve analysis, Budget constraints, Consumers equilibrium, Change in income and prices.	Lecturing and Student Activity	Final exam (Summative)	CLO2 & CLO5
5.	Derivation of demand curves, Income and substitution effects, and Consumers surplus.	Lecturing and Group discussion	Final Exam (Summative)	CLO4
6.	Production function; Law of diminishing return; Stage of production; Law of variable proportion; Short run and long run production and costs.	Lecturing and Slide presentation	Home Work (Formative)	CLO5
7.	Definition, Macro-economic performance, Measuring national product and national income – GNP, NNP, NI,	Lecturing, Questioning and Answer questioning	Home Work (Formative) and Midterm and Final exam (Summative)	CLO6
8.	Personal disposable income, Nominal and Real GNP, Circular flow of income, and Value added.	Lecturing and Slide presentation	Final exam (Summative)	CLO6
9.	Concepts of aggregate demand and planned spending, Aggregate supply,	Lecturing, Visual presentation, and Group discussion	Final exam (Summative)	CLO6
10.	Equilibrium output / income, Change in equilibrium output, and Multiplier.	Slide presentation and Lecturing	Final exam (Summative)	CLO2 & CLO6
11.	Definition & functions of money, Different kinds of money, Banking – Goldsmith banking, Commercial bank and the money stocks,	Lecturing and Group discussion	Presentations (Formative) Midterm Final exam	CLO3

			(Summative)	
12.	Functions of central bank, Money supply, Open market operations, and High powered money.	Lecturing and Group discussion	Final exam (Summative)	CLO3
13.	Overview of the economy of Bangladesh, Major sectors of the economy and their contribution to national income, GDP growth.	Lecturing, Questioning and Answer questioning	Presentations (Formative) Midterm Final exam (Summative)	CLO7
14.	Export and import items, Balance of trade, Balance of payment, Unemployment, and Inflation.	Lecturing and Visual presentation	Final exam (Summative)	CLO7

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

Recommended Readings:	
i.	Samuelson and W.D. Nordhaus (2010).Economics, 19th Edition, McGraw Hill.
ii.	A. Koutsoyiannis (1979). Modern Microeconomics, Macmillan Press Ltd.
Supplementary Readings:	
i.	Baumol, W. and Blinder, A. (2010).Economics: Principles and Policy, Harcourt Brace Jovanovich.
ii.	M. Parkin (2003).Microeconomics, 6th Edition, Addision Wesley.
iii.	J.E. Stiglitz (2003).Principles of Microeconomics, 3rd Edition, Norton &Company, Inc P.A.
iv.	R.G. Lipsey and K. A. Chrystal (2004).Economics, 10th Edition (FirstIndian Edition), Oxford University Press.
v.	R.G. Lipsey and K. A. Chrystal (2004).Economics, 15th Edition, OxfordUniversity Press.
vi.	W. J. L. Ryan and D. W. Pearce. Price Theory.

BNQF Code: 06132107, Departmental Code: ICT-2107

Course Title: Algorithm Design

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

Algorithms deal with the efficient ways to solve different mathematical and real life problems. It covers the common algorithms, algorithmic paradigms, and data structures used to solve computational problems. This course emphasizes the relationship between algorithms and programming and explores algorithms from the programmer's perspective for solving problems efficiently using various programming languages.

Course Objectives

1. To provide the understanding of principles of algorithm
2. To use programming principles in problem solving for various algorithm techniques
3. To enhance communication social skills through group project

Course Learning Outcomes (CLO)	
After completing the course, students will be able to:	
CLO1	Analyze and calculate time complexity and space complexity of various algorithms or any written code using mathematical formula and comparison of algorithms.
CLO2	Generate and interpret the output of iterative and recursive codes with the analysis of the problem definition.
CLO3	Identify which algorithm listed under which algorithmic paradigm. Compare among various algorithms/implemented codes and choose the efficient one.
CLO4	Break down and describe the simulation of various algorithms for different input values.
CLO5	Design and apply appropriate algorithms to solve real life problems.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	**PLO**											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√	√				√						
CLO2		√		√								
CLO3				√	√							
CLO4			√									
CLO5				√								√

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Introduction, Motivation Course logistics, Algorithm, Properties of good algorithm, Application Areas of Algorithm.	Lecture, Discussion	Class Test	CLO1
2.	Complexity Analysis of Algorithms, Asymptotic Notations, Recurrences, Insertion Sort and its Complexity Analysis.	Lecture, Discussion, Problem Solving	Class Test	CLO1

3.	Divide and Conquer approach and Merge Sort, Algorithm of Merge Sort, Complexity Analysis Merge Sort,	Lecture, Discussion	Assignment	CLO1, CLO2
4.	Divide and Conquer approach and Merge Sort, Algorithm of Merge Sort, Complexity Analysis Merge Sort,	Lecture, Discussion, Problem Solving	Class Test	CLO1, CLO2
5.	Algorithm of LCS, Dynamic Programming, Matrix Chain Multiplication Example,	Lecture, Discussion	Class Test	CLO2
6.	Algorithm of MCM, and Example of Longest Common Subsequence, Complexity Analysis.	Lecture, Discussion	Exam	CLO2, CLO3
7. &8.	***Overview Class and Mid Term Exam***			
9.	Greedy Algorithm, Activity Selection Problem, Huffman Codes and it's application,	Lecture, Discussion Problem Solving	Class Test, Exam	CLO3
10.	Knapsack problem, NP-Hard and NP-Complete Problems, Traveling Salesperson Problem, Complexity Analysis	Lecture, Discussion Problem Solving	Class Test	CLO4
11.	Representation of Graphs, Breadth First Search, Depth First Search, Algorithm of BFS and DFS,	Lecture, Discussion	Exam	CLO5
12.	Minimum Spanning Tree, Kruskal and Prims Algorithm, Complexity Analysis.	Lecture, Discussion Problem Solving	Assessment	CLO5
13	Single Source Shortest Paths, Dijkstra's Algorithm, and Bellman-Ford Algorithm. All pair Shortest Path, Floyd Warshall Algorithm, Backtracking, n- Queen Problem, and Complexity Analysis, Branch and Bounds.	Lecture, Discussion Problem Solving	Assessment	CLO5
14.	Computational Geometry, Line Segment Properties, Convex Hull, Graham Scan Algorithm of Convex Hull, Number Theory, GCD, Modular Arithmetic, Prime Number generation, Complexity Analysis. **Review and Makeup class (if any)**	Lecture, Discussion Problem Solving	Assessment	CLO5
15.&16.	***Final Term Exam & Feedback***			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance	5%
		b. Assignment/Presentation	5%
		c. Quiz/Instant Test	5%
		d. Class Performance	5%
		e. Class Test/Mid Term	20%
Make-up Procedures	2.	**Final Exam**	**60%**
	Total:		100%

Learning Materials

1. *Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.,* "*Introduction to Algorithms*"*, 4th Ed., MIT Press and McGraw-Hill, 2022.*
2. *Ellis Horowitz, Sanguthevar Rajasekaran ,* "*Computer Algorithms*"*, 1st Ed., W. H. Freeman, 1997.*
3. *Robert Sedgewick, Kevin Wayne, "Algorithms", 4th Ed, Addison-Wesley Professional, 2014.*

BNQF Code: 06112109, Department Code: MATH-2109

Course Title: Numerical Analysis

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** GED
Pre-requisites (if any**):** None

Rationale

The aim of the course is to present a creation, analyzing, and implementation algorithms for obtaining numerical solutions to problems of calculus; selection of a best element (with regard to some criteria) from some set of available alternatives.

Course Objectives

1. To find acceptable approximate solutions when exact solutions are either impossible or so arduous and time-consuming as to be impractical.
2. To devise alternate methods of solution better suited to the capabilities of computers.
3. To formulate problems in their fields of research as optimization by defining the underlying independent variables, the proper cost function, and the governing constraint functions.

Course Learning Outcomes (CLO)

After completing the course, students will know how to:

CLO1 Use different numerical methods for solving any computational problem.

CLO2 Locate and use good mathematical calculations while developing software.

CLO3 Get the accuracy that is desired from any computational task.

CLO4 Assess the reliability of the numerical results.

CLO5 Determine the effect of round off error or loss of significance.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLOs	PLOs											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2			√									
CLO3				√								
CLO4				√								
CLO5				√								

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Accuracy and precision, Error definitions, Round-off errors, Truncation errors.	Lecture, Discussion	Class Test	CLO3, CLO5
2.	The bisection method, the false-position method	Lecture, Discussion, Problem Solving	Class Test	CLO1, CLO2
3.	The Newton-Raphson method, Secant method.	Lecture, Discussion, Problem Solving	Class Test	CLO1, CLO2
4.	Gauss elimination, Gauss Jordan method	Lecture, Discussion, Problem Solving	Class Test	CLO1, CLO2
5.	Jacobi iteration, Gauss Seidel method	Lecture, Discussion, Problem Solving	Assignment	CLO1, CLO2

6.	Linear interpolation, Lagrange interpolating polynomials, Newton's divided difference interpolating polynomials	Lecture, Discussion	Class Test, Quiz	CLO4
7.	**Review and makeup class form week 1 to 6 and Mid-semester exam.**			CLO1, CLO2, CLO3, CLO4, CLO5
8.	Linear regression, Linear curve fitting methods, Least square method	Lecture, Discussion	Class Test, Quiz	CLO4
9.	Non-linear curve fitting methods, Polynomial of *n*th degree	Lecture, Discussion	Class Test	CLO4
10.	Power function, Exponential function, Polynomial regression	Lecture, Discussion	Exam	CLO1, CLO2
11.	Numerical differentiation, The trapezoidal rule	Lecture, Discussion Problem Solving	Assessment	CLO1, CLO2
12.	Integration with unequal segments, Simpson's 3/8 Rule.	Lecture, Discussion Problem Solving	Assessment	CLO1, CLO2
13.	Solution by Taylor's series, Euler's method, Heun's method, Runge-Kutta method	Lecture, Discussion Problem Solving	Class Test	CLO1, CLO2, CLO3
14.	**Review and makeup class form week 8 to 13 and Mid-semester exam.**			CLO1, CLO2, CLO3, CLO4

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Continuous Assessment: Class Test, Assignment, Presentation **Summative:** Mid-Semester and Semester Final Exam	1.	Attendance:	5%
	2.	Mid Semester Exam	20%
	3.	Class Test/ Assignment/ Presentation/ Case study/ Sudden Test/ Tutorial	15%
	4.	Semester Final Examination	60%
Make-up Procedures			
Repeat Course, Mid-Semester Incomplete Exam, Semester Final Incomplete Exam			
	Total:		100%

Learning Materials

1. *Numerical Methods by E. Balagurusamy.*
2. *Introductory Methods of Numerical Analysis by S.S. Sastry.*

Course Title: Entrepreneurship Management

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** GED
Pre-requisites (if any**):** None

Rationale of the Course: This course explores the basic concepts and processes of management that will help the students to examine the fundamental roles and processes of planning, leading, organizing and controlling that comprise the managers' role. As, graduates should have basic knowledge of finance that determines the decisions variables for making bottom line of the business. This course also provides the maiden understanding about the importance of finance in business operations. Moreover, entrepreneurship plays a critical role in the industrial development of a country like Bangladesh; this course is designed to equip the students with the essential knowledge and practice to develop their enterprise.

Course Objectives:

1. To provide the understanding about how to identify and apply appropriate management techniques for managing contemporary organizations.
2. To understand the basic concepts of finance, time value of money, capital budgeting, risk and return for making financial decisions.
3. To introduce students to the fundamentals of entrepreneurship development in SMEs for playing the premier role in the industrial development of Bangladesh.

Course Learning Outcomes (CLOs):

Upon completion of the course, students should be able to:

CLO1 Understand the different types of management and explain the nature and purpose of management.
CLO2 Understand environmental forces that affect managerial efficiency and describe the major considerations in organizing an enterprise's resources, including human resources.
CLO3 Evaluate the alternative leadership styles and make a decision regarding their appropriate use.
CLO4 Apply time value of money concept in business problems and capital budgeting technique in evaluating projects and to select the best project.
CLO5 Understand the concepts, features, qualities, functions, types of entrepreneurships, entrepreneurship development factors, entrepreneurship development cycle and the role of entrepreneurship in the economic development.

Mapping Course Learning Outcomes (CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2	√											
CLO3	√											
CLO4	√	√										

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	**Entrepreneurship**: Definition, Historical Background of Entrepreneurship in Bangladesh, Characteristics, Functions, Roles, Classification, Entrepreneurship and Economic Development, Entrepreneurship as a Critical Resource -	Lecture, Discussion	Class Test	CLO1, CLO2
2.	**Entrepreneur**: Definition, Features, Qualities, Classification, Differentiate Mangers from Entrepreneur; Intrapreneurship: Concept, Features and Difference from Entrepreneurship; Ethics and Social Responsibility of Entrepreneurs.	Lecture, Discussion,	Class Test Exam	CLO1, CLO2
3.	**Theories and Models for Entrepreneurship Development**: Sociological theories, Socio-psychological theories, Cultural theories and other theories; Models of	Lecture, Discussion,	Class Test Exam	CLO1, CLO2

	entrepreneurial motivation; and Entrepreneurial development cycle.			
4.	**Environment of Entrepreneurship**: Factors Affecting Entrepreneurial Environment- Classification of Business Environment: Political, Legal, Economic and Technical Aspects; Main Characteristics and Salient Features of Industrial Policy; and Assessing Entrepreneurial Environment.	Lecture, Discussion,	Assignment Exam	CLO1, CLO2
5.	**Women and other Social Entrepreneurship**: Women Entrepreneurship and Economic Development; Problems, Prospects and Success Factors of Women Entrepreneurship in Bangladesh; Background, Characteristics, Basic Concepts,	Lecture, Discussion	Class Test, Exam	CLO1, CLO2
6.	Principles and Models of Social Entrepreneurship and Social Business; and Cases of Successful Entrepreneurs.	Lecture,	Exam	CLO1, CLO2
7.	*Review and makeup class (if any) and Mid Term Exam 1 & Feedback*			
8.	**Entrepreneurship Development in Bangladesh**: Problems and Prospects of Entrepreneurship Development in Bangladesh; Policy Guidelines and Sources of Institutional Assistances for Entrepreneurship Development.	Lecture, Discussion	Class Test, Exam	CLO1, CLO2, CLO3
9.	Roles of BSCIC, MIDAS, Grameen Bank, Universities and Government & Non-Government Organizations in the Development of Entrepreneurship Development in Bangladesh; and different Schemes of Entrepreneurial Training in Bangladesh.	Lecture, Discussion	Class Test, Exam	CLO1, CLO2
10.	**Introduction to SMEs**: Concept ofSMEs in different Countries; Role and Features of SMEs: Comparison with Large Business; Fields of SMEs; Government Policies and Support of SMEs Development in Bangladesh; Problems of SMEs; and Current Status of SMEs in Bangladesh.	Lecture, Discussion	Class Test, Exam	CLO1, CLO2, CLO4
11.	**Management of SMEs**: Understanding various Aspects of Small Business Management; Marketing of Small Business; Financial Management of Small Business; and Legal Aspects of Small Business.	Lecture, Discussion	Class Test, Exam	CLO1, CLO2
12.	**Business Plan:** Outline of a Model Business Plan for Small Firm; Valuation of a Business; Cost Approach; Market Value Approach; Capitalized Income Approach; and Buying an Existing Business versus new one.	Lecture,	Exam	CLO1, CLO2
13.	**Franchising**: Meaning,Purpose, Types, Features, Problems of Franchising; Evaluating Franchise Opportunities; and Future of Franchising.	Lecture,	Exam	
14.	*Review and makeup class (if any) and Mid Term Exam 2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%

Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. Stephen P. Robbins, David A. DeCenzo, Mary Coulter and Ian Anderson, Fundamentals of Management (7th Ed.). Pearson Education, Inc., 2013.
2. Lawrence J. Gitman and Chad J. Zutter, Principles of Managerial Finance (14th Ed.). Pearson Education Limited, 2015.
3. S. S. Khanka, Entrepreneurial Development.
4. Nazrul Islam and Mamun, Entrepreneurship Development.
5. William L. Megginson and Mary jone Byrd: Small Business Management;
6. Robert D. Hisrich and Michael P. Peters, Entrepreneurship.
7. Thomas W. Zimmerer and Norman M. Scarborough, Essentials of Entrepreneurship and Small Business Management;

BNQF Code: 06132104, Departmental Code: ICT-2104

Course Title: Object Oriented Programming Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

OOP is an important language to learn because of its compact syntax and ability to interact with hardware directly. Because compiled OOP interacts directly with the hardware it is running on, OOP is a good choice for programmers that are writing drivers for custom hardware. In addition, due its high-performance OOP is also a good choice for programming games that utilize fast-paced 3D graphics. Finally, this course provides another example of how object-oriented programming has been realized, and this presents an excellent opportunity for comparing and contrasting languages such as Java, C++. OOP is used frequently in areas such as game development, hardware manufacturing, embedded systems, and for military applications.

Course Objectives

1. To learn how to implement copy constructors and class member functions.
2. To understand the concept of data abstraction and encapsulation.
3. To learn how to overload functions and operators in OOP.
4. To learn how containment and inheritance promote code reuse in OOP.
5. To learn how inheritance and virtual functions implement dynamic binding with polymorphism.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Able to identify classes, objects, members of class and relationships among them needed for solving real-life problem and build software programs
CLO2 Able to develop unified modeling language (UML) model and write computer programs using OOP principles to solve real-life problem
CLO3 Able to apply knowledge of object oriented programming in software project

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1				√								
CLO2					√							
CLO3				√								√

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Discussion on Basic Java, Working with Eclipese/IntelliJ IDE and write simple Java programs	Use Eclipse/IntelliJ IDE to implement simple Java program and some exercises	Class Test	Background Preparation week
2.	Working with Java basic programming based on discussion.	Write code to implement Java programming with input-output using Eclipse or IntelliJ; 2-3 Exercises	Assignment, Lab Performance	CLO1, CLO3
3.	Write Java program using class and constructor to solve problem. Use StarUML to create UML model.	Implement Java class and use object for solving problem; Student form team for the project and fill the team info	Assignment, Lab Performance	CLO1, CLO2

		using Google form.		
4.	Working with Java IO and array with array of objects; Using command line argument array in Java	Problem solving using Java IO and array of objects with overloading methods	Assignment, Lab Performance	CLO1, CLO2
5.	Working with Inheritance in Java for problem solving; Using abstract class and interface	Use Java to write program based on inheritance and using interface for multiple inheritance.	Assignment, Lab Performance	CLO1, CLO2
6.	Working with runtime polymorphism and using interface in Java	Working with runtime polymorphism and using interface in Java	Assignment, Lab Performance, Project Concept Presentation by Team Lead	CLO1, CLO2, CLO3
7.	*Review and makeup class(if any) and Lab Test Exam1 & Feedback*			
8.	Working with exception handling in Java and problem solving	Working with exception handling in Java and problem solving	Assignment, Lab Performance	CLO1, CLO2
9.	Working with collection and thread programming in Java	Working with collection and thread programming in Java	Assignment, Lab Performance	CLO1, CLO2
10.	Working with Java networking API and socket programming	Working with Java networking API and socket programming	Assignment, Lab Performance	CLO1, CLO2
11.	Working with client-server computing in Java	: Working with client-server computing in Java	Assignment, Lab Performance	CLO2, CLO3
12.	Course Project presentation by the Team Lead	Course Project presentation	Course Project presentation	Project Implementation Presentation by Team
13.	Review on topics discussed of Wk 8, Wk 9 ,Wk 10 and wk 11			CLO1, CLO2, CLO3
14.	*Lab Performance Test and Project based assessment of course projects*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Lab Test Exam and Final Laboratory Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Lab Performance	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Lab Test Exam	20%

Make-up Procedures	6.	Final Laboratory Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials:

8. Y. Daniel Liang, Introduction to Java Programming
9. D.S. Malik , Java Programming: From Problem Analysis to Program Design

BNQF Code: 06132108, Departmental Code: ICT-2108

Course Title: Algorithm Design Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

Algorithms are the soul of computing. The construction and analysis of algorithms is a basic and very important part of modern computer science. In mathematics and computer science, an algorithm is a step-by-step procedure which is used for calculation, data processing, and automated reasoning. All computer programs can be described as algorithms that operate on a structured set of data, or as a concatenation of such algorithms. To construct a large program with a reasonable time and space consumption it is essential to have efficient solutions to the problem parts. Algorithms help to acquire necessary skills to recognize problem scenarios and identify the right algorithms that can be used, to modify an existing algorithm or develop a new one for new problems.

Course Objectives

1. Provides an introduction to mathematical modeling of computational problems.
2. Covers the common algorithms, algorithmic paradigms, and data structures used to solve these problems.
3. Emphasizes the relationship between algorithms and programming, and introduces basic performance measures and analysis techniques for these problems.

Course Learning Outcomes (CLO):	
After completing the course, students will be able to:	
CLO1	Solving problems using appropriate algorithm.
CLO2	Implement the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.
CLO3	Implement the greedy paradigm and explain when an algorithmic design situation calls for it.
CLO4	Implement the dynamic-programming paradigm and explain when an algorithmic design situation calls for it.
CLO5	Implement major graph algorithms and their analyses. Employ graphs to model engineering problems, when appropriate.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	**PLO**											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1			√									√
CLO2		√			√							
CLO3				√								
CLO4									√		√	
CLO5						√				√		

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Searching a key in an array a. Linear Search b. Binary Search	Lecture, Discussion	Class Performance	CLO1
2.	Sorting an array using a. Insertion Sort b. Selection Sort c. Bubble Sort	Lecture, Discussion, Sorting Problem Solving	Instant Test, Class Performance, Class Test	CLO1
3.	Divide and conquer approach for calculating $a^b \ mod \ c$, $where \ a, b, c \leq 2^{32}$	Lecture, Discussion	Assignment	CLO1, CLO2

4.	Using divide and conquer approach for sorting: Merge Sort, Using divide and conquer approach for sorting: Quick Sort	Lecture, Discussion, Divide and Conquer Problem Solving	Instant Test, Class Performance	CLO1, CLO2
5.	Using data structure for sorting: Heap Sort, Linear time sorting: Counting Sort, Radix Sort	Discussion, Divide and Conquer Problem Solving	Class Test, Assignment	CLO2
6.	Task Scheduling using Greedy Approach, Fractional Knapsack and Greedy Coin Change.	Lecture, Discussion, Greedy Problem Solving	Exam	CLO2, CLO3
7.&8.	***Overview Class and Mid Term Exam***			
9.	Huffman Coding, Binary Search Tree	Discussion, Greedy Problem Solving	Class Test, Exam	CLO3
10.	Fibonacci Number Using Dynamic Programming, Rod Cutting Using Dynamic Programming.	Lecture, Discussion, DP Problem Solving	Instant Test, Class Performance, Class Test	CLO1, CLO4
11.	Knapsack Problem using Dynamic Programming, Coin Change Using Dynamic Programming.	Lecture, Discussion, DP Problem Solving	Exam	CLO1, CLO4
12.	LCS using Dynamic Programming, Bit Masking for Solving Travelling Salesman Problem Using Dynamic Programming.	Discussion, DP Problem Solving	Instant Test, Class Performance, Class Test	CLO1, CLO4
13	Graph Representation and Breadth First Search (BFS), Depth First Search (DFS) and Topological Sort.	Lecture, Discussion Graph Problem Solving	Class Performance, Class Test	CLO1, CLO5
14.	Single Source Shortest Path a. Dijkstra Algorithm b. Bellman Ford Algorithm	Discussion Graph Problem Solving	Instant Test, Class Performance, Class Test	CLO1, CLO5
15.	Minimum Spanning Tree a. Prim's Algorithm b. Kruskal Algorithm	Discussion Graph Problem Solving	Assessment	CLO1, CLO5
16.	***Final Term Exam & Feedback***			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Report, Class Performance **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance:	5%
		b. Instant Test / Class Performance	10%
		c. Class Test	20%
		d. Report	5%
Make-up Procedures	2.	**Final Exam**	**60%**
		a. Viva	20%
		b. Final Lab Exam	40%
	Total:		**100%**

Learning Materials:

1. *Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.,* "*Introduction to Algorithms*"*, 4th Ed., MIT Press and McGraw-Hill, 2022.*
2. *Thomas H. Cormen,* "*Algorithms Unlocked*"*, 1st Ed., The MIT Press.*
3. *Robert Sedgewick, Kevin Wayne, "Algorithms", 4th Ed, Addison-Wesley Professional, 2014.*
4. *Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson.*

BNQF Code: 06112110, Departmental Code: MATH-2110

Course Title: Numerical Analysis Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** GED
Pre-requisites (if any**):** None

Rationale:

The aim of the course is to apply programming knowledge to implement and analyze numerical algorithms for solving problems of calculus with other numerical problems from available alternatives.

Course Objectives:

1. To know how to find approximate solutions and analyze errors.
2. To implement high level programming to solve different numerical problems.
3. To apply well known numerical alternatives to solve differential and integral calculations.

Course Learning Outcomes (CLO):

After completing the course, students will know how to:

CLO1 Estimate accuracy and errors for solving any computational problem.

CLO2 Use good mathematical solutions while developing software.

CLO3 Use high level programming to solve numerical problems.

CLO4 Get solution for regression problems and numerical equations.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLOs	PLOs											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1				√								
CLO2					√							
CLO3					√							
CLO4				√								

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Use of numerical equations for estimating approximate results and errors.	Lecture, Discussion	Lab Test	CLO1
2.	Implementation of bisection and false-position method	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO2
3.	Implementation of Newton-Raphson and Secant method.	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO2, CLO3
4.	Implementation of Gauss elimination	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO2, CLO3
5.	Implementation of Gauss Jordan method	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO2
6.	Implementation of Jacobi iteration	Lecture, Group Discussion	Lab Test, Lab Report	CLO3

7.	**Review and makeup class form week 1 to 6 and Mid-semester exam (Quiz and Viva).**			CLO1, CLO2, CLO3
8.	Implementation of Gauss Seidel method	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO2, CLO3
9.	Implementation of Linear interpolation, Lagrange interpolating polynomials	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO4
10.	Implementation of , Newton's divided difference interpolating polynomials	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO3, CLO4
11.	Implementation of Taylor's series,	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO2, CLO4
12.	Implementation of Euler's method, Heun's method.	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO2, CLO3,CLO4
13.	Implementation of Runge-Kutta method.	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO2, CLO3
14.	**Review and makeup class form week 8 to 13 and Mid-semester exam (Quiz and Viva).**			CLO2, CLO3, CLO4

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Continuous Assessment: Class Test, Assignment, Presentation **Summative:**	1.	Attendance:	5%
	2.	Mid Semester Exam	20%
	3.	Quiz/ Report/ Performance Test/ Viva / Tutorial	15%
	4.	Semester Final Examination	60%
Make-up Procedures			
	Total:		100%

Learning Materials:

1. *Numerical Methods by E. Balagurusamy.*
2. *Introductory Methods of Numerical Analysis by S.S. Sastry.*

BNQF Code: 06122201, Departmental Code: ICT-2201

Course Title: Electromagnetic Theory and Antenna

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):**

Rationale

This course builds on the Electromagnetics courses to discuss the conditions and constraints of wave propagation and the design of antennas to be used to achieve radio wave probation.

Course Objectives

The objectives of this course are as follows.

1. Obtain an understanding of Maxwell's equations and be able to apply them to solving practical electromagnetic fields problems.
2. Fundamental concepts covered will include: laws governing electrodynamics, plane wave propagation in different media, power flow, polarization, transmission and reflection at an interface, transmission lines, microwave networks, waveguides, radiation and antennas, wireless systems design and examples.

Course Learning Outcomes (CLO)

After completing the course, students will be able to

CLO1 use Maxwells equations to calculate fields from dynamic charge/current distributions

CLO2 analyse plane waves in lossless and lossy media discover errors in a program and describe how to fix them.

CLO3 analyse TEM waves in transmission lines

CLO4 analyse EM-waves in waveguide

CLO5 analyse antennas and radiating system

CLO6 calculate fields from antennas and antenna systems

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2		√										
CLO3				√								
CLO4				√								
CLO5				√								
CLO6				√								

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Field equations based on laws of Coulomb, Ampere and Faraday; Displacement current; Maxwell′s equation	Lecture, Discussion Problem Solving		CLO1
2.	Units and dimensions of field vectors; E-H symmetry; Lorenz′s lemma; Scalar and vector potentials; Retarded potentials. Wave equations; Plane wave concept; Plane electromagnetic waves in free-space, in conducting,	Lecture, Discussion Problem Solving		CLO1, CLO2
3.	Dielectric and in ionized media. Pointing vector; Joule heating in good conductors; Intrinsic impedance and	Lecture, Discussion		CLO3, CLO4

	propagation constant. Boundary conditions; The laws of reflection and Snell′s law of refraction; Reflection from dielectrics and conductors;			
4.	Fresnel′s equations; The Brewster angle; Total reflection; Skin effect; Phase and group velocities, Reflection and refraction in the ionosphere.	Lecture, Discussion		CLO3, CLO4
5.&6.	***Mid Term Exam***			
7.	Introduction, Wire Antennas; Aperture, Microstrip, Array, Reflector and Lens Antennas; Radiation mechanism; Current distribution on a thin wire antenna.	Lecture, Discussion		CLO4
8.	Radiation patterns, Radiation power density, Radiation intensity, Beamwidth, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth	Lecture, Discussion Problem Solving		CLO4
9.	Polarization, Input impedance, Antenna radiation efficiency, Vector effective length, Maximum directivity and maximum effective area,	Lecture, Discussion Problem Solving		CLO4
10.	Antenna temperature, Friis Formula: Antennas in Free Space.	Lecture, Discussion Problem Solving		CLO4
11.	Introduction, Linear and Planar Arrays, The Uniform Linear Array, Parasitic Elements: Uda–Yagi Antennas, Reflector Antennas, Monopole Antennas	Lecture, Discussion		CLO5
12.	Corner Reflectors, Parabolic Reflector Antennas. Horn Antennas, Loop Antennas, Helical Antennas, Patch Antennas.	Lecture, Discussion Problem Solving		CLO4, CLO5
13	Antenna Ranges, Radiation patterns, Gain and directivity measurements; Radiation efficiency	Lecture, Discussion Problem Solving		CLO4, CLO5
14.	Impedance, current and polarization measurements; Scale model measurements.	Lecture, Discussion Problem Solving		CLO4, CLO5
15. 16.	***Makeup classes and Final Term Exam***			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	5%
	2.	Mid Term	
		a. Class Test:	5%
		b. Assignment/Presentation:	5%
		c. Exam	30%
Make-up Procedures	3.	Final Term	
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam		a. Class Test	5%
		b. Assignment/ Presentation:	5%
		c. Exam	40%
	Total:		100%

Learning Materials

1. S. Ramo, J.R. Whinnery and T.V. Duzer: Fields and Waves in Communication Electronics
2. J.D. Ryder: Networks, Lines and Fields
3. Corson and Lorain: Introduction to Electromagnetic Field and Wave.
4. D. K. Chang: Electromagnetic Fields and Waves
5. Constantine A. Balanis: Antenna Theory
6. J D Kraus: Antennas

BNQF Code: 06112203, Departmental Code: ICT-2203

Course Title: Digital Logic Design

Credit Hr.: 2.00, **Contact Hr.:** 2.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

This subject is intended to teach the students basics, concepts, principles and working of digital circuits putting forth the use of a transistor as a switch, number systems, Boolean Algebra, logic gates, counters and so on. The cognition attained in this subject will be useful later for solving problems in technology areas like Microprocessors and Microcontrollers, Communication Systems, Industrial Electronics, Instrumentation as well as Control Systems and their design.

Course Objectives

1. To understand how logic circuits are used to solve engineering problems.
2. To understand the relationship between abstract logic characterizations and practical electrical implementations.
3. To demonstrate knowledge of fundamental Boolean principles and manipulation and their application to digital design.
4. To gain in-depth understanding of combinational and sequential digital/logic circuits, and modular design techniques.
5. To acquire the ability to design, analyze and synthesize logic circuits.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1	Explain the elements of digital system abstractions such as digital representations of information, digital logic, Boolean algebra etc.
CLO2	Describe how analog signals are used to represent digital values in different logic families, including characterization of the noise margins.
CLO3	Draw the appropriate truth table from a description of a combinational logic function.
CLO4	Understand the gate-level implementation of a combinational logic function described by a truth table using and/or/inv gates, muxes or ROMs, and analyze its timing behavior.
CLO5	Describe the operation and timing constraints for latches and registers.
CLO6	Draw a circuit diagram for a sequential logic circuit and analyze its timing properties.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2	√											
CLO3		√										
CLO4			√									
CLO5	√			√								
CLO6				√								
CLO7				√								

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy				
Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Digital and Analog quantities, Signals, Sampling using ADC & DAC, Binary digits, Logic Levels, Digital waveforms, Introduction to Logic Gates, Truth tables for 2,3,and 4 inputs, Logic symbols, Boolean expressions, Fundamental Gates AND, OR and NOT gates. Importance of XOR, XNOR gates.	Lecture, Discussion	Class Test	CLO1 CLO2
2.	Boolean Variables, Boolean Algebra, Basic Theorems, Laws and rules of Boolean algebra, Boolean Functions, Complement of a function, Demorgan's Theorems (Two, Three variables) Logic Simplification using Boolean Algebra.	Lecture, Discussion	Class Test	CLO1 CLO2 CLO3
3.	Min terms and Max terms, Sum of Product terms(SOP), Product of Sum terms (POS), Conversion Between Canonical/ Standard Forms, Boolean Minimization using Karnaugh Map up to 4 Variable for SOP and POS. Don't Care Conditions Verification by using Binary Testing Techniques for standard and Minimized form.	Lecture, Discussion	Class Test	CLO1, CLO2 CLO3
4.	Introduction to Number systems, Binary, Octal, Decimal and Hexadecimal, Number system conversions, Octal to Binary, Octal to Decimal, Octal to Hexadecimal, Hexadecimal to Binary, Hexadecimal to Decimal, Hexadecimal to Octal,1'S complement,2'S complement, Binary addition, Binary subtraction, Binary multiplication, Binary Division, Digital codes (ASCII, Binary Coded Decimal), BCD addition, Gray Code,4 Bit Binary to Gray code convertor, Gray to Binary code converters by using XOR gates.	Lecture, Discussion	Class Test	CLO1, CLO2, CLO3
5.	NAND & NOR as Universal gates, implementation of Combinational logic circuits using NAND or NOR gates only. Half –Adder combinational logic design, Full-Adder combinational logic design and Expressions of Sum and Carry in XOR, Implementation by using K-maps for Sigma and Carry output.	Lecture, Discussion	Assignment	CLO2 CLO3
6.	Half subtractor, Full subtractor, 4 Bit Parallel binary Adder, Controlled Inverter, Combinational logic design for Decoders Active High / Active low • 2 lines to 4 lines decoder • 3 lines to 8 lines decoder • 4 lines to 16 lines decoder • BCD to Decimal Decoder	Lecture, Discussion Problem Solving	Exam	CLO3, CLO4

	• BCD to 7 Segment decoder with Table implementation.			
7.&8.	***Mid Term Exam***			CLO1, CLO2, CLO3, CLO4
9.	Combinational logic design for Encoders and Multiplexers and DEMultiplexers.	Lecture, Discussion Problem Solving	Class Test, Exam	CLO5
10.	BCD Adder design, 2 bit, 3 bit and 4 bit Magnitude, Comparator design, Sequential circuits, Function of Latch, SR latch using NAND and NOR gates, Active high and active low latch design,	Lecture, Discussion Problem Solving	Class Test	CLO5, CLO6
11.	SR Flip-Flop, D Flip-Flop, JK Flip-Flop and T Flip Flop, Clocking, Flip- Flop Applications (Counters, Frequency divider, Registers and Memory)	Lecture, Discussion	Exam	CLO6
12.	Excitation tables for SR, JK, T and D Flip-Flops, Flip Flop conversions SR to D, JK to D, Sequential logic design process, State diagram and State tables, Steps to design sequential circuit.	Lecture, Discussion Problem Solving	Assessment	CLO6, CLO7
13	Sequential logic design process, State diagram and State tables, Steps to design sequential circuit, 4 Bit Up/Down Synchronous Counters design with clock diagram	Lecture, Discussion Problem Solving	Assessment	CLO6, CLO7
14.	4 Bit Asynchronous Counters design with clock diagram, Up/Down and Auto reset operations usingNAND gate (Trauncated sequence) Registers, Serial in serial out, Serial in parallel out, Parallel in serial out and parallel in Parallel out **Review and Makeup class (if any)**	Lecture, Discussion Problem Solving	Assessment	CLO7, CLO8
15.&16.	***Final Term Exam & Feedback***			CLO5, CLO6, CLO7, CLO8

Assessment Strategy	Course Evaluation Process and Mark Distributions		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	10%
	2.	Mid Term	
		a. Class Test:	5%
		b. Assignment/Presentation:	5%
		c. Exam	30%
Make-up Procedures	3.	Final Term	
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam		a. Class Test	5%
		b. Assignment/ Presentation:	5%
		c. Exam	40%
	Total:		100%

Learning Materials:

1. *R P Jain, "Modern Digital Electronics", McGraw Hill*
2. *Morris & Miller, "Design with TTL Integrated Circuit", McGraw Hill*
3. *Ronald J Tocci, "Digital Systems, Principles and Applications ", Prentice Hall*

BNQF Code: 06122205, Departmental Code: ICT-2205

Course Title: Database Management Systems

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

This course will introduce the basic principles in Database Management Systems (DBMS). The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively information from a DBMS.

Course Objectives

1. To understand the different issues involved in the design and implementation of a database system.
2. To study the physical and logical database designs, database modeling.
3. To understand and use data manipulation language to query, update, and manage a database
4. To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency,
5. To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1	Explain the fundamental concepts of a relational database system.
CLO2	Utilize a wide range of features available in a DBMS package.
CLO3	Analyze database requirements and determine the entities involved in the system and their relationship to one another.
CLO4	Develop the logical design of the database using data modeling concepts such as entity-relationship diagrams.
CLO5	Create a relational database using a relational database package.
CLO6	Manipulate a database using SQL.
CLO7	Design and implementation of real-life RDBMS using data modeling and diagramming tools.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2					√							
CLO3		√										
CLO4			√									
CLO5					√							
CLO6			√									
CLO7			√									

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy				
Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Database concepts, database management system, Database system versus file system, Database language, Database user administration, Database system structure, Storage manager,	Lecture, Discussion	Class Test, Quiz, Instant Test, Final Exam	CLO1, CLO2
2.	The evolution of data models, importance of data models, degrees of data abstraction, business rules. Overview of Physical storage medium, Database architecture.	Lecture, Discussion	Class Test, Quiz, Instant Test, Final Exam	CLO1, CLO2
3.	Entity sets, Relationship sets, Mapping Cardinalities, Keys, Attributes, Entity relationship diagram, Weak entity sets, Specialization, Generalization, Structure of Relational databases, Design of E-R Database Schema, Reduction of an E-R schema to table.	Lecture, Discussion & Problem Solving	Class Test, Quiz, Instant Test, Final Exam	CLO3, CLO4
4.	Structure of relational databases, relational algebra, Extended relational-algebra operations, Modification of the database, Views, Normalization, Decomposition, Functional Dependencies, Closure of a set of Functional dependencies.	Lecture, Discussion & Problem Solving	Class Test, Quiz, Instant Test, Final Exam	CLO3, CLO4
5.	***Class Test 01***			CLO1, CLO2, CLO3, CLO4
6.	Structured Query Language: Selection, projection, Union, Set difference, Cartesian-product, Rename, Set-intersection, Natural-join, Assignment, projection, Aggregate functions, Deletion, Insertion, Updating, Views.	Lecture, Discussion & Problem Solving	Class Test, Assignment, Presentation, Instant Test, Final Exam	CLO4, CLO5, CLO6
7.	Structured Query Language: Nested sub-queries, Set membership, Set comparison, Embedded SQL, Cursors, Dynamic SQL, ODBC and JDBC. Basic Concepts of OLAP, Comparison between OLAP and OLTP, Introduction to NoSQL Systems.	Lecture, Discussion & Problem Solving	Class Test, Assessment, Presentation, Instant Test, Final Exam	CLO4, CLO5, CLO6
8.	Integrity and Security and Relational Database Design: Domain constraint, Integrity, Assertions, Triggers, Authorization, Authentication, Security, Privileges, Roles, Audit trails, Encryption-Decryption Algorithm.	Lecture, Discussion & Problem Solving	Class Test, Assignment, , Presentation, Instant Test, Final Exam	CLO4, CLO5, CLO6, CLO7
9.	Transaction: ACID Properties, Transaction state diagram, Implementation of Atomicity and Durability, Shadow copy technique, Concurrent Execution, Serializability, Recoverability, Recoverable schedule, Cascade-less Schedules, Implementation in Isolation, Testing of Serializability.	Lecture, Discussion & Problem Solving	Class Test, Presentation, Instant Test, Final Exam	CLO4, CLO5, CLO6, CLO7
10.	***Class Test 02***			CLO4, CLO5, CLO6, CLO7
11.	Concurrency Control, Recovery System and Distribute databases: Lock-Based Protocols, Granting of locks, Two-phase locking protocol, Graph based protocol, Tree protocol, Timestamp based protocols.	Lecture, Discussion & Problem Solving	Class Test, Assignment, Quiz, Assessment, Presentation, Instant Test, Final Exam	CLO4, CLO5, CLO6
12.	Concurrency Control, Recovery System and Distribute databases: Deadlock detection and recovery. Failure	Lecture, Discussion & Problem Solving	Class Test, Assignment,	CLO4, CLO5,

	classification, Storage types, Checkpoints. Distributed data, Replication and Fragmentation		Quiz, Assessment, Presentation, Instant Test, Final Exam	CLO6, CLO7
13	Indexing and Hashing: Types of Indexing, B Tree, B+ tree, Hash function, Hash Tables, Collision likelihoods and load factors for hash tables, A simple Hash Table in operation, Strategies for dealing with collisions, Linear Probing, Double Hashing, Choosing good hash functions, Complexity of hash tables.	Lecture, Discussion & Problem Solving	Class Test, Assignment, Quiz, Assessment, Presentation, Instant Test, Final Exam	CLO4, CLO5, CLO6, CLO7
14.	Review	Lecture, Discussion, Problem Solving		CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7
15.&16.	***Final Term Exam & Feedback***			CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	5%
	2.	Mid Term	
		a. Class Test:	5%
		b. Assignment/Presentation:	10%
		c. Exam	20%
Make-up Procedures	3.	Final Term	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials:

5. Database Systems Concepts, 7th Edition by A. Silberschatz, H. Korth and S. Sudarshan, Publisher: McGraw Hill.
6. Fundamentals of Database Systems, 7th Edition by Ramez Elmasri.
7. An Introduction to Database Systems, 7th Edition by C. J. Date.
8. An Introduction to Database Systems, 3rd Edition by R. Ramakrishnan and J. Gehrke.

BNQF Code: 06112207, Departmental code: ICT-2207

Course Title: Computer Organization and Architecture

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):**

Rationale

This course focuses on the function and design of various components necessary to process information digitally. The study of computer architecture and organization focuses on the interface between hardware and software, and emphasizes the structure and behavior of the system.

Course Objectives

The objectives of this course are as follows.

1. To understand aspects of computer architecture and program performance.
2. To provide essential understanding of different subsystems of modern computer system and design aspects these subsystems.
3. To understand the stages in instruction life cycle.
4. To understand performance enhancement methods in instruction execution.

Course Learning Outcomes (CLO)

After completing the course, students will be able to

CLO1 demonstrate computer architecture concepts related to design of modern processors, memories and I/O.

CLO2 analyze the performance of commercially available computers.

CLO3 to develop logic for assembly language programming

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2		√										
CLO3			√									

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Instruction sets- formats, cycle, timing etc.; Addressing modes; Types of Instruction; RISC characteristics; CISC characteristics.	Lecture, Discussion		CLO1, CLO3
2.	Different types of data representation; Addition and Subtraction	Lecture, Discussion Problem Solving		CLO3
3.	Multiplication Algorithms; Division Algorithms.	Lecture, Discussion Problem Solving		CLO3
4.	Introduction, combinational circuits, sequential circuits, the register level, register-level components	Lecture, Discussion Problem Solving		CLO3
5.	Design method, the processor-level, processor-level	Lecture, Discussion		CLO1

	components, design techniques.			
6.	Accumulated based CPU, instruction sets, instruction format, CPU with general register organization, Additional features of processor	Lecture, Discussion Problem Solving		CLO1, CLO3
7.	Processor basic: Program execution steps, processor memory communication, user and supervisor modes, CPU operation	Lecture, Discussion Problem Solving		CLO1
8.	***Mid Term Exam***			
9.	Control Design: Introduction; Instruction sequencing, instruction interpretation, Hardwired control, multiplier control unit	Lecture, Discussion		CLO1, CLO2
8.	CPU control unit, micro programmed control; microinstruction, micro programmed sequencer	Lecture, Discussion Problem Solving		CLO1, CLO2
9.	Memory devices and characteristics, RAM and ROM organization, serial access memory; virtual memory, memory hierarch	Lecture, Discussion Problem Solving		CLO1, CLO2
10.	Main-memory allocation, segments and pages, High speed memories; interleaving, cache memory, associative memory	Lecture, Discussion Problem Solving		CLO1, CLO2
11.	Basic concepts, Bus control, Arbitration, I/O interface circuit	Lecture, Discussion		CLO1, CLO2
12.	Programmed I/O, DMA and Interrupts, I/O processors.	Lecture, Discussion		CLO1, CLO2
13	Parallel processing; Pipelining; Vector processing	Lecture, Discussion Problem Solving		CLO1, CLO2
14.	Multiprocessors; Array processor, Bit-slice processor, Interconnection structures.	Lecture, Discussion Problem Solving		CLO1, CLO2
15. 16.	***Makeup classes and Final Term Exam***			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	5%
	2.	Mid Term	
		a. Class Test:	5%
		b. Assignment/Presentation:	10%
		c. Exam	20%
Make-up Procedures	3.	Final Term	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. J. P. Hayes, Computer Architecture and Organization
2. Dr. M. Rafiquzzaman, Fundamentals of Computer System Architecture
3. Romesh S. Gaonkar, Microprocessor, Architecture, Programming & Application with 8085
4. John Hennesy, David Patterson: Computer Organization and Design

BNQF Code: 06122209, Departmental Code: ICT-2209

Course Title: Analog and Digital Communication

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

This course provides a thorough introduction to the basic principles and techniques used in analog and digital communication. The course will introduce analog and digital modulation techniques, communication receiver and transmitter design, baseband and bandpass communication techniques, line coding techniques, noise analysis, and multiplexing techniques. The course also introduces analytical techniques to demonstrate the performance of communication systems.

Course Objectives

1. To understand analog and digital communication techniques.
2. To learn data and pulse communication techniques.
3. To be familiarized with source and Error control coding.
4. To acquire knowledge to study the noise performance of analog modulation techniques.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Understand the basics of communication system.

CLO2 Examine various types of modulation techniques and compare between them

CLO3 Explain baseband signals in time domain and in frequency domain

CLO4 Understand different types of transmitters and receivers.

CLO5 Understand the concepts of Multiplexing.

CLO6 Explain the importance of synchronization in communication systems

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2				√								
CLO3		√										
CLO4	√											
CLO5	√											
CLO6	√											

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Introduction to Communication Systems: Block diagram of communication system, Need for modulation, Amplitude Modulation - Time and frequency domain description, Generation of AM wave -Switching modulator, Detection of AM Wave - Envelope detector.	Lecture, Discussion	Class Test	CLO1
2.	Amplitude Modulation:	Lecture,	Class Test	CLO2,

	DSB-SC modulation - time and frequency domain description, Generation of DSB-SC Wave – Balanced Modulators, Coherent detection of DSB-SC Modulated waves, SSB modulation - time and frequency domain description, Phase discrimination method for generating SSB, Demodulation of SSB Wave, principle of Vestigial side band modulation, Applications of AM, Problems related to power and bandwidth calculations of AM	Discussion		CLO3
3.	Amplitude Modulation: DSB-SC modulation - time and frequency domain description, Generation of DSB-SC Wave – Balanced Modulators, Coherent detection of DSB-SC Modulated waves, SSB modulation - time and frequency domain description, Phase discrimination method for generating SSB, Demodulation of SSB Wave, principle of Vestigial side band modulation, Applications of AM, Problems related to power and bandwidth calculations of AM	Lecture, Discussion	Class Test	CLO2, CLO3
4.	Angle Modulation: Basic concepts of Phase Modulation, Frequency Modulation: Single tone Frequency modulation, Spectrum Analysis of Sinusoidal FM Wave using Bessel functions, Constant Average Power, Transmission bandwidth of FM Wave, Generation of FM Signal-Armstrong Method, Detection of FM Signal: Phase locked loop, Applications of FM, Comparison of FM and AM.	Lecture, Discussion	Class Test	CLO2
5.	Angle Modulation: Basic concepts of Phase Modulation, Frequency Modulation: Single tone Frequency modulation, Spectrum Analysis of Sinusoidal FM Wave using Bessel functions, Constant Average Power, Transmission bandwidth of FM Wave, Generation of FM Signal-Armstrong Method, Detection of FM Signal: Phase locked loop, Applications of FM, Comparison of FM and AM.	Lecture, Discussion	Assignment	CLO2
6.	Transmitters: Classification of Transmitters, AM Transmitters, FM Transmitters. Receivers: Radio Receiver – Super heterodyne receiver, Image frequency, AGC, FM Receiver.	Lecture, Discussion Problem Solving	Exam	CLO4
7.&8.	***Mid Term Exam***			CLO1, CLO2, CLO3, CLO4
9.	Sampling and Analog to digital Conversion Sampling theorem, Sampling and signal reconstruction, Aliasing, Types of sampling, Quantization, PCM, Companding, DPCM, ADPCM, Delta modulation, Adaptive delta modulation,	Lecture, Discussion Problem Solving	Class Test, Exam	CLO2
10.	Sampling and Analog to digital Conversion Sampling theorem, Sampling and signal reconstruction, Aliasing, Types of sampling, Quantization, PCM, Companding, DPCM, ADPCM, Delta modulation, Adaptive delta modulation,	Lecture, Discussion Problem Solving	Class Test	CLO2
11.	Digital Data Transmission Components of digital communication system, line coding, pulse shaping, Scrambling, Regenerative Repeater, Eye Diagram, Timing Extraction, Detection Error Probability, M-ary communication, Digital Carrier Systems	Lecture, Discussion	Exam	CLO6

12.	Digital Modulation Techniques: Block diagram of digital transmission and reception, ASK (definition, waveform), BPSK(definition, waveform), reception of BPSK, Geometrical representation of BPSK signals, QPSK(definition, waveform), QPSK transmitter , QPSK receiver, signal space representation of QPSK,	Lecture, Discussion Problem Solving	Assessment	CLO6
13	Multiplexing: Frequency Division multiplexing, Time Division Multiplexing	Lecture, Discussion Problem Solving	Assessment	CLO5
14.	**Concepts of Information theory:** Information, Entropy, Shannons Hartley law, Source codingTechniques-Huffman coding, Shannon-Fano coding, and channelcoding techniques **Review and Makeup class (if any)**	Lecture, Discussion Problem Solving	Assessment	CLO6
15.&16.	***Final Term Exam & Feedback***			CLO2, CLO5, CLO6,

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	5%
	2.	Mid Term	
		a. Class Test:	5%
		b. Assignment/Presentation:	10%
		c. Exam	20%
Make-up Procedures	3.	Final Term	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials

1. *George Kennedy, Electronic communication systems*
2. *Taub and Schilling, Principles of communication systems*
3. *Martin S Roden , Analog and Digital Communication systems*
4. *Sol Lepatine , Electronic communication*
5. *Dennis Roody and John Coolen, Electronic communication*
6. *J Dunlop & D G Smith, Telecommunication Engg.*
7. *Simon Haykin John, Communication Systems*
8. *Proakis&Salehi, Communication Systems Engineering*
9. *B P Lathi , Analog& Digital Communication*
10. *B P Lathi, Communication Systems*

BNQF Code: 06112204, Departmental Code: ICT-2204

Course Title: Digital Logic Design Lab

Credit Hr.: 1.0, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any)**:** None

Rationale:

Digital Electronics Lab is helpful for the students to acquire the basic knowledge of digital logic levels and its application to construct digital electronics circuits. This course will prepare students to perform the analysis and design of various digital electronic circuits.

Course Objectives:

1. To understand the fundamental concepts and techniques used in digital electronics.
2. To understand and examine the structure of various number systems and its application in digital design.
3. To analyse and design various combinational and sequential circuits

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Investigate combinational circuits using hardware and software tools.

CLO2 Investigate sequential circuits using hardware and software tools.

CLO3 Work in a team and communicate effectively.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	POL2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1				√								
CLO2					√							
CLO3									√			

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy				
Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Identify the Basic Gates (AND, OR, NOT) & Some other Gates (NOR, NAND, XOR, XNOR).	Lecture, Discussion	Performance Test	CLO1
2.	Simplify and implement functions with necessary gates.	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1
3.	Implement a 3-bit Binary-to-Gray code convertor circuit with required gates.	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1
4.	Implement Full Adder circuits	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2
5.	Implement functions using decoder and gates.	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2
6.	Implement functions using multiplexers.	Lecture, Group Discussion	Performance Test, Lab Report	CLO2
7.	*Review and makeup class and Mid Term Exam 1 (Quiz and Viva) & Feedback*			
8.	Implement registers.	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2, CLO3
9.	Implement Ripple Counters.	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO3
10.	Implement Arbitrary Synchronous Counters.	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO3
11.	Implement a sequence recognizer‘1011’	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO3
12.	Realization of SR Latch Using Integrated Circuit NAND and NOR Gates	Lecture, Group Discussion	Performance Test, Lab Report	CLO3
13.	Realization of SR Latch Using Integrated Circuit NAND and NOR Gates *Review and makeup class (If any)*	Group Discussion	Lab Presentation	CLO3
14.	*Review and makeup class and Mid Term Exam 2 (Quiz and Viva) & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Continuous Assessment: Class Test, Assignment, Presentation **Summative:**	Sl.	Category	Mark %
	1.	Attendance:	
	2.	Mid Term	
		a. Quiz:	
		b. Viva:	
		c. Performance Test:	
		d. Lab Report:	
Make-up Procedures	3.	Final Term	
		a. Quiz:	
		b. Viva:	
		c. Performance Test:	

		d. Lab Report:	
	Total:		100%

Learning Materials:

e. *R P Jain, "Modern Digital Electronics", McGraw Hill*

f. *Morris & Miller, "Design with TTL Integrated Circuit", McGraw Hill*

g. *Ronald J Tocci, "Digital Systems, Principles and Applications ", Prentice Hall*

Recommended Readings: 1. Supplementary Read: 2, 3.

BNQF Code: 06122206, Departmental Code: ICT-2206

Course Title: Database Management Systems Sessional

Credit Hr.: 1.0, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

A Database Management System (DBMS) Sessional provides hands-on experience in designing, implementing, and managing databases, which are crucial components of modern applications. Through practical exercises, students can learn to create and manipulate databases, query data efficiently, and understand data integrity and security. This course enables students to grasp key concepts such as normalization, indexing, and transaction management. Additionally, it fosters teamwork and problem-solving skills as students work on real-world database projects. As data continues to grow in complexity and volume, proficiency in DBMS becomes increasingly valuable for future professionals. This course empowers students with the practical skills and knowledge needed to address the challenges of data management and make informed decisions in the world of information technology.

Course Objectives:

1. To train students to use DBMSs (e.g., MySQL, Oracle, etc.)
2. To give practical experience in retrieving information from a database system efficiently and effectively.
3. Give an introduction to systematic database design approaches covering conceptual design, logical design and an overview of physical design.
4. To develop ability to design, develop/create, and manipulate a relational database using a DBMS.
5. Motivate the participants to relate all these to one or more commercial product environments as they relate to the developer tasks.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 To understand the formal foundation of the relational model of data.

CLO2 To execute SQL and procedural interfaces to SQL comprehensively.

CLO3 To formulate systematic database design approaches covering conceptual design, logical design and an overview of physical design.

CLO4 To present the concepts and techniques relating to query processing by SQL engines.

CLO5 To apply normalization techniques to normalize the database.

CLO6 To apply the concept of indexing, transaction and query processing to develop the database applications.

CLO7 Design and implementation of real-life RDBMS using data modeling and diagramming tools

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1				√								
CLO2					√							
CLO3			√									
CLO4		√										
CLO5					√							
CLO6			√									
CLO7			√									

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy				
Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Working with MySql or SQL editor and Oracle live SQL editor (using Online/Offline editors) Creation of a database and writing SQL queries to retrieve information from the database.	Lecture and Hand on practice with MySql or SQL editor. Student form team for the project and fill the team information.	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO1, CLO2
2.	Working with Lucid chart to draw E-R model (using Online editors)	Lecture and Hand on practice with MySql or SQL editor, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO1, CLO2, CLO3
3.	Draw E-R model and convert it to Relational Schema. Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables.	Review exercises, Solve problems using MySql or SQL editor, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO3
4.	Working with MySql or SQL Queries using Oracle live SQL editor. Performing Insertion, Deletion, Modifying, Altering, Updating and Viewing records based on conditions.	Review exercises, Solve problems using MySql or SQL editor, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO3, CLO4
5.	***Class Test 01***			CLO1, CLO2, CLO3, CLO4
6.	Working with MySql or SQL nested queries using Oracle live SQL editor. Nested queries, Sub queries.	Review exercises, Solve problems using MySql or SQL editor, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO3, CLO4, CLO5, CLO7
7.	Implementation of different JOINS.	Review exercises, Solve problems using MySql or SQL editor, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final	CLO3, CLO4

			Term Exam	
8.	Application of different aggregate functions.	Review exercises, Solve problems using MySql or SQL editor, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO3, CLO4
9.	Queries using Conversion functions, string functions, date functions.	Review exercises, Solve problems using MySql or SQL editor, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO3, CLO4
10.	***Class Test 02***			CLO3, CLO4, CLO5
11.	Views, Sequences, Synonyms	Review exercises, Solve problems using MySql or SQL editor, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO3, CLO4
12.	Database Design using ER modeling, normalization, Hash, Index etc Implementation for any application	Review exercises, Solve problems using MySql or SQL editor, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO5, CLO6
13	Case Study using real life database applications.	Review exercises, Solve problems using MySql or SQL editor, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO3, CLO4, CLO5, CLO6, CLO7
14.	Review	Discussion, Problem Solving	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7
15.&16.	***Final Term Exam & Project Showcasing***			CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7

Assessment Strategy	Course Evaluation Process and Mark Distributions		
Exam **Continuous Assessment:** Class Test, Report, Class Performance **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance:	5%
		b. Instant Test / Class Performance	10%
		c. Class Test	20%
		d. Report	5%
Make-up Procedures	2.	**Final Exam**	**60%**
		a. Viva	20%
		b. Final Lab Exam	40%
	Total:		**100%**

Learning Materials:

1. Database Systems Concepts, 7th Edition by A. Silberschatz, H. Korth and S. Sudarshan, Publisher: McGraw Hill.
2. Oracle Database 10g: The Complete Reference, Author: Kavin Loney
3. An Introduction to Database Systems, 7th Edition by C. J. Date.
4. Fundamentals of Relational Database Management Systems, Author: S. Sumathi and S. Esakkirajan.

BNQF Code: 06122210, Departmental Code: ICT-2210

Course Title: Analog and Digital Communication Sessional

Credit Hr.: 1.0, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any)**:** None

Rationale:

Analog and digital communication is a fundamental field that plays a crucial role in transmitting and receiving information. This laboratory course is designed to provide students with hands-on experience in analog and digital communication systems. By working with real-world analog communication equipment and techniques, students can gain a deeper understanding of the theoretical concepts they learn in their lectures. The course aims to bridge the gap between theory and practice, enabling students to design, implement, and troubleshoot analog communication systems.

Course Objectives:

1. Apply theoretical concepts learned in analog and digital communication theory courses to practical situations.
2. Design and construct communication systems.
3. Operate and calibrate various communication equipment and instruments.
4. Analyze and troubleshoot common issues in analog and digital communication systems.
5. Gain experience in working with analog and digital modulation and demodulation techniques.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Understand the basic principles of analog communication, including modulation and demodulation techniques.

CLO2 Analyze and select appropriate modulation schemes for specific communication applications.

CLO3 Demonstrate different modulations including amplitude modulation (AM) and frequency modulation (FM) transmitters and receivers.

CLO4 Operate and calibrate various analog communication equipment, such as signal generators, oscilloscopes, and spectrum analyzers.

CLO5 Perform experiments to measure signal-to-noise ratio, bandwidth, and distortion in analog communication systems.

CLO6 Identify and troubleshoot common issues in analog communication systems, including interference and distortion.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	POL2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2				√								
CLO3				√								
CLO4					√							
CLO5					√							
CLO6		√										

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy				
Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	To understand and the concept of Pulse Code Modulation and To observe the Performance of PCM system	Lecture, Discussion	Performance Test	CLO1
2.	To understand and the role of signal compression/Expansion on S/N ratio	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO5
3.	To understand the concept of Delta Modulation and to achieve the Delta Modulation / De- Modulation	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1,CLO2
4.	To study the performance of An-adaptive Delta modulator/De-modulator circuits	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2
5.	To Study and observe the performance of Digital carrier system—ASK,PSK,FSK	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO4,CLO2
6.	To Study and observe the performance of Return to Zero (RZ) types of line codes.	Lecture, Group Discussion	Performance Test, Lab Report	CLO2
7 .	*Review and makeup class and Mid Term Exam 1 (Quiz and Viva) & Feedback*			
8.	To Study and observe the effect of signal Distortion using EYE-Diagram.	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2, CLO3
9.	To Study and Perform sampling theorem and reconstruction.	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2
10.	To study and perform PAM, PWM, PPM	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1
11.	To study and perform TDM pulse amplitude modulation/demodulation.	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1
12.	To establish a PCM based transmission-reception link.	Lecture, Group Discussion	Performance Test, Lab Report	CLO3
13.	Pulse Position Modulation & Demodulation *Review and makeup class (If any)*	Group Discussion	Lab Presentation	CLO1
14.	*Review and makeup class and Mid Term Exam 2 (Quiz and Viva) & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Continuous Assessment: Class Test, Assignment, Presentation **Summative:**	Sl.	Category	Mark %
	1.	Attendance:	
	2.	Mid Term	
		a. Quiz:	
		b. Viva:	
		c. Performance Test:	
		d. Lab Report:	

Make-up Procedures	3.	Final Term	
		a. Quiz:	
		b. Viva:	
		c. Performance Test:	
		d. Lab Report:	
	Total:		100%

Learning Materials:

1. *George Kennedy, Electronic communication systems*
2. *Taub and Schilling, Principles of communication systems*
3. *Martin S Roden , Analog and Digital Communication systems*
4. *Sol Lepatine , Electronic communication*
5. *Dennis Roody and John Coolen, Electronic communication*
6. *J Dunlop & D G Smith, Telecommunication Engg.*

BNQF Code: 06123101, Departmental Code: ICT-3101

Course Title: Data Communication and Networks

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core

Pre-requisites (if any**):** None

Rationale:

In this course, the student will get the idea of using various process, model, functionalities, and protocols of various layers in the network according to given circumstances, their architecture, and their applications. Student can apply that knowledge to implement in different networks.

Course Objectives:

1. To provide the idea of different networks and commands.
2. To provide an idea of using various models in the networks according to given circumstances.
3. To gain knowledge of different networking functions and features for implementing optimal solutions.
4. To identify different routing concepts for implementing network solutions.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Describe and apply the building blocks of Computer Networks.

CLO2 Explain and differentiate the functionalities and protocols of various layers in OSI Network model.

CLO3 Prepare and apply the building skills of subnetting and routing mechanisms.

CLO4 Identify and organize the purpose of each component of the TCP/IP protocol.

CLO5 Demonstrate the capacity optimization of channels through multiplexing.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2		√										
CLO3					√							
CLO4					√							
CLO5				√								

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	**Introduction to Data Communications**: Data communications concepts and components, Analog vs digital communication, Data transmission modes: simplex, half-duplex, full-duplex, Transmission impairments: attenuation, distortion, noise	Lecture, Discussion	Assignment	CLO1
2.	**Signals and Transmission**: Data and signals (analog/digital), Transmission media: guided (twisted pair, coaxial, fiber optic) and unguided (radio, microwave, satellite), Channel capacity: Nyquist theorem, Shannon	Lecture, Discussion	Assignment	CLO1

	capacity, Bandwidth, data rate, and throughput			
3.	**Data Encoding and Modulation**: Digital-to-digital conversion (line coding, block coding, scrambling), Analog-to-digital conversion (sampling, quantization, PCM, delta modulation), Digital-to-analog modulation (ASK, FSK, PSK, QAM), Multiplexing techniques: FDM, TDM, WDM, CDM	Lecture, Discussion	Class Test	CLO2
4.	**Data Communication Equipment**: Modems, multiplexers, repeaters, hubs, switches, routers, gateways, Transmission impairments and performance issues The Physical Layer: the theoretical basis for data communication, Guided transmission media, wireless transmission, communication satellites etc.	Lecture, Discussion	Assignment	CLO2
5.	The Data link layer: Data link layer design issues, Error detection and correction, Elementary data link protocols.	Lecture, Discussion Problem Solving	Assignment	CLO2
6.	**Review and makeup class (if any)**	Lecture, Discussion Problem Solving	Exam	CLO2
7.	***Mid Term Exam***			
8.	The medium access control sub layer: Ethernet, Wireless LANs, Broadband Wireless, Bluetooth etc.	Lecture, Discussion Problem Solving	Class Test, Exam	CLO2, CLO3, CLO4
9.	The Network layer: Network layer design issues, Routing Algorithms, Congestion Control Algorithms, Quality of service, Internet working, IP address, Subnetting, Static and dynamic routing and protocols.	Lecture, Discussion Problem Solving	Assignment	CLO2, CLO4
10.	**IP Addressing and Routing**: Structure of IPv4 and IPv6 addresses, Classes of IP addresses (A, B, C, D, E), Subnetting and supernetting (CIDR), Static vs dynamic IP (DHCP), Private vs public IP addresses, IP routing basics (default gateway, static/dynamic routing), Introduction to ICMP and ARP	Lecture, Discussion Problem Solving	Class Test	CLO2, CLO4
11.	The Transport layer: The transport service, Elements of transport protocols, A simple transport protocols. The Session and Presentation layers: Different protocols.	Lecture, Discussion	Assessment	CLO2, CLO4
12.	The Application layer: The Domain Name System, Electronic Mail, World Wide Web, Multimedia, Different protocols etc.	Lecture, Discussion Problem Solving	Assessment	CLO5
13.	**Review and makeup class (if any)**	Lecture, Discussion Problem Solving	Assessment	CLO5
14.	***Mid Term Exam***			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	10%
	2.	Mid Term	20%
	3.	Class Test	5%
	4.	Assignment/Presentation:	5%
	5.	Final Term	60%
Make-up Procedures			
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials:

1. *J James F. Kurose and Keith W. Ross, "Computer Networking, a top-down approach", 7th Ed., Pearson, 2016.*

2. *Andrew S. Tanenbaum,* "*Computer Networks*"*, 5th Ed., Pearson, 2012.*
3. *William A Shay, "Understanding communication and networks", 3rd Ed, Cengage Learning, 2003.*
4. *Leon-Garcia and I. Widjaja, "Communication Networks", 2nd Ed, McGraw-Hill Education, 2003.*
5. *Bertsekas and Gallagar, "Data Networks", 2nd Ed, Pearson, 1992.*
6. *Douglas Comer & D. L. Stevens, "Internetworking with TCP/IP", At & T Tli edition, Prentice Hall,1993.*
7. *Richard Stevens, "TCP/IP Utilities - Vol. I, The protocols", 2nd Ed, Addison-Wesley Professional,2011.*
8. *SidnieFeit,," TCP/IP: Architecture, Protocols, and Implementation with IPv6 and IP Security", Subsequent edition, 1996.*
9. *Behrouz A. Fourouzan, "Data Communications and Networking", 5th edition, McGraw-Hill Education, 2012.*

BNQF Code: 06133103, Departmental Code: ICT-3103

Course Title: Software Engineering

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

This course introduce to the student the idea of using various process models in the software industry according to given circumstances, their architecture, and their applications. Student can apply these architectures and techniques in different given circumstances.

Course Objectives

1. To provide the idea of decomposing the given problem into Analysis, Design, Implementation, Testing, and Maintenance phases.
2. To provide an idea of using various process models in the software industry according to given circumstances.
3. To gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.
4. To introduce the software life cycle models.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1	Prepare the SRS, Design document, and Project plan of a given software system.
CLO2	Apply Project Management and Requirement analysis.
CLO3	Analyze and apply the cost estimate and problem complexity using various estimation techniques, Principles to S/W project development.
CLO4	Generate test cases using the techniques involved in selecting: (a) White Box testing (b) Block Box testing.
CLO5	Solve the legal and ethical issues in computer society.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1						√						
CLO2		√										
CLO3		√										
CLO4		√										
CLO5											√	

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Concepts of software engineering, Requirements definition, modularity.	Lecture, Discussion	Class Test	CLO1
2.	Data specifications, functional specifications.	Lecture, Discussion	Class Test	CLO1
3.	Verification, documentation, software maintenance, software support tools.	Lecture, Discussion	Class Test	CLO1, CLO2
4.	Software project organization, quality assurance and communication skills.	Lecture, Discussion	Class Test	CLO1, CLO2

5.	Project Metrics, estimation for software concepts, project metrics, estimation for software concepts	Lecture, Discussion	Assignment	CLO2
6.	Agility, agility principles, extreme programming, review, risk management, requirement Analysis.	Lecture, Discussion Problem Solving	Exam	CLO2, CLO3
7.&8.	***Mid Term Exam***			CLO1, CLO2, CLO3
9.	Analysis modeling, data modeling, design concept, structured design	Lecture, Discussion Problem Solving	Class Test, Exam	CLO3
10.	Software testing strategies, white-box testing, control structure testing, black-box testing, basis path testing	Lecture, Discussion Problem Solving	Class Test	CLO4
11.	Protecting programs and data (copyright, patents and trade secrets), legal and ethical l issues in selling and producing correct and usable software, threats to integrity and confidentiality	Lecture, Discussion	Exam	CLO5
12.	Case studies of ethics (use of computer services, privacy rights, ownership of programs.	Lecture, Discussion Problem Solving	Assessment	CLO5
13	Ethics of hacking or cracking	Lecture, Discussion Problem Solving	Assessment	CLO5
14.	Codes of ethics and professional conducts: IEEE, ACM, Computer Ethics Institute **Review and Makeup class (if any)**	Lecture, Discussion Problem Solving	Assessment	CLO5
15.&16.	***Final Term Exam & Feedback***			CLO3, CLO4, CLO5

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	10%
	2.	Mid Term	
		d. Class Test:	5%
		e. Assignment/Presentation:	5%
		f. Exam	30%
Make-up Procedures	3.	Final Term	
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam		d. Class Test	5%
		e. Assignment/ Presentation:	5%
		f. Exam	40%
	Total:		100%

Learning Materials

3. *Roger S. Pressman,* "*Software Engineering: A Practitioner's Approach*"*, 6th Ed., McGraw Hill, 2004.*
4. *Sommerville,* "*Software Engineering*"*, 8th Ed., Pearson, 2006.*
5. *David Gustfson, "Schaum's Outline of Software Engineering", 2nd Ed, McGraw Hill, 2002.*

BNQF Code: 06113105, Departmental Code: ICT-3105

Course Title: Microprocessor and Embedded System

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** Computer Fundamental

Rationale:

The purpose of this course is to teach students the fundamentals of microprocessor and microcontroller systems. Knowledge of microprocessors will provide a quicker grasping and understanding of the internal working and operation of microcontroller-based control systems in industry. The student will be able to incorporate these concepts into their electronic designs for other courses where control can be achieved via a microprocessor/controller implementation.

Course Objectives:

1. To introduce students with the architecture and operation of typical microprocessors and microcontrollers.
2. Familiarize the students with the programming and interfacing of microprocessors and microcontrollers.
3. To study the structure and timing of typical microprocessors, memories, UARTS, timer/counters, serial devices and related devices, MUX and related control structures for building systems
4. To introduce various advanced processor architectures such as 80X86, Pentium and Multicore Processors
5. Provide strong foundation for designing real world applications using microprocessors and microcontrollers.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1	Explain the microprocessor's and Microcontroller's internal architecture and its operation within the area of manufacturing and performance.
CLO2	Explain the addressing of memory and peripherals in a microprocessor / microcontroller system.
CLO3	Examine the construction of CPU, know registers and bus systems.
CLO4	Compare microprocessors and microcontroller.
CLO5	Design and implement programs on 8086, PIC.
CLO6	Design and implement 8051 microcontroller based systems.
CLO7	Draw a simple memory schema, explain the planning of memory of microcomputer system.
CLO8	Evaluate assembly language programs and download the machine code that will provide solutions to real-world control problems.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2		√										
CLO3			√									
CLO4				√								
CLO5			√									
CLO6			√									
CLO7			√									
CLO8					√							

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy				
Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Microprocessors and Microcomputer, Evolution of Microprocessor, Microprocessor Instruction set and Computer language, Microprocessor organization, General architecture of microprocessor and its operation, Memory, Input/Output(I/O) devices, RISC and CISC processors, Co-processors, Parallel processing. CPU organization, Information and number formats, Instruction set, Instruction format and Instruction types.	Lecture, Discussion	Class Test, Assessment, Presentation, Instant Test, Final Exam	CLO1, CLO4
2.	Data movement, Arithmetic and logic instructions, Flow control, Procedures, macros and subroutines, Instruction Execution, Programming Languages, Assembly Language Programs, Number Systems Intel 8085 Microprocessor: Introduction, Internal Architecture, Register Structure, Memory Addressing, Addressing Modes, Instruction set, 8085 programming model, Instruction Classification, How to write, Assemble and Execute a simple program, Memory Interfacing, Interfacing Output Displays, Interfacing Input Devices.	Lecture, Discussion	Class Test, Assessment, Presentation, Final Exam	CLO1, CLO3, CLO4
3.	8086 Microprocessor: Properties, Architecture, Registers, FLAGS register, Physical address calculation, Addressing modes, Instruction set, Instruction format, Fetch-decode-Execution cycle, Interrupt, Types of interrupt, Handling interrupt request, Interrupt vector and table. Internal Architecture of the 8086/8088 Microprocessors, Data Registers, Segment Registers, Physical Memory Address and Logical Address Calculations, Pointer and Index Registers, Instruction Pointer, Flag Register	Lecture, Discussion & Problem Solving with example	Class Test, Presentation, Instant Test, Final Exam	CLO1, CLO2, CLO3, CLO4
4.	I/O operation: Isolated and memory mapped I/O, DMA technique, I/O ports, I/O processor, I/O Interfaces, DMA Controllers and Interrupts, Serial and Parallel Communication Interfaces, Synchronous and Asynchronous Communications, Interrupt and Interrupt service routine	Lecture, Discussion & Problem Solving with example	Class Test, Quiz, Final Exam	CLO1, CLO2, CLO3
5.	***Class Test 01***			CLO1, CLO2, CLO3, CLO4, CLO5
6.	Microcontrollers: Introduction, History, Microcontrollers versus microprocessors, Internal architecture, Instruction set, microcontroller features, 8051 microcontroller architecture, 8051 addressing modes, 8051 hardware features, 8051 programming	Lecture, Discussion & Problem Solving with example	Class Test, Final Exam	CLO6, CLO7

7.	PIC Microcontroller: PIC microcontroller features, PIC 16C6X/7X microcontroller, Architecture, Memory organization, I/O ports, Interrupts, Timers, A/D I/O. Peripheral Interfacing: Parallel versus serial transmission, Synchronous and Asynchronous serial data Transmission, Basic concept of Serial I/O, Software controlled asynchronous serial I/O, The 8085-serial I/O Lines: SID and SOD, DMA controllers.	Lecture, Discussion & Problem Solving with example	Class Test, Presentation, Instant Test, Final Exam	CLO5, CLO6, CLO7, CLO8
8.	The FLAGS Register, How Instructions Affect the Flags Jump, Conditional Jumps, The JMP Instruction, High Level Structures, Branching Structures, Microprocessor Pin Configuration, Direct Memory Access, Addressing banking	Lecture, Discussion & Problem Solving with example	Class Test, Assignment, Quiz, Presentation, Final Exam	CLO7
9.	High Level Structures, Looping Structures Computational problem solving using branching and looping structures, Revision on Flag Registers and their effects on Arithmetic Operations, Logical Shift and Rotation Instructions & their operation in problem solving, The Stack and Stack operations in Microprocessor 8086, Applications of Stack operation in problem solving	Lecture, Discussion & Problem Solving with example	Class Test, Quiz, Presentation, Final Exam	CLO5, CLO6, CLO7
10.	***Class Test 02***			CLO3, CLO4, CLO5, CLO6, CLO7
11.	Signed and Unsigned Multiplication-Division in Microprocessor 8086, Computational Problem solving using Multiplication-Division instructions, Directional Flag and use of it in String operations, Moving and Storing Strings in Microprocessor 8086	Lecture, Discussion & Problem Solving with example	Assignment, Presentation, Instant Test, Final Exam	CLO5, CLO6, CLO7, CLO8
12.	Instruction Set, Opcode, Protected Mode Operations, Hyper-Threading Technology. Introduction to Interrupts, Interrupt Vectors and Instructions, Interrupt Control, Interrupt in the Personal Computer	Lecture, Discussion & Problem Solving with example	Assessment, Presentation, Instant Test, Final Exam	CLO6, CLO7, CLO8
13	Advanced Microprocessors: Intel 80286 architecture, 80286-memory management, Protection; Intel 80386 functional diagram; 80386 modes; Multi programming, 80486 and Pentium microprocessor Next Generation Microprocessor: Intel Core Architecture, Intel Dual Core, Core 2 Duo, Core 2 Quad, Core i3, Core i5, Core i7, Mobile Microprocessors, ARM, Helio, Atom.	Lecture, Discussion & Problem Solving with example	Instant Test, Final Exam	CLO7, CLO8
14.	Review	Lecture, Discussion & Problem Solving		CLO6, CLO7,

		with example		CLO8
15.&16.	***Final Term Exam & Feedback***			CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7, CLO8

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance:	5%
		b. Assignment/Presentation:	5%
		c. Quiz / Instant Test	5%
		d. Class Performance	5%
		e. Class Test / Mid Term	20%
Make-up Procedures	2.	**Final Exam**	**60%**
	Total:		**100%**

Learning Materials:

1. Computer Architecture and Organization, 5th Edition by John P. Hayes.
2. Microprocessors and Microcomputer based system Design, 2nd Edition by Md. Rafiquzzaman.
3. Microprocessors and System Design, 1st Edition by Gibson & Cheu.
4. Microprocessors and Interfacing: Hardware and Software, 1st Edition by D. V. Hall.
5. Language Programming Technique in IBM PC, 1st Edition by Alan R. Miller.

BNQF Code: 06113107, Departmental Code: ICT-3107

Course Title: Operating System

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

As Operating System plays a vital role in real world life, the purpose of this course is to ensure the learners to know about its inner structure and functionalities.
.

Course Objectives:

1. To understand the operating system structure
2. To understand processes, process scheduling, threads, CPU scheduling
3. To know the use of different management techniques in OS

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1	Learn the basic design principles of operating system
CLO2	Understand the process scheduling algorithms and their comparisons
CLO3	Summarize the major security issues associated with distributed systems along with the range of techniques available for increasing system security
CLO4	Select appropriate approaches for building a range of distributed systems
CLO5	Know the different management and their tasks

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2		√										
CLO3		√										
CLO4			√									
CLO5			√									

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Introduction to operating system; Types of operating systems; System Calls; Operating system structures; Virtual Machines; Operating system generation.	Lecture, Discussion	Class Test	CLO1
2.	Introduction to Process; Process Control; Process Scheduling; Threads; CPU Scheduling; Deadlocks.	Lecture, Discussion	Class Test	CLO1, CLO2
3.	Principles of I/O hardware and I/O software; Application I/O Interface; Kernel I/O Subsystem.	Lecture, Discussion	Class Test	CLO1, CLO2
4.	Main Memory **(**Swapping; Paging; Segmentation; Paging Algorithms); Virtual Memory.	Lecture, Discussion	Class Test	CLO1, CLO2, CLO3
5.	File systems; File structure; File directories, Security and protection techniques; Shared file and file server;	Lecture, Discussion	Assignment	CLO2

	File System Implementation,			
6.	Disk Structure; Disk Management.	Lecture, Discussion Problem Solving	Exam	CLO2, CLO5
7.&8.	***Mid Term Exam***			CLO1, CLO2, CLO3, CLO5
9.	Distributed system definition; Architecture; Networking; Networking protocols; Distributed File Systems.	Lecture, Discussion Problem Solving	Class Test, Exam	CLO2 CLO3
10.	UNIX, LINUX, MS-DOS, Influential OS, MACH System, WINDOWS.	Lecture, Discussion Problem Solving	Class Test	CLO4
11.	Deadlock handing, prevention, detection, avoidance, recovery, Semaphore,Classical Problem of Synchronization.	Lecture, Discussion	Exam	CLO5
12.	Scheduling Criteria, Scheduling algorithms, Thread Scheduling, Multiple processor Scheduling, Realtime CPU Scheduling.	Lecture, Discussion Problem Solving	Assessment	CLO5
13	Segmentation, Paging, Demand Paging, Thrashing, Memory Map File,	Lecture, Discussion Problem Solving	Assessment	CLO5
14.	File Access Methods and sharing, File recovery, Access Control, Virtual Machine, Distributed Systems. **Review and Makeup class (if any)**	Lecture, Discussion Problem Solving	Assessment	CLO5
15.&16.	***Final Term Exam & Feedback***			CLO3, CLO4, CLO5

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	5%
	2.	Class Test/ Assignment/ Presentation	15%
	3.	Mid Semester Exam	20%
Make-up Procedures	4.	Final Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts.
2. Andrew S. Tanenbaum, Modern Operating Systems.
3. Andrew S. Tanenbaum, Distributed Operating Systems

BNQF Code: 06133109, Departmental Code: ICT-3109

Course Title: Internet Programming

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

The course introduces the basic concepts of the World Wide Web, and the principles and tools that are used to develop Web applications. The course will provide an overview of Internet technology and will introduce the current Web protocols, client side and server-side programming, communication and design.

Course Objectives:

1. Gain the skills and project-based experience needed for entry into web design and development careers
2. Use a variety of strategies and tools to create websites
3. Develop awareness and appreciation of the many ways that people access the web, and will be able to create standards-based websites that can be accessed by the full spectrum of web access technologies

Course Learning Outcomes (CLO):	
After completing the course, students will be able to:	
CLO1	Define modern protocols and systems used on the Web (such as Unix, Apache, HTML, HTTPS, Git, URLs, CSS, JavaScript, JSON, PHP)
CLO2	Explain the functions of clients and servers on the Web, and describe the strengths and weaknesses of the client-server Internet approaches to web design and implementation
CLO3	Program, access, and manipulate data through the adoption of accepted standards, mark-up languages, client-side programming, and server-side programming
CLO4	Design and implement an interactive web site(s) with regard to issues of usability, accessibility, and internationalization
CLO5	Design and implement a client-server internet application that accommodates specific requirements and constraints, based on analysis, modeling, or requirements specification
CLO6	Justify and explain particular Internet application concepts, relevant alternatives, and decision recommendations, including design considerations for internet security

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	**PLO**											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√					√						
CLO2	√		√									
CLO3		√			√							
CLO4			√						√			
CLO5				√								
CLO6				√				√				

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Brief History of the Internet, What is World Wide Web? Why Create a Web Site? Web Standards.	Lecture, Discussion	Class Test	CLO1
2.	Client/Server Architecture, Basic Principles Involved in Developing a Web Site, Planning Process, Five Golden Rules of Web Designing, Designing Navigation Bar, Page	Lecture, Discussion, Problem Solving	Class Test	CLO1

	Design, Home Page Layout, Design Concept.			
3.	Browser and Web Document, Static, Active and Dynamic pages, Programming paradigms and Web programming. Object-oriented vs. Object based programming, What should and should not be programmed on the Web, Tasks suitable for programming on the Web, Choice of programming language for Web programming.	Lecture, Discussion	Assignment	CLO1, CLO2, CLO3
4.	Introduction to XHTML, *HTML* – HTML Basics, Basic Document Skeleton, Block and Inline Elements, Working with Text, Lists, Tables, Frames, Hyperlinks, Images, Multimedia, Forms and controls. HTML5 Features.	Lecture, Discussion, Problem Solving	Class Test	CLO1, CLO2
5.	*Cascading Style Sheets (CSS)* – CSS Basics, Tag Selectors, Conflicting Rules, Use CSS for Styling HTML Document, Box Model, Frames. Compound CSS Selectors, Layouts, Pseudo-Classes, Creating Style Sheet, External CSS, Fonts, Creating page Layout and Site Designs, CSS Properties.	Lecture, Discussion	Class Test	CLO2, CLO6
6.	*JavaScript:*Introduction to Scripting, Control Statements, Functions, Arrays, Objects, Document Object Model (DOM), Events, XML and RSS,	Lecture, Discussion	Exam	CLO2, CLO3
7.	Ajax-Enabled Rich Internet Applications. Introduction to the Browser's Objects, Interacting with the User using HTML Forms, Using Windows and Frames Objects,	Lecture, Discussion	Exam	CLO2, CLO4
8.	***Mid Term Exam***			
9.	String Manipulation-String Methods, Regular Expressions, String Object, Using the RegExp Object's Constructor; Timers in a Web Page, Storing Information: Cookies, Manipulating the DOM, JavaScript and XML.	Lecture, Discussion Problem Solving	Class Test, Exam	CLO3
10.	*Ajax:* Using the XMLHttpRequest Object, Creating Simple Ajax Module, Form Fields with Ajax. *JavaScript Frameworks:* Digging Deeper into jQuery, Diving into Prototype, Introduction to Bootstrap, Introduction to Scriptaculous.	Lecture, Discussion Problem Solving	Class Test	CLO4
11.	*Web Servers* (IIS and Apache)- Multitier Application Architecture, Accessing Web Servers, Apache HTTP Server. *PHP*- Overview of PHP, Basic Scripting and Looping Constructs, Arrays, Functions,	Lecture, Discussion	Exam	CLO4, CLO5
12.	Creating PHP Pages Using PHP5, String Processing and Regular Expressions, Introduction to the Apache Web Server, Configuring and Using Mysql,	Lecture, Discussion Problem Solving	Assessment	CLO5, CLO6
13	Working with Databases and Forms, Using Cookies, Sending E-mail, E-Commerce Site, Wordpress. Classic Technology: Common Gateway Interface (CGI): Definition, Characteristics.	Lecture, Discussion Problem Solving	Assessment	CLO5
14.	Introduction to *Ruby on Rails* Scripting. Introduction to *Perl* Scripting. Introduction to *ASP.NET* (Active Server Pages.NET). An Introduction to Laravel Framework. **Review and Makeup class (if any)**	Lecture, Discussion Problem Solving	Assessment	CLO5, CLO6
15.&16.	***Final Term Exam & Feedback***			

Assessment Strategy	Course Evaluation Process and Mark Distributions		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		f. Attendance	5%
		g. Assignment/Presentation	5%
		h. Quiz/Instant Test	5%
		i. Class Performance	5%
		j. Class Test/Mid Term	20%
Make-up Procedures	2.	**Final Exam**	**60%**
	Total:		100%

Learning Materials:

6. *W. Jacson Gilmore, Beginning PHP 5 and MYSQL, From Novice to Professional, Apress, 2004.*
7. *Chris Bates, Web Programming, Building Internet Applications, 2nd ed., John Wiley & Sons, Ltd., 2002.*
8. *G. McComb, Web Programming Languages, John Wiley & Sons, Inc., 1997.*
9. *1. A. Berson, Client/Server Architecture, 2nd ed., McGraw-Hill Series on Computer Communications, 1996*
10. *P. Wilton, Beginning JavaScript, Wrox Press Inc., 2000*

BNQF Code: 06123102, Departmental Code: ICT-3102

Course Title: Data Communication and Networks **Sessional**

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any)**:** None

Rationale:

This course is designed to impart knowledge about detailed knowledge of Computer Networks, various protocols used in Communication, Managing and configuring Cisco Switches and Routers, and various WAN technologies.

Course Objectives:

1. To explain network technologies and how devices access local and remote networks.
2. To explain how switching operates in a small to a medium-sized business network.
3. To implement basic network connectivity between devices.
4. To configure initial settings on a network device using the Cisco command-line interface (CLI).

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Identify the fundamental technologies for the hardware and software of the internet and their addressing mechanism.

CLO2 Analyze the conceptual and implementation aspects of network applications and their use in most of the application.

CLO3 Apply the knowledge of the basic binary systems to solve sub-netting problems and can identify and make an evaluation on the underlying principles of routing algorithms and their related protocols being applied to the Internet.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	POL2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1				√								
CLO2				√								
CLO3					√							

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Work using CISCO Packet Tracer; Introduce with networking devices.	Lecture, Discussion	Performance Test	CLO1
2.	Exploring IPv4, Subnet Masks and Gateway	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1
3.	Analyzing packets from real network, PING test	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1
4.	ARP process and MAC Learning	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2

5.	VLSM - Subnetting part 1, VLSM - Subnetting part 2, VLSM – Subnetting part 3.	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2
6.	Skill test based on Packet Tracer Activity	Lecture, Group Discussion	Performance Test, Lab Report	CLO2
7.	*Review and makeup class and Mid Term Exam 1 (Quiz and Viva) & Feedback*			
8.	Implementing Static Routing	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2, CLO3
9.	Implementing Dynamic Routing - RIPv2, Routing loops and	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO3
10.	the prevention mechanism	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO3
11.	Route Summarization, Re-distribution of routes	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO3
12.	Challenge Skill Test (Based on all the technologies learnt from this course so far) - Packet tracer activity.	Lecture, Group Discussion	Performance Test, Lab Report	CLO3
13.	Design and Configure Dynamic NAT using CISCO Packet Tracer. *Review and makeup class (If any)*	Group Discussion	Lab Presentation	CLO3
14.	*Review and makeup class and Mid Term Exam 2 (Quiz and Viva) & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Report, Class Performance **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		e. Attendance:	5%
		f. Instant Test / Class Performance	10%
		g. Class Test	20%
		h. Report	5%
Make-up Procedures	2.	**Final Exam**	**60%**
		c. Viva	20%
		d. Final Lab Exam	40%
	Total:		**100%**

Learning Materials:

1. James F. Kurose & Keith W. Ross, “Computer Networking- A Top-Down Approach”, 6th Edition.
2. Behrouz A. Forouzan , “Data Communications and Networking”, 4th Edition.
3. Tod Lammle , “CCNA, Study Guide”, 6th Edition.

Recommended Readings: 1. Supplementary Read: 2, 3.

BNQF Code: 06133104, Departmental Code: ICT-3104

Course Title: Software Engineering Sessional

Credit Hr.: 1.0, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites: None

Rationale:

This course demonstrates to the student the design and build of high-quality software and exposes them to real-world strategies and procedures that will give them a competitive edge in the market. Student can apply these strategies and techniques in different circumstances.

Course Objectives:

1. To provide the idea of decomposing the given problem into Analysis, Design, Implementation, Testing, and Maintenance phases.
2. To provide an idea of using various process models in the software industry according to given circumstances.
3. To gain the knowledge of how Analysis, Design, Implementation, Testing, and Maintenance processes are conducted in a software project.
4. To develop any application using any programming language.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Apply SDLC to software development.
CLO2 Prepare SRS document for a given application.
CLO3 Prepare UML design document for a given application.
CLO4 Develop any application using any programming language.
CLO5 Analyze test developed software by using any testing strategy.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1					√							
CLO2				√								
CLO3				√								
CLO4					√							
CLO5				√								

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Introduction to SDLC.	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1
2.	Introduction to techniques of requirement specification	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1
3.	Prepare the SRS document	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1, CLO2

4.	Prepare project plan of a given software system	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1, CLO2
5.	Introduction to UML	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2, CLO3
6.	Introduction to use case diagram	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2, CLO3
7.	**Review and Makeup class and *Mid Term Exam 1***			
8.	Introduction to class diagram	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2, CLO3
9.	Introduction to object diagram and sequence diagram	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2, CLO3
10.	Prepare UML document for any given software	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO3
11	Development of an application project using any software development tools	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO4
12.	Generate test cases using software testing strategy: White Box testing	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO5
13.	Generate test cases using software testing strategy: Block Box testing	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO5
14.	**Review and Makeup class and *Mid Term Exam 2***			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Report, Class Performance **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance:	5%
		b. Instant Test / Class Performance	10%
		c. Class Test	20%
		d. Report	5%
Make-up Procedures	2.	**Final Exam**	**60%**
		a. Viva	20%
		b. Final Lab Exam	40%
	Total:		**100%**

Learning Materials:

1. *Roger S. Pressman,* "*Software Engineering: A Practitioner's Approach*", *6th Ed., McGraw Hill, 2004..*
2. *David Gustfson,* "*Schaum's Outline of Software Engineering*", *2nd Ed., McGraw Hill,2002.*

Recommended Readings: 1. Supplementary Readings: 2.

BNQF Code: 06113106, Departmental Code: ICT-3106

Course Title: Microprocessor and Embedded System Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

This lab course is designed to teach students about basic principles of microprocessor and assembly language programming skills and real time applications of Microprocessor as well as microcontroller.

Course Objectives:

1. Apply the fundamentals of assembly level programming of microprocessors and microcontroller.
2. Work with standard microprocessor real time interfaces.
3. Troubleshoot interactions between software and hardware.
4. Analyze abstract problems and apply a combination of hardware and software to address the problem;
5. Use standard test and measurement equipment to evaluate digital interfaces.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Provide understanding of microprocessor, interfaces, interrupts.
CLO2 To understand the architecture of widely used microprocessor model like 8086.
CLO3 Understand details about microprocessor with memory and peripheral chips involving system design.
CLO4 Describe the concept of Programmable Interrupt Controller (PIC) and DMA.
CLO5 To analyze the architecture and instruction set of 80286 and 80386 microcontroller.
CLO6 To design I/O circuits and memory interfacing circuits.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2		√										
CLO3				√								
CLO4				√								
CLO5					√							
CLO6					√							

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Basics of Assembly Language Programming. Assembly Language Syntax, Program Data, Variables, Naming Constraints Copy, Load and Compare Strings and its operations	Lecture and Hand on practice with Assembly Language and Assembly Emulator. Student form team for the project and fill the team information.	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO1, CLO2

2.	The Stack and Stack operations in Microprocessor 8086, Applications of Stack operation in problem solving Computational problem solving using branching and looping structures	Lecture and Hand on practice with Assembly Language and Assembly Emulator, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO2, CLO3
3.	Lab practice for the basic arithmetic and logic operations available in assembly language. Discuss string operations and demonstrating a variety of string operations including search and search & replace. Code demonstrating on how 8, 16, 32 and 64-bit values can be used with software code	Lecture and Hand on practice with Assembly Language and Assembly Emulator, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO2, CLO3
4.	Introducing with Processor Status and Flag Register and related examples.	Lecture and Hand on practice with Assembly Language and Assembly Emulator, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO2, CLO3
5.	***Class Test 01***			CLO1, CLO2, CLO3, CLO4
6.	Programming with Flow Control Instructions and related examples. Lab practice on the use of branching, flags, stacks, procedures, macros, and interrupts. Jump, Conditional Jumps, The JMP Instruction, High Level Structures, Branching Structures	Lecture and Hand on practice with Assembly Language and Assembly Emulator, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO3, CLO4
7.	Programming with Logic, Shift and Rotate Instructions and related examples.	Lecture and Hand on practice with Assembly Language and Assembly Emulator, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO3, CLO5
8.	Programming with Multiplication and Division Instructions and related examples.	Lecture and Hand on practice with Assembly Language and Assembly Emulator, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO5, CLO6
9.	Programming with Arrays and Addressing Modes and related examples	Lecture and Hand on practice with Assembly Language and Assembly Emulator, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO3, CLO4, CLO5,
10.	***Class Test 02***			CLO3, CLO4, CLO5, CLO6

11.	Programming with String Instructions and related examples. Creating and Running a Program, Displaying a String, Case Conversion Program	Lecture and Hand on practice with Assembly Language and Assembly Emulator, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO4, CLO6
12.	Introducing with Procedures and related examples.	Lecture and Hand on practice with Assembly Language and Assembly Emulator, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO5, CLO6
13	Introducing with Files and related problems	Lecture and Hand on practice with Assembly Language and Assembly Emulator, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam	CLO4, CLO5, CLO6
14.	Review	Discussion, Problem Solving		CLO1, CLO2, CLO3, CLO4, CLO5, CLO6
15.&16.	***Final Term Exam & Project Showcasing***			CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7, CLO8

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Report, Class Performance **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance:	5%
		b. Instant Test / Class Performance	10%
		c. Class Test	20%
		d. Report	5%
Make-up Procedures	2.	**Final Exam**	**60%**
		a. Viva	20%
		b. Final Lab Exam	40%
	Total:		**100%**

Learning Materials:

5. Microprocessor and Interfacing, By B. V. Hall
6. The Intel Microprocessors, By Barry B. Brey.
7. The Art of Assembly Language By Randall Hyde
8. The 8051 Microcontroller and Embedded Systems: Using Assembly and C, M. A. Mazidi, R. McKinlay, J. G. Mazidi

BNQF Code: 06113108, Departmental Code: ICT-3108

Course Title: Operating System Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

Operating systems are central to computing activities. An operating system is a program that acts as an intermediary between a user of a computer and the computer hardware. Two primary aims of an operating system are to manage resources (e.g. CPU time, memory) and to control users and software. Operating system design goals are often contradictory and vary depending of user, software, and hardware criteria. This course describes the fundamental concepts behind operating systems, and examines the ways that design goals can be achieved..

Course Objectives:

1. The course objectives ensure the development of students applied skills in operating systems related areas.
2. Students will gain knowledge in writing software routines modules or implementing various concepts of operating system.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Able to explain the functions, facilities, structure of operating systems and fundamental operating system abstractions.

CLO2 Able to analyze the structure of operating system and design the applications to run in parallel either using process or thread models of different OS.

CLO3 Able to analyze the performance and apply different algorithms used in major components of operating systems, such as scheduler, memory manager, concurrency control manager and mass-storage manager, I/O manager, file manager.

CLO4 Able to analyze and justify the various device and resource management techniques, managing deadlock situations for timesharing and distributed systems.

CLO5 Summarize the major security issues associated with distributed systems along with the range of techniques available for increasing system security.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2		√										
CLO3				√								
CLO4					√							
CLO5					√							

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Introduction to operating system	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1
2.	Functions, facilities and structure of operating system.	Lecture, Discussion,	Performance	CLO1

		Lab Assignment	Test, Lab Report	
3.	Introduction to scheduling	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1, CLO2
4.	Simulate the following CPU scheduling algorithms a. Round Robin b. SJF c. FCFS d. Priority	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2, CLO3
5.	Paging, swapping	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1, CLO2
6.	Simulate all page replacement algorithms a. FIF b. LRU c. OPTIMAL	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2, CLO3
7.	**Review and Makeup class and *Mid Term Exam 1***			
8.	Simulate all file allocation strategies a. Sequential b. Indexed c. Linked	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO3, CLO4
9.	Simulate all File Organization Techniques a. Single level directory b. Two level	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO3, CLO4
10.	Simulate Bankers Algorithm for Dead Lock Avoidance.	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO4
11	Simulate Bankers Algorithm for Dead Lock Prevention	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO4
12.	Introduction to operating system security	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO5
13.	Simulation of a firewall design.	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO5
14.	**Review and Makeup class and *Mid Term Exam 2***			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance	5%
		b. Assignment/Presentation	5%
		c. Quiz/Instant Test	5%
		d. Class Performance	5%
		e. Class Test/Mid Term	20%
Make-up Procedures	2.	**Final Exam**	**60%**
	Total:		100%

Learning Materials:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts.
2. Andrew S. Tanenbaum, Modern Operating Systems.
3. Andrew S. Tanenbaum, Distributed Operating Systems

BNQF Code: 06133110, Departmental Code: ICT-3110

Course Title: Internet Programming Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

Internet and Web become an integral part of human life. It exists in every possible dimension which makes this art essential to learn. This course studies both theoretical and practical approaches to Web Engineering through various real-life problems & solutions. And how state of the art technologies can be learned and used later. Introduction to the Web and Internet; Requirement Engineering; Client-side development using HTML, CSS, JS; Server-side development with PHP with MySQL; Testing; MVC framework; A brief overview of other latest technology (independent topics).

Course Objectives:

1. Gain the skills and project-based experience needed for entry into web design and development careers
2. Use a variety of strategies and tools to create websites
3. Develop awareness and appreciation of the many ways that people access the web, and will be able to create standards-based websites that can be accessed by the full spectrum of web access technologies

Course Learning Outcomes (CLO):	
After completing the course, students will be able to:	
CLO1	Define modern protocols and systems used on the Web (such as Unix, Apache, HTML, HTTPS, Git, URLs, CSS, JavaScript, JSON, PHP)
CLO2	Explain the functions of clients and servers on the Web, and describe the strengths and weaknesses of the client-server internet approaches to web design and implementation
CLO3	Program, access, and manipulate data through the adoption of accepted standards, mark-up languages, client-side programming, and server-side programming
CLO4	Design and implement an interactive web site(s) with regard to issues of usability, accessibility and internationalization
CLO5	Design and implement a client-server internet application that accommodates specific requirements and constraints, based on analysis, modelling or requirements specification
CLO6	Justify and explain particular internet application concepts, relevant alternatives and decision recommendations, including design considerations for internet security

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	**PLO**											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√				√	√						√
CLO2				√	√							
CLO3								√		√		
CLO4							√					
CLO5									√		√	
CLO6								√				

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Introduction to the Web Engineering and different tools:	Lecture, Discussion	Class	CLO1

	Intro to different tools/IDEs/editors.		Performance	
2.	Working with HTML: Writing Basic webpage using mark-up language	Lecture and Hand on practice with HTML. Student form team for the project and fill the team information.	Instant Test, Class Performance, Class Test	CLO1, CLO2
3.	Working with CSS: Applying design to html elements	Lecture and Hand on practice with CSS.	Instant Test	CLO1, CLO2
4.	Creating Layout: Creating layout/responsive webpage	Hand on practice with CSS.	Instant Test	CLO1, CLO2
5.	Working with JS: Client-side programming and solving problems with JS	Lecture and Hand on practice with JavaScript.	Class Test	CLO1, CLO2, CLO3, CLO5
6.	Working with Forms	Hand on practice with JavaScript and HTML.	Exam	CLO2, CLO3, CLO4
7.	DOM and Basic PHP	Hand on practice with JavaScript.	Exam	CLO2, CLO3, CLO4
8.	***Mid Term Exam***			
9.	Using form for basic data manipulation with JS, PHP	Lecture and Hand on practice with PHP.	Instant Test, Class Performance, Class Test	CLO1, CLO2, CLO4
10.	Working with PHP: Server-side programming and solving complex problems with PHP	Hand on practice with PHP.	Class Performance, Class Test	CLO2, CLO3, CLO5
11.	Working with MySQL and PHP: Handling DBMS using MySQL	Solve problems using MySQL	Class Test	CLO2, CLO3
12.	Front end and Back end integration: Project Integration	Project Presentation & Lab Evaluation	Project Assessment	CLO4, CLO5
13	Overall Project integration	Project Presentation & Lab Evaluation	Project Assessment	CLO4, CLO5
14.	Project integration and presentation	Project Presentation & Lab Evaluation	Project Assessment	CLO4
15.&16.	***Final Term Exam & Feedback***			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance	5%
		b. Assignment/Presentation	5%
		c. Quiz/Instant Test	5%
		d. Class Performance	5%
		e. Class Test/Mid Term	20%
Make-up Procedures	2.	**Final Exam**	**60%**
	Total:		100%

Learning Materials:

1. *W. Jacson Gilmore, Beginning PHP 5 and MYSQL, From Novice to Professional, Apress, 2004.*
2. *Alan Beautieu, Learning SQL, O'Reilly Media Inc., 2005M.E. Davis and J.A. Phillips, Learning PHP & MySQL, O'Reilly Media Inc., 200*
3. *R. Nixon: Learning PHP, MySQL & JavaScript: with jQuery, CSS & HTML5. O'Reilly, 2018.*
4. *Alan Beautieu, Learning SQL, O'Reilly Media Inc., 2005M.E. Davis and J.A. Phillips, Learning PHP & MySQL, O'Reilly Media Inc., 200*

BNQF Code: 06123201, Departmental code: ICT-3201
Course Title: Digital Signal Processing

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

This course helps to analyze, synthesize, modify, separate, enhance, and modify various audio, image, video, and communication signals. It forms, compresses and delivers entertainment, games, clever applications (translation, location, music ID, speech recognition, speech generation etc.). It enables, supports, and enhances interfaces between humans, between machines and between humans and machines.

Course Objectives:

1. Apply the principles of discrete-time signal analysis to perform various signal operations.
2. Apply the principles of z-transforms to finite difference equations.
3. Apply the principles of Fourier transform analysis to describe the frequency characteristics of discrete-time signals and systems.
4. Apply the principles of signal analysis to filtering and visualizing signals.

Course Learning Outcomes (CLO):

After completing the course, students will able to:

CLO1 Specify the sampling, quantization, and signal conditioning requirements for a given DSP application.

CLO2 Apply signal transformations from time domain to frequency domain.

CLO3 Creatively design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, sustainability etc.

CLO4 Estimate spectra of discrete-time signals using the fast Fourier transform (FFT).

CLO5 Design finite impulse response (FIR) and infinite impulse response (IIR) discrete-time filters for lowpass, high-pass, bandpass, bandstop, and arbitrary frequency response applications.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLOs	PLOs											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2		√										
CLO3				√								
CLO4				√								
CLO5			√									

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Introduction; Digital Signal Processing; Sampling and Analog-to-Digital Conversion.	Lecture, Discussion	Class Test	CLO1
2.	Discrete Time Signals; Ambiguity in Digital signals; Discrete Time Systems; Application areas for DSP; Key DSP operations: Convolution, Correlation.	Lecture, Discussion	Class Test	CLO1, CLO2
3.	Introduction to z-Transform; General Results of z-transform; Inverse z-Transform: Inspection Method, Partial Fraction Expansion, Power Series	Lecture, Discussion	Class Test	CLO2

	Expansion.			
4.	Contour Integration; Comparison of inverse z-transform method; Properties of z-transform; Complex Convolution Theorem and Parseval's Relation.	Lecture, Discussion	Class Test	CLO1, CLO2
5.	Frequency analysis of discrete time signal, properties of DFT, circular convolution method: circle method, Matrix method, DFT-IDFT method.	Lecture, Discussion	Assignment	CLO2, CLO4
6.	Fast Fourier Transform, Radix-2 FFT Algorithm, Decimation in time FFT algorithm, Decimation in frequency FFT algorithm.	Lecture, Discussion	Exam	CLO4
7.	**Review and makeup class form week 1 to 6 and Mid-semester exam.**			CLO1, CLO2, CLO4
8.	Discrete-Time Systems; Block Diagram and Signal Flow Graph Representation of Digital Networks;	Lecture, Discussion	Class Test, Exam	CLO3
9.	Matrix Representation of Digital Networks; Basic Structures of IIR Systems: Direct Form, Cascade forms, Parallel Form; Transposed Forms.	Lecture, Discussion	Class Test	CLO3
10.	Basic Structures of FIR Systems; Finite Precision Effects; Tellegen's Theorem for Digital Filters and Its Applications.	Lecture, Discussion	Exam	CLO3, CLO5
11.	Digital Filters; Types of Digital Filters: FIR and IIR; Choosing between FIR and IIR Filters.	Lecture, Discussion	Assessment	CLO5
12.	Digital Filter Design Steps; Design of FIR Filters: Design of FIR Filters by Windowing, Design of Optimum Equiripple Linear-Phase FIR Filters Design of IIR Filters.	Lecture, Discussion	Assessment	CLO3, CLO5
13.	Classical Continuous-Time Low-Pass Filter Approximations, Conversion of Transfer Functions from Continuous to Discrete Time, Frequency Transformations of Low Pass Filters.	Lecture, Discussion	Assessment	CLO1, CLO3, CLO5
14.	**Review and makeup class form week 8 to 13 and Mid-semester exam.**			CLO1, CLO3, CLO5

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Continuous Assessment: Class Test, Assignment, Presentation, Quiz **Summative:** Mid-Semester and Semester Final Exam	1.	Attendance:	5%
	2.	Mid Semester Exam	20%
	3.	Class Test/ Assignment/Presentation/ Sudden Test/ Quiz/ Tutorial	15%
	4.	Semester Final Examination	60%
Make-up Procedures			
Repeat Course, Mid-Semester Incomplete Exam, Semester Final Incomplete Exam			
	Total:		100%

Learning Materials:

11. Introduction to Digital Signal Processing, Tatsuo Higuchi, Shoukoudou
12. Digital Signal Processing, Written by A.V. Oppenheim and R.W. Schafer, Translated by Hikaru Date, Koronasha
13. Digital Signal Processing -- Principles, Algorithms, and Applications, J.G. Proakis and D.G. Manolakis, Third Edition
14. Digital Signal Processing-Poornachandra.

BNQF Code: 06113203, Departmental Code: ICT-3203

Course Title: IT Management

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

The purpose of this course is to ensure students' understanding with the concepts of E-commerce and E-governance. The selection and implementation of technologies for better security and to focus on payment methods, internet strategies, shopping strategies and so on.

Course Objectives:

1. To provide the understanding of fundamental concepts of E-commerce and E-governance
2. To gather knowledge about various security technologies
3. To enhance understanding about different payment methods and on-line commerce environment.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Analyze the basic principles of E-commerce and E-governance
CLO2 Design a solid foundation in the basic concepts of online commerce environment.
CLO3 Analyze a substantial number of basic payment methods
CLO4 Apply the tools for implementing the rules of better governance in online.

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2	√	√										
CLO3				√								
CLO4					√							√

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Definition of e-Commerce, Defining B2B, B2C and C2C Commerce. Advantages & Disadvantages of e-commerce, Tools for enabling e-commerce.	Lecture, Discussion	Class Test	CLO1, CLO2
2.	E-commerce infrastructure, internet, Extranet, Intranet, WWW, WebPages & their Design, HTML, XML, WML, WAP., Electronic Data Interchange Standards EDIFACT, ANSI X12, Value Added Network Services.	Lecture, Discussion,	Class Test Exam	CLO1, CLO2
3.	Security Issues in e-Commerce, Symmetric Key Encryption, Digital Encryption Standards (DES), Public Key Encryption, RSA System.	Lecture, Discussion,	Class Test Exam	CLO1, CLO2

4.	Digital Signature, Digital Signature Certification Authority, MIME and MIME Standards, PGP for e-mail.	Lecture, Discussion,	Assignment Exam	CLO1, CLO2
5.	Electronic Payment Systems, Credit Cards, Electronic Funds Transfer, Electronic Cheque Payments, Electronic Cash, Issues in Cash Payment .	Lecture, Discussion	Class Test, Exam	CLO1, CLO2, CLO3
6.	Mobile commerce, MicroPayments over the Internet, Digital Watermark, C2C Commerce.	Lecture, Discussion	Exam	CLO1, CLO2, CLO3
7.	*Review and makeup class(if any) and Mid Term Exam 1 & Feedback*			
8.	Introduction to e-Governance, Analyzing the concept of e-Governance , Understanding the Relationship-governance and e-governance;:	Lecture, Discussion	Class Test, Exam	CLO1, CLO4
9.	E-Government at work: e-administration and e-services; e-democracy; Local e-government.	Lecture, Discussion	Class Test, Exam	CLO4,
10.	E-governance and democratic governance via the Internet; e-Governance and information systems in public administration and services	Lecture, Discussion	Exam	CLO4
11.	E-Governance applications in administration and planning	Lecture, Discussion	Exam	CLO4
12.	Information security and privacy protection; Future directions of e-governance.	Lecture, Discussion	Exam	CLO4
13.	Review	Lecture, Discussion	Exam	
14.	*Review and makeup class(if any) and Mid Term Exam 2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials:

1. E-Commerce Services and Application: A Practical Guide by Lee Sai Peck, Mohammad Zahidur Rahman.
2. E-Commerce by Smith R, Speaker M, & Thompson M (Prentice Hall, India)
3. E-Commerce by V Rajaraman
4. E-Governance: A Global Perspective on a New Paradigm by Toshio Obi (Editor), IOS Press
5. E-Governance: Styles of Political Judgement in the Informaton Age Polity by Perri 6, Palgrave Macmillan

BNQF Code: 06123205, Departmental Code: ICT-3205

Course Title: Optical Fiber Communication

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

This course mainly focuses on different types of fiber and their applications, light sources and detectors, couplers, splitters, wavelength-division multiplexers, and state-of-the-art devices used in the latest high-bandwidth communication systems.

Course Objectives

1. To learn the basic elements of optical fiber transmission link, fiberglass modes configurations and structures
2. To understand different kinds of losses, signal attenuation in optical fiber & other dispersion factor.
3. To learn various optical sources, LED/LASER structures, receivers (PIN, APD), and noise performance.
4. To understand of optical network system components, variety of networking aspects, SONET.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Understand optical network system components, variety of networking aspects.

CLO2 Differentiate losses in optical fiber link and state transmission characteristics of optical fiber.

CLO3 Design optical fiber communication links using appropriate optical fibers light sources, detectors.

CLO4 Explore concept of designing and operating principles of modern optical systems and networks

CLO5 Design and manage networks with appropriate consideration and SONET.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2		√										
CLO3			√									
CLO4	√											
CLO5			√									

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Basic Optical communication system, Advantages and application of optical fiber communication systems.	Lecture, Discussion	Class Test	CLO1
2.	Propagation in Dielectric waveguides: Slab waveguide, Modes in symmetric and asymmetric waveguide, coupling to the waveguide, Dispersion and distortion in the slab waveguide, integrated optic component.	Lecture, Discussion	Class Test	CLO1
3.	Attenuation in optical fiber: Introduction, attenuation, absorption, Rayleigh scattering, Pulse distortion and	Lecture, Discussion	Class Test	CLO1, CLO2

	information rate.			
4.	Optical fiber and fiber cables, Classification of fiber and fiber cables, step index fiber, graded index fiber, Description of modes and types of modes, Different type of modes,	Lecture, Discussion	Class Test	CLO1, CLO2
5.	Numerical aperture and multipath dispersion in step-index and graded index fiber, Construction of fiber and fiber optic cable.	Lecture, Discussion	Assignment	CLO2
6.	Light sources: LED, LD, Optical amplifiers, fiber laser, vertical cavity surface-emitting laser diodes.	Lecture, Discussion	Exam	CLO2, CLO3
7.&8.	***Mid Term Exam***			CLO1, CLO2, CLO3
9.	Light detectors: Photo detection, photomultiplier, semiconductor photodiode, PIN photo diode, Avalanche photodiode, and their comparison.	Lecture, Discussion	Class Test, Exam	CLO3
10.	Coupler and connectors: Connector principle, fiber end preparation, splices, connectors, source coupling, loss mechanism.	Lecture, Discussion	Class Test	CLO4
11.	Network distribution and fiber components: Direction coupler, star coupler, optical switches, wavelength converters, isolator, Attenuators, circulator, polarization, port configuration of coupler, fiber Bragg grating, Array wave guide gratings, diffraction gratings.	Lecture, Discussion	Exam	CLO5
12.	Noise and detection: Thermal and shot noise's, error rates, receiver circuit design, coherent optical fiber detection system, optic heterodyne receivers.	Lecture, Discussion	Assessment	CLO5
13	System design: analogue and digital system design, few practical problem and example, application of fiber optic communication in telecommunication.	Lecture, Discussion	Assessment	CLO5
14.	Optical Communication: Optical Communication system with analog and digital modulation formats; performance and system budgets; Multi channel system. **Review and Makeup class (if any)**	Lecture, Discussion	Assessment	CLO5
15.&16.	***Final Term Exam & Feedback***			CLO3, CLO4, CLO5

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	10%
	2.	Mid Term	
		a. Class Test:	5%
		b. Assignment/Presentation:	5%
		c. Exam	30%
Make-up Procedures	3.	Final Term	

Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam		a. Class Test	5%
		b. Assignment/ Presentation:	5%
		c. Exam	40%
	Total:		100%

Learning Materials

1. *John M. Senior ,Optical Fiber Communication.*
2. *D. K. Mynbaev, Fiber Optic communication teach*

BNQF Code: 06123207, Departmental Code: ICT-3207

Course Title: Telecommunication Engineering

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

The main goal of this course is to provide a comprehensive coverage of different mobile services and adequate knowledge in cellular communication, adequate mastery in solving technical problems. This comprehensive course is designed for undergraduate students to address all major segments of wireless & cellular telecommunications. This course will satisfy a 100-level requirement for courses in computer science and engineering for undergraduate majors.

Course Objectives:

1. To address the evaluation of fundamental and advanced Internet and software technologies relevant for E-Commerce.
2. To describe, identify and classify E-Commerce applications and systems.
3. To classify and identify existing and emerging E-Commerce business models.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1	Recognize and identify the GSM, GPRS and Bluetooth software model for mobile computing.
CLO2	Demonstrate applications that are mobile-device specific and demonstrate current practice in mobile computing contexts.
CLO3	Categorize the characteristics and limitations of mobile hardware devices including their user-interface modalities.
CLO4	Analyze QoS over wire and wireless channels.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1			√									
CLO2		√										
CLO3			√									
CLO4			√									

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	History and evolution of mobile radio systems.	Lecture, Discussion	Class Test	CLO1, CLO2
2.	Types of mobile wireless services/systems –Cellular, WLL, Paging	Lecture, Discussion	Class Test	CLO1, CLO2
3.	Satellite systems, Standard, Future trends in personal wireless systems.	Lecture, Problem Solving	Assignment	CLO1, CLO2
4.	Cellular concept and frequency reuse, Multiple Access Schemes.	Lecture, Problem Solving	Exam	CLO1

5.	Channel assignment and handoff, Interface and system capacity, Trunking and Erlang capacity calculations.	Lecture, Problem Solving	Exam	CLO1
6.	Radio wave propagation issues in personal wireless systems, Propagation models.	Lecture, Problem Solving	Exam	CLO4
7.	*Mid Term Exam 1 & Feedback*			
8.	Multipath fading and based and impulse models, Parameters of mobile multipath channels, Antenna systems in mobile radio.	Lecture, Discussion Problem Solving	Class Test, Exam	CLO4
9.	Analog and digital modulation techniques, Performance of various modulation techniques –Spectral efficiency, Error rate.	Lecture, Discussion Problem Solving	Class Test	CLO3
10.	Power Amplification, Equalization/Rake receiver concepts	Lecture, Discussion	Exam	CLO3
11.	Diversity and Space-time processing, Speech coding and channel coding	Lecture, Discussion Problem Solving	Exam	CLO3
12.	Multiple Access Techniques –FDMA, TDMA and CDMA systems.	Lecture, Discussion Problem Solving	Exam	CLO3
13.	Operational systems, Wireless networking, design issues in personal wireless systems.	Lecture, Discussion Problem Solving	Assessment	CLO3
14.	*Mid Term Exam 2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	10%
	2.	Mid Term	20%
	3.	Class Test	5%
	4.	Assignment/Presentation:	5%
Make-up Procedures	5.	Final Term	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials:

1. *Jochen Schiller,* "*Mobile communications*", *2nd Ed., Addison-Wesley, Pearson Education, 2003.*
2. *W. Stallings,* "*Wireless Communications and Networks*", *2nd Ed., Pearson Prentice Hall, 2005.*
3. *Theodore S Rappaport, "Wireless communications principle and practice", 2nd Ed, Prentice Hall PTR, 2007.*
4. *John Proakis, "Digital Communication", 4th Ed, McGraw-Hill Science/Engineering/Math, 2005.*

BNQF Code: 06133209, Departmental Code: ICT-3209

Course Title: Artificial Intelligence

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** Structured Programming, Data Structure, Algorithm, OOP.

Rationale:

This course will introduce the basic principles in artificial intelligence research. It will cover simple representation schemes, problem solving paradigms, constraint propagation, and search strategies. Areas of application such as knowledge representation, natural language processing, expert systems, vision and robotics will be explored. The Prolog and Python programming language will also be introduced for corresponding lab courses.

Course Objectives:

1. Provide you with understanding of the role of Artificial Intelligence, Expert Systems and Decision Models in managerial decision-making
2. Develop abilities to apply, build and modify decision models to solve real problems
3. Explore the issues involved in the design and development of Artificial Intelligence Based Decision Support Systems and discuss the role these systems play in the business environment
4. Gain an In-Depth Knowledge of a particular type of Artificial Intelligence Technique, namely Genetic Algorithms
5. Gain the knowledge to build a prototype Artificial Intelligence Based Decision Support System

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1	Represent knowledge using propositional calculus and predicate calculus.
CLO2	Use inference rules to produce predicate calculus expression.
CLO3	Solve problems using search techniques: depth-first, breadth-first, forward chaining, backward chaining, best-first, branch-and-bound, and-or-graph, and heuristic search
CLO4	Analyze and design a fuzzy logic system using fuzzy logic tool box
CLO5	Analyze and design a neural network system using neural network toolbox
CLO6	Analyze and design a rule-based expert system
CLO7	Design a machine vision system application

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2		√										
CLO3				√								
CLO4			√									
CLO5			√									
CLO6			√									
CLO7					√							

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO

1.	Course Introduction, Grading policies, exams, and concept of Artificial Intelligence, Introduction to AI, Understand the fundamental ideas and concepts of AI, Know about the initial experiments and future scopes of AI	Lecture, Discussion	Class Test, Quiz, Final Exam	CLO1
2.	Intelligent Agents: Explain about agent and rational agents, Define PEAS for any given agent, Explain about different kinds of Agents' Environments, Differentiate between different kinds of agents	Lecture, Discussion	Class Test, Quiz, Final Exam	CLO1
3.	Solving Problem by Searching: Apply Uninformed search algorithms on given problems, Analysing the performances of different algorithms	Lecture, Discussion & Problem Solving	Class Test, Quiz, Presentation, Final Exam	CLO1, CLO3
4.	Informed Search: Explain Heuristic functions for some toy problems, Simulate and apply A* search and SMA* on a given problem, explain about Hill Climbing Search, explain about Local Search, Apply Local search on a given problem, explain about Genetic Algorithm to solve a problem. Online Search Agents and Unknown Environments.	Lecture, Discussion & Problem Solving	Class Test, Assignment, Presentation, Instant Test, Final Exam	CLO1, CLO3
5.	***Class Test 01***			CLO1, CLO3
6.	Game Playing: Evaluate utility functions of some basic game playing algorithms, apply greedy and minimax algorithm on some popular turn taking games, Static board evaluation Adversarial Search: Optimal Decisions in Games, Alpha-Beta Pruning, Imperfect, Real-Time Decisions, Games That Include an Element of Chance.	Lecture, Discussion & Problem Solving	Class Test, Assignment, Presentation, Instant Test, Final Exam	CLO3, CLO4
7.	Expert system architecture, Rule-based system Architectures, Representation and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.	Lecture, Discussion & Problem Solving	Class Test, Assignment, Presentation, Instant Test, Final Exam	CLO2, CLO6, CLO7
8.	Logical Agents: Explain about Logical agents, Apply First Order Propositional Logic to infer new knowledge. Knowledge and Reasoning: Knowledge-Based Agents, The Wumpus World, Propositional Logic and Predicate Logic, Knowledge Representation.	Lecture, Discussion & Problem Solving	Class Test, Assignment, Presentation, Instant Test, Final Exam	CLO2, CLO4, CLO6, CLO7
9.	Uncertainty: Explain about uncertain features of real world, Explain Kolmogorov's axioms, Probability and Conditional Probability, Dependent and independent conditional probability, Bayes Theorem to take decision in some uncertainty-based problems Learning: Learning from Observations, Knowledge in Learning, Statistical Learning Methods, Reinforcement Learning.	Lecture, Discussion & Problem Solving	Class Test, Assignment, Presentation, Instant Test, Final Exam	CLO4, CLO8
10.	***Class Test 02***			CLO2, CLO3, CLO4, CLO6,

				CLO7
11.	Fuzzy Logic Systems: Fuzzy Logic Systems Architecture, Example of a Fuzzy Logic System, Application Areas of Fuzzy Logic Artificial Neural Network: Basic Structure of ANNs, Types of Artificial Neural Networks, Machine Learning in ANNs, Back Propagation Algorithm, Bayesian Networks (BN), Application	Lecture, Discussion & Problem Solving	Assessment, Instant Test, Final Exam	CLO4, CLO5, CLO7
12.	Natural Language Processing: Components of NLP, Steps in NLP, Implementation Aspects of Syntactic Analysis. Perception: Image Formation, Early Image Processing Operations, Extracting Three-Dimensional Information, Object Recognition, Statistical language models Robotics: Robotic Perception, Planning to Move, planning uncertain movements, Moving.	Lecture, Discussion & Problem Solving	Assessment, Instant Test, Final Exam	CLO4, CLO5, CLO7
13	Neural Network: Fundamental ideas about Neural Network, Threshold and activation function,Single neuron functionality, Architecture of Neural network, Different types of activation functions, Backpropagation, Error calculation methods	Lecture, Discussion & Problem Solving	Assessment, Final Exam	CLO5, CLO7
14.	Review	Lecture, Discussion, Problem Solving		CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7, CLO8
15.&16.	***Final Term Exam & Feedback***			CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7, CLO8

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance:	5%
		b. Assignment/Presentation:	5%
		c. Quiz / Instant Test	5%
		d. Class Performance	5%
		e. Class Test / Mid Term	20%

Make-up Procedures	2.	**Final Exam**	**60%**
	Total:		**100%**

Learning Materials:

1. Stuart Russell and Peter Norvig, Artificial Intelligence A Modern Approach
2. E. Ritch and K. Knight, Artificial Intelligence
3. Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, Eastern Economy Edition by G. A. Vijayalakshmi Pai and Sanguthevar Rajasekaran.
4. D. W. Patterson, Introduction to AI

BNQF Code: 06123202, Departmental Code: ICT-3202

Course Title: Digital Signal Processing Sessional

Credit Hr.: 1.0, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**): None**

Rationale:

This course aims to analyze, synthesize and modify audio, video, image and communication signals of LTI systems and implementation of various conversion, translation, signal processing etc. techniques using MATLAB.

Course Objectives:

1. Identify and plot various discrete signals.
2. Implement the principles of z-transforms to finite difference equations.
3. Implementation of Fourier transforms to analyze the frequency characteristics of discrete-time signals.
4. Use computer programming tools to process and visualize signals
5. Implementation of discrete time systems.

Course Learning Outcomes (CLO):

After completing the course, students will able to:

CLO1 Use Matlab to create, display, and analyze signals in the time-domain.

CLO2 Use Matlab to analyze and display signals in the frequency-domain using the FFT algorithm to model the DTFT as well as for spectral analysis using the DFT.

CLO3 Perform convolution and simulate LTI systems and difference equations.

CLO4 Plot pole-zero diagrams for LTI systems with rational transforms, use Matlab to study properties of the z-transform and its relationship to stability.

CLO5 Design FIR and IIR Filters using Matlab to meet specifications on their frequency response using window design, frequency sampling design, and the bilinear transformation

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLOs	PLOs											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1					√							
CLO2					√							
CLO3				√	√							
CLO4					√							
CLO5				√	√						√	

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Implementation and analysis of Sampling and Analog-to-Digital Conversion.	Lecture, Discussion	Lab Test	CLO1
2.	Analyze and plotting of various Discrete Time Signals.	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO1
3.	Implementation of Convolution and Correlation	Lecture, Discussion,	Lab Test,	CLO3

		Lab assignment	Lab Report	
4.	Find the General Results of z-transform	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO4
5.	Apply Inverse z-Transform with Partial Fraction Expansion	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO4
6.	Apply Inverse z-Transform with Power Series Expansion, Contour Integration	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO4
7.	**Review and makeup class form week 1 to 6 and Mid-semester exam (Quiz and Viva).**			CLO1, CLO3, CLO4
8.	Frequency analysis of discrete time signal, properties of DFT	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO2
9.	Implement circular convolution method with circle method, Matrix method	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO2
10.	Implement circular convolution method with DFT-IDFT method	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO2
11.	Implementation of Fast Fourier Transform, Radix-2 FFT Algorithm	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO2
12.	Implementation of Decimation in time FFT algorithm, Decimation in frequency FFT algorithm	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO2, CLO5
13.	Design of FIR Filters by Windowing	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO5
14.	**Review and makeup class form week 8 to 13 and Mid-semester exam (Quiz and Viva).**			CLO2, CLO5

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Report, Class Performance **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance:	5%
		b. Instant Test / Class Performance	10%
		c. Class Test	20%
		d. Report	5%
Make-up Procedures	2.	**Final Exam**	**60%**
		a. Viva	20%
		b. Final Lab Exam	40%
	Total:		**100%**

Learning Materials:

1. Introduction to Digital Signal Processing, Tatsuo Higuchi, Shoukoudou
2. Computer-Based Exercises for Signal Processing Using MatLab, C.S. Burrus and et al, ISBN 0-13-364845-1, Prentice Hall, 1994
3. Digital Signal Processing, Written by A.V. Oppenheim and R.W. Schafer, Translated by Hikaru Date, Koronasha
4. Digital Signal Processing -- Principles, Algorithms, and Applications, J.G. Proakis and D.G. Manolakis, Third Edition
5. Digital Signal Processing-Poornachandra.

BNQF Code: 06123206, Departmental Code: ICT-3206

Course Title: Optical Fiber Communication Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any)**:** None

Rationale:

Optical fiber communication is a critical technology that underpins modern telecommunications, providing high-speed, reliable data transmission over long distances. This laboratory course is designed to provide students with hands-on experience in working with optical fiber systems, components, and equipment. It aims to bridge the gap between theoretical knowledge and practical application, allowing students to gain skills and confidence in working with optical communication technologies.

Course Objectives:

1. To Setup and configure optical fiber communication systems.
2. To Measure and analyze optical power, loss, and dispersion in optical fibers.
3. To Understand the principles of optical signal modulation and demodulation
4. To Gain hands-on experience with optical fiber splicing and connectors.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Identify the fundamental principles of optical fiber communication..

CLO2 Operate optical communication equipment, including optical sources, detectors, and signal processing devices

CLO3 Apply critical thinking skills to diagnose and resolve issues in optical fiber communication systems.

CLO4 Demonstrate an understanding of safety precautions when working with lasers and high-power optical equipment.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	POL2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2					√							
CLO3			√									
CLO4				√		√						

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy				
Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Fiber Optic Data Links	Lecture, Discussion	Performance Test	CLO1
2.	Fiber to Fiber Joints and OTDR	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1
3.	Numerical Aperture	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1
4.	Misalignment Losses	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2
5.	Linear Attenuation	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2
6.	Injection Losses	Lecture, Group Discussion	Performance Test, Lab Report	CLO2
7 .	*Review and makeup class and Mid Term Exam 1 (Quiz and Viva) & Feedback*			
8.	Connector Losses	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2, CLO3
9.	Characteristics of a LED	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO3
10.	Photodetector Characteristics	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO3
11.	Transmission of Information	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO3
12.	Eye pattern measurement	Lecture, Group Discussion	Performance Test, Lab Report	CLO3
13.	Eye pattern measurement *Review and makeup class (If any)*	Group Discussion	Lab Presentation	CLO3
14.	*Review and makeup class and Mid Term Exam 2 (Quiz and Viva) & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Continuous Assessment: Class Test, Assignment, Presentation **Summative:**	Sl.	Category	Mark %
	1.	Attendance:	
	2.	Mid Term	
		a. Quiz:	
		b. Viva:	
		c. Performance Test:	
		d. Lab Report:	
Make-up Procedures	3.	Final Term	
		a. Quiz:	
		b. Viva:	
		c. Performance Test:	
		d. Lab Report:	
	Total:		100%

Learning Materials:

1. *John M. Senior ,Optical Fiber Communication.*
2. *D. K. Mynbaev, Fiber Optic communication teach*

Recommended Readings: 1. Supplementary Read: 2, 3.

BNQF Code: 06133210, Departmental Code: ICT-3210

Course Title: Artificial Intelligence Sessional

Credit Hr.: 1.0, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** Structured Programming Lab, Data Structure Lab, Algorithm Lab, OOP Lab.

Rationale:

This course will introduce the practical application and way of implementation in artificial intelligence research. It will cover simple representation schemes, problem solving paradigms, constraint propagation, and search strategies. Areas of application such as knowledge representation, natural language processing, expert systems, vision and robotics will be explored. The Prolog and Python programming language will be used for solving AI related problems.

Course Objectives:

1. Provide you with understanding of the role of Artificial Intelligence, Expert Systems and Decision Models in managerial decision-making
2. Develop abilities to apply, build and modify decision models to solve real problems
3. Explore the issues involved in the design and development of Artificial Intelligence Based Decision Support Systems and discuss the role these systems play in the business environment
4. Gain an In-Depth Knowledge of a particular type of Artificial Intelligence Technique, namely Genetic Algorithms
5. Gain the knowledge to build a prototype Artificial Intelligence Based Decision Support System

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1	Learn about the role and place of Prolog in the area of Artificial Intelligence (AI), and in programming-language research more in general
CLO2	Learn the basic principles of Prolog by doing a number of exercises
CLO3	Solve problems using search techniques: depth-first, breadth-first, forward chaining, backward chaining, best-first, branch-and-bound, and-or-graph, and heuristic search
CLO4	Analyze and design a fuzzy logic system using fuzzy logic tool box
CLO5	Analyze and design a neural network system using neural network toolbox
CLO6	Analyze and design a rule-based expert system
CLO7	Design a machine vision system application

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2		√										
CLO3				√								
CLO4			√									
CLO5				√								
CLO6				√								
CLO7			√									

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning	Assessment	CLO

		Strategy	Strategy	
1.	AI and programming languages; PROLOG under Windows and Unix; PROLOG exercises:	Lecture and Hand on practice with Prolog. Student form team for the project and fill the team information.	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam.	CLO1, CLO2
2.	Implement knowledge base representation using Prolog.	Lecture and Hand on practice with Prolog, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam.	CLO1, CLO2
3.	Discuss the basics of Python and Google Colab.	Work using Jupyter notebook and Google Colab, Problem solving exercise, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam.	CLO3, CLO7
4.	Implement basic search algorithms	Review exercises, Solve computational problems using Google Colab / Python, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam.	CLO3
5.	***Class Test 01***			CLO1, CLO2, CLO3, CLO7
6.	Implement Uninform search algorithms	Review exercises, Solve computational problems using Google Colab / Python, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam.	CLO3
7.	Implement Inform search algorithms	Review exercises, Solve computational problems using Google Colab / Python, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam.	CLO3
8.	Implement Heuristic search algorithms	Review exercises, Solve computational problems using Google Colab /	Instant Test, Class Performance, Class Test,	CLO3, CLO8

		Python, Project Update	Report Writing. Final Term Exam.	
9.	Implement Adviserial search algorithms and Genetic search algorithms.	Review exercises, Solve computational problems using Google Colab / Python, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam.	CLO3
10.	***Class Test 02***			CLO3, CLO8
11.	Implement Constrain Satisfaction Problem (CSP) algorithms	Review exercises, Solve computational problems using Google Colab / Python, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam.	CLO5, CLO6
12.	Implement ANN and NLP related algorithms	Review exercises, Solve computational problems using Google Colab / Python, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam.	CLO4, CLO5, CLO6
13	Implement RNN and NLP related algorithms	Review exercises, Solve computational problems using Google Colab / Python, Project Update	Instant Test, Class Performance, Class Test, Report Writing. Final Term Exam..	CLO4, CLO5, CLO6, CLO7
14.	Review	Discussion, Problem Solving		CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7, CLO8
15.&16.	***Final Term Exam & Project Showcasing***			CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7, CLO8

Assessment Strategy	Course Evaluation Process and Mark Distributions		
Exam **Continuous Assessment:** Class Test, Report, Class Performance **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance:	5%
		b. Instant Test / Class Performance	10%
		c. Class Test	20%
		d. Report	5%
Make-up Procedures	2.	**Final Exam**	**60%**
		a. Viva	20%
		b. Final Lab Exam	40%
	Total:		**100%**

Learning Materials:

1. Programming with Python, T.R. Padmanabhan, Springer, 2016
2. Prolog programming for artificial intelligence. Bratko, I., 2001. Pearson education.
3. Intro to Python for Computer Science and Data Science, Daitel & Daitel, Pearson 2020
4. Machine Learning: Step-by-Step Guide to Implement Machine Learning Algorithms with Python by Russell, Rudolph

BNQF Code: 06124101, Departmental Code: ICT-4101
Course Title: Wireless and Mobile Communication

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale

The purpose of this course is to increase students' knowledge and understanding in wireless and mobile communication associated with cellular radio system, multiple access techniques, error detection & correction, wireless networks, digital mobile communication standards etc.

Course Objectives

1. To deepen the knowledge of wireless and mobile communication
2. To know the basic elements of cellular radio system
3. To enhance students' understanding on various modulation techniques and error correction.
4. To gather knowledge about wireless networks and mobile communication systems.

Course Learning Outcomes (CLO)

After completing the course, students will be able to:

CLO1 Explain the basic concepts, evolution, devices and operations of wireless and mobile communication.

CLO2 Summarize the fundamental features of cellular radio system.

CLO3 Incorporate standards of mobile communication system.

CLO4 Understand the basics of modulation techniques such as FDMA, TDMA, CDMA, etc.

CLO5 Describe wireless LAN, Wi-Fi, Wi-MAX, mobile ad-hoc network and so on.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLOs	PLOs											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2		√										
CLO3			√									
CLO4			√									
CLO5				√								

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Concept, History of wireless communication, Evolution and fundamentals of Mobile Communication, Mobile and Wireless devices. A market for mobile communications, mobile system architecture, design, performance and operation, antenna at cell site and mobile antenna.	Lecture, Discussion	Class Test	CLO1
2.	Radio wave propagation: Propagation characteristics, EIRP, models for radio propagation, Fresnel zone, reflection, diffraction, scattering, fading, modeling of multipath channel.	Lecture, Discussion	Class Test	CLO1, CLO2
3.	Basic Elements of a Cellular Radio System/Network, Principles of Operations, Concept of cell and cell cluster, improving the capacity of a system, frequency reuse, cell splitting and sectoring, co-site, co-channel and adjacent channel interferences	Lecture, Discussion	Class Test	CLO2

4.	Hand off and dropped calls, frequency allocation techniques, improving coverage and capacity in cellular systems, concept of BTS, BSC and MSC, roaming, planning of mobile cellular networks.	Lecture, Discussion	Class Test	CLO2
5.	Introduction to Digital modulation techniques, modulation methods in cellular wireless systems, OFDM. Block coding, convolution coding and Turbo coding.	Lecture, Discussion	Assignment	CLO4
6.	Multiple access techniques: FDMA, TDMA, CDMA, CDMA capacity, probability of bit error considerations, CDMA compared with TDMA.	Lecture, Discussion	Exam	CLO4
7.	**Review and makeup class form week 1 to 6 and Mid-semester exam.**			CLO1, CLO2, CLO4
8.	Spread spectrum principle, Direct Sequence Spread Spectrum (DSSS), System model, Spreading codes for ISE rejection,	Lecture, Discussion	Class Test, Exam	CLO3, CLO4
9.	RAKK receiver, Frequency Hopping Spread spectrum (FHSS).	Lecture, Discussion	Class Test	CLO4
10.	Wireless LAN, IEEE 802.11 Standards, Architecture, Services, Mobile Ad hoc Networks, WiFi and WiMAX, Wireless Local Loop	Lecture, Discussion	Exam	CLO5
11.	GSM architecture, Location tracking and call setup, Mobility management, Handover, Security of GSM, SMS, International roaming for GSM, call recording, functions subscriber, and service data management,	Lecture, Discussion	Class Test	CLO3, CLO5
12.	Mobile Number portability, VoIP service for Mobile Networks, GPRS Architecture, GPRS procedures, attach and detach procedures, PDP context procedure, combined RA/LA update procedures, Billing.	Lecture, Discussion	Assignment	CLO3
13.	**Digital mobile communication standards:** GSM, GPRS, EDGE, CDMA, 3G, Wi-Fi, WiMAX and 4G systems, mobile IP and VoIP, wireless sensor networks.	Lecture, Discussion	Assignment	CLO3, CLO5
14.	**Review and makeup class form week 8 to 13 and Mid-semester exam.**			CLO3, CLO4, CLO5

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Continuous Assessment: Class Test, Assignment, Presentation **Summative:** Mid-Semester and Semester Final Exam	1.	Attendance:	5%
	2.	Mid Semester Exam	20%
	3.	Class Test/ Assignment/Presentation:	15%
	4.	Semester Final Examination	60%
Make-up Procedures			
Repeat Course, Mid-Semester Incomplete Exam, Semester Final Incomplete Exam			
	Total:		100%

Learning Materials:

15. Wireless Communication Principle and Practice by T.S. Rappaport
16. Fundamentals of Wireless Communications, David Tse, PramodViswanath
17. Mobile Communication by Jochen Schiller
18. Wireless and Mobile Network Architectures by Yi bing Lin
19. Mobile Communications Design Fundamentals by William C.Y Lee
20. Wireless Communications, Andrea

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

Machine learning is one of the fastest growing areas of computer science, with far-reaching applications. The aim of this course is to introduce machine learning, and the algorithmic paradigms it offers, in a principled way. The course provides a theoretical account of the fundamentals underlying machine learning and the mathematical derivations that transform these principles into practical algorithms.

Course Objectives:

1. To introduce key concepts in pattern recognition and machine learning; including specific algorithms for classification, regression, clustering, and probabilistic modeling.
2. To give a broad view of the general issues arising in the application of algorithms to analyzing data, common terms used, and common errors made if applied incorrectly.

Course Learning Outcomes (CLO):	
After completing the course, students will be able to:	
CLO1	State-of-the-art algorithms such as Support Vector Machines and Bayesian networks
CLO2	Kernel methods for handling high dimensional and non-linear patterns
CLO3	Theoretical concepts and the motivations behind different learning frameworks
CLO4	Key concepts, tools, and approaches for pattern recognition on complex data sets
CLO5	Be able to solve real-world machine learning tasks: from data to inference.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	**PLO**											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√	√										
CLO2		√		√								
CLO3	√		√									
CLO4					√	√						
CLO5									√			√

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Introduction: Definition of learning systems. Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation.	Lecture, Discussion	Assignment	CLO4, CLO5
2.	Inductive Classification: The concept learning task. Concept learning as search through a hypothesis space. General-to-specific ordering of hypotheses. Finding maximally specific hypotheses. Version spaces and the candidate elimination algorithm. Learning conjunctive concepts. The importance of inductive bias	Lecture, Discussion	Assignment	CLO4, CLO3

3.	Decision Tree Learning: Representing concepts as decision trees. Recursive induction of decision trees. Picking the best splitting attribute: entropy and information gain. Searching for simple trees and computational complexity. Occam's razor. Overfitting, noisy data, and pruning.	Lecture, Discussion, Problem Solving	Class Test	CLO1, CLO2, CLO4
4.	Ensemble Learning: Using committees of multiple hypotheses. Bagging, boosting, and Decorate. Active learning with ensembles. Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing.	Lecture, Discussion	Assignment	CLO1, CLO2
5.	Computational Learning Theory: Models of learnability: learning in the limit; probably approximately correct (PAC) learning. Sample complexity: quantifying the number of examples needed to PAC learn.	Lecture, Discussion	Class Test, Assignment	CLO2
6.	Rule Learning: Propositional and First-Order: Translating decision trees into rules. Heuristic rule induction using separate and conquer and information gain. First-order Horn-clause induction (Inductive Logic Programming) and Foil. Learning recursive rules. Inverse resolution, Golem, and Progol.	Lecture, Discussion	Class Test	CLO2, CLO3, CLO5
7.	Artificial Neural Networks: Neurons and biological motivation. Linear threshold units. Perceptron: representational limitation and gradient descent training. Multilayer networks and backpropagation. Hidden layers and constructing intermediate, distributed representations. Overfitting, learning network structure, recurrent networks.	Lecture, Discussion	Class Test	CLO3, CLO4
8.	***Mid Term Exam***			
9.	Support Vector Machines: Maximum margin linear separators. Quadratic programming solution to finding maximum margin separators. Kernels for learning non-linear functions. Bayesian Learning: Probability theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression. Bayes nets and Markov nets for representing dependencies.	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1, CLO3, CLO4
10.	Instance-Based Learning: Constructing explicit generalizations versus comparing to past specific examples. k-Nearest-neighbor algorithm. Case-based learning. Text Classification: Bag of words representation. Vector space model and cosine similarity. Relevance feedback and Rocchio algorithm. Versions of nearest neighbor and Naive Bayes for text.	Lecture, Discussion Problem Solving	Class Test	CLO2, CLO4
11.	Clustering and Unsupervised Learning: Learning from unclassified data. Clustering. Hierarchical Agglomerative Clustering. k-means partitional clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labeled and unlabeled data.	Lecture, Discussion	Exam	CLO3, CLO4, CLO5
12.	Deep Feedforward Network: Gradient-based learning; Hidden units; Architectural design; Backpropagation	Lecture, Discussion Problem Solving	Assessment	CLO3, CLO5

	algorithms; Parameter norm penalties; Dataset augmentation; Early stopping. Structured Probabilistic models for Deep Learning: Challenges of unstructured modeling; Learning about dependencies; Inference and approximate inference; Sampling from graphical models.			
13	Language Learning: word-sense disambiguation, sequence labeling. Hidden Markov models (HMM's). Viterbi algorithm for determining most-probable state sequences. Forward-backward EM algorithm for training the parameters of HMM's. Use of HMM's for speech recognition, part-of-speech tagging, and information extraction. Conditional random fields (CRF's). Probabilistic context-free grammars (PCFG). Parsing and learning with PCFGs. Lexicalized PCFGs.	Lecture, Discussion Problem Solving	Assessment	CLO3, CLO4, CLO5
14.	**Review and Makeup class (if any)**	Lecture, Discussion Problem Solving	Assessment	CLO5
15.&16.	***Final Term Exam & Feedback***			CLO3, CLO4, CLO5

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		k. Attendance	5%
		l. Assignment/Presentation	5%
		m. Quiz/Instant Test	5%
		n. Class Performance	5%
		o. Class Test/Mid Term	20%
Make-up Procedures	2.	**Final Exam**	**60%**
	Total:		100%

Learning Materials:

1. *Pattern Classification (2nd ed.) Richard O. Duda, Peter E. Hart and David G. Stork September 3, 1997*
2. *Machine Learning, Tom M. Mitchell, McGraw-Hill International Editions Computer Science Series*
3. *Introduction to Artificial Neural Systems, 1st Edition by Zurada J.M., Publisher: West Publishing Company.*
4. *Introduction to Machine Learning by Alex Smola and S.V.N. Vishwanathan, Cambridge University Press, 2008.*

BNQF Code: 06114105, Departmental code: ICT-4105

Course Title: Research Methodology and Technical Writing

Credit Hr.: 2.00, **Contact Hr.:** 2.00, **Course Type:** Core

Pre-requisites (if any**):** None

Rationale:

The goal of this course is to train the students to critically evaluate a well-defined set of research subject and to summarize the findings concisely in a paper of scientific quality. The paper will be evaluated based on the ability to understand a topic, communicate it and identify issues. Results from this term paper will be presented to fellow students and a committee of faculty members. This course also gives students a working knowledge of technical writing and communication for ICT discipline. The students will know the mechanics of writing, including structure, style and clarity, as well as the conventions of scientific writing in Information and Communication Technology.

Course Objectives:

1. To introduce the language of research, ethical principles and challenges, and the elements of the research process within quantitative, qualitative, and mixed methods approaches to the students.
2. Student's will use these theoretical underpinnings to begin to critically review literature relevant to their field or interests and determine how research findings are useful in forming their understanding of their work, social, local and global environment.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Analyzing the nature of problem to be studied and identifying the related area of knowledge.
CLO2 Critique ethical principles of research, ethical challenges and approval processes
CLO3 Collecting data in an organized and controlled manner so as to arrive at valid decisions
CLO4 Reviewing literature to summarize how others have approached or dealt with the problem.
CLO5 organize and conduct research in a more appropriate manner

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2								√				
CLO3				√								
CLO4	√											√
CLO5	√											√

Course Content and Mapping CLOs with the Teaching-Learning & Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Introduction to Research Methodology	Lecture, Discussion	Class Test Exam Assignment	CLO1, CLO2, CLO5
2.	Research Process	Lecture, Discussion, Problem Solving	Collect a title of research proposal	CLO2, CLO4

3.	Research Process	Lecture, Discussion, Problem Solving	Collect a title of research proposal	CLO2, CLO4
4.	Sample design	Lecture, Problem Solving	Panel discussion	CLO4, CLO5
5.	Sample design	Lecture, Problem Solving	Panel discussion	CLO4, CLO5
6.	Data collection methods	Lecture, Discussion Problem Solving	Students are required to collect data related to their research proposal	CLO3
7.	*Review and makeup class(if any) and Mid Term Exam 1 & Feedback*			
8.	Data collection methods	Lecture, Discussion Problem Solving	Students are required to collect data related to their research proposal	CLO3
9.	Measurement: Scaling, reliability and validity	Interactive discussion	Group discussion	CLO1
10.	Measurement: Scaling, reliability and validity	Interactive discussion	Group discussion	CLO1
11.	Data Analysis	Lecture, Problem Solving	Presentation	CLO5
12.	Data Analysis	Lecture, Problem Solving	Presentation	CLO5
13.	Research Ethics	Lecture, Problem Solving	Question and answering session	CLO2
14.	*Review and makeup class(if any) and Mid Term Exam 2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Attendance, Class Test, Assignment, Presentation **Summative:** Mid Semester Exam and Final Semester Exam	SL	Category	Mark%
	1.	Attendance	5%
	2.	Class Test	5%
	3.	Assignment	5%
	4.	Presentation	5%
	5.	Mid Semester Exam	20%
Make-up Procedures	6.	Final Semester Exam	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials:

7. Research Methodology: C.R. Kothari
8. Research Methodology: Ranjit Kumar

BNQF Code: 06134107, Departmental Code: ICT-4107

Course Title: Big Data & Cloud Computing

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

In today's digital age, organizations are inundated with vast amounts of data from various sources, leading to the emergence of Big Data and Cloud Computing as critical technologies. Big Data provides the means to extract valuable insights from this data, while Cloud Computing offers scalable and flexible infrastructure for storage and computation. This course aims to provide students with a comprehensive understanding of both Big Data and Cloud Computing, their synergistic relationship, and how they can be harnessed to drive innovation and growth in modern businesses.

Course Objectives:

1. To equip students with a deep understanding of the concepts, principles, and technologies behind Big Data and Cloud Computing.
2. O familiarize students with the tools, frameworks, and platforms used in Big Data and Cloud Computing, empowering them to effectively work with large datasets, implement data processing workflows, and deploy applications in cloud environments.
3. To expose them to examples of applications and trade offs which typically occur in engineering system design, and to ask them to apply the knowledge in design problems.
4. To develop hands-on skills in utilizing key technologies such as Hadoop, MapReduce, Hive, HBase, and cloud platforms like AWS, Azure, and Google Cloud, ensuring students can practically implement Big Data and Cloud solutions.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1	Explain concepts and terminology related to Big Data and Cloud Computing.
CLO2	Describe the challenges with Big Data analysis and techniques used to perform Big Data analysis in the Cloud.
CLO3	Describe different types of Cloud platforms and their advantages and disadvantages for Big Data analysis such as scalability and performance in different contexts.
CLO4	Use a cloud-based platform to store, update, and manage Big Data.
CLO5	Create data-driven models for Big Data analysis based on existing frameworks.
CLO6	Suggest and provide reason for a suitable Cloud solution for a Big Data analysis problem.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	**PLO**											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2	√											
CLO3	√											
CLO4			√									
CLO5			√									
CLO6		√										

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy				
Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	**Introduction of Big Data:** Introduction, V's of Big Data, Big Data as an Opportunity, Big Data Analytics, Stages of Big Data Analytics, Types of Big Data Analytics, Big Data Analytics in Different Domains, Problems with Big Data Restaurant Analogy.	Lecture, Discussion	Class Test	CLO1
2.	**Hadoop Distributed File System:** What is Hadoop and how it works as a Solution, Hadoop Master-Slave Architecture, Name Node & Data Node, Secondary Name node & Checkpointing, HDFS Data Blocks, HDFS Replication, HDFS Read/Write Mechanism	Lecture, Discussion	Class Test	CLO1
3.	MapReduce, YARN, MapReduce Job Workflow, YARN Architecture, Hadoop Architecture, Hadoop Ecosystem, Hadoop Cluster Mode, Hadoop Ecosystem, MapReduce Last	Lecture, Discussion	Class Test	CLO1, CLO4
4.	**Sqoop Of Data:** Features of Sqoop, Sqoop Architecture, Import Sqoop Command, Export Sqoop Command, List Database Command, Flume Architecture.	Lecture, Discussion	Class Test	CLO1, CLO4
5.	**Dataset Processing System:** Pig, Pig vs MapReduce, Pig Architecture, Pig Components, Pig Data Models, Pig Commands, Hive, Hive Architecture, Hive Components, Metastore, Hive Commands, Type Systems, Hive Data Models, Hive Partitioning, Bucketing in Hive.	Lecture, Discussion	Assignment	CLO5
6.	**Hadoop Data Storing Process:** Basic of Database, Types of Database, SQL database, NoSql database, Types of NoSQL Databases, History of HBase, HBase vs RDBMS, Uses of HBase,	Lecture, Discussion Problem Solving	Exam	CLO2, CLO3
7.&8.	***Mid Term Exam***			CLO1, CLO2, CLO4, CLO5
9.	Companies Using HBase, HBase Operation, HBase Shell, Single Map,Multidimensional Map, Multidimensional Columns, Row vs Column Oriented Databases, HBase Data Models,	Lecture, Discussion Problem Solving	Class Test, Exam	CLO3
10.	HBase Physical Storage, HBase Architecture, HBase Components, HBase Read Write Mechanism, Compaction in HBase, HBase Shell, HBase Client API.	Lecture, Discussion Problem Solving	Class Test	CLO6
11.	**Cloud Computing:** Introduction to Cloud Computing, Cloud service Models, Cloud Deployment Models, Cloud Service Providers, Coud	Lecture, Discussion	Exam	CLO6

	Computing vs On Premise Infrastructure, Cloud Computing Myths.			
12.	**AWS**: Introduction of AWS. AWS Global Infrastructure (AZ, Edge Locations, Regions), AWS Service Domains, EC Instances in AWS, AWS S Storage Service, AWS IAM and KMS, AWS Networking and VPC, AWS CloudWatch,	Lecture, Discussion Problem Solving	Assessment	CLO6
13	**Microsoft Azure:** Introduction of Microsoft Azure, Azure Service Domains, Azure Sign UP and Launching VM, Azure Virtual Networks,	Lecture, Discussion Problem Solving	Assessment	CLO6
14.	Azure Virtual Networks Part, IoT on Azure, What Is GCP?, Sign Up To Google Console, GCP Infrastructure, Google Cloud Console, GCP Storage. **Review and Makeup class (if any)**	Lecture, Discussion Problem Solving	Assessment	CLO2, CLO3, CLO6
15.&16.	***Final Term Exam & Feedback***			CLO2, CLO3, CLO6

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	10%
	2.	Mid Term	
		a. Class Test:	5%
		b. Assignment/Presentation:	5%
		c. Exam	30%
Make-up Procedures	3.	Final Term	
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam		a. Class Test	5%
		b. Assignment/ Presentation:	5%
		c. Exam	40%
	Total:		100%

Learning Materials:

1. *Explain the Cloud Like I'm 10, Todd Hoff.*
2. *Cloud Computing For Dummies, Daniel Kirsch, Judith Hurwitz*
3. *Big Data A Revolution That Will Transform How We Live, Work, And Think, Viktor Mayer Schönberger, Kenneth Cukier*
4. *Big Data Techniques and Technologies in Geoinformatics, Hasan A. Karimi*

BNQF Code: 06124113, Departmental Code: ICT-4113

Course Title: Internet of Things

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** Basic Electrical Engineering, Microprocessor and Embedded System.

Rationale:

The Internet of Things (IoT) course equips students with knowledge of interconnected devices, data collection, and real-time communication. This understanding of IoT's impact on industries prepares students for a technology-driven world, enhancing problem-solving skills and innovative thinking. They learn to harness IoT's potential to optimize processes, increase efficiency, and create novel solutions, making them industry-ready with a competitive edge. Through hands-on experiences, students explore IoT's role in transforming various sectors, fostering adaptability in an evolving technological landscape. This course empowers students to contribute effectively to IoT's evolution, empowering them with skills essential for tomorrow's digital world..

Course Objectives:

1. Understand the fundamental concepts and principles of the Internet of Things (IoT), including its architecture and components.
2. Explore various communication protocols and technologies used in IoT systems, such as MQTT and CoAP.
3. Gain insight into IoT security challenges and strategies to protect connected devices and data.
4. Learn about data analytics and interpretation within IoT ecosystems, enabling informed decision-making.
5. Explore real-world applications of IoT in industries like healthcare, smart cities, agriculture, and manufacturing, fostering a broader perspective on its impact.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Understand the concepts and principles of IoT and its applications.
CLO2 Describe the components of IoT ecosystems, including sensors, connectivity, and data analytics.
CLO3 Analyze the challenges and opportunities in IoT implementation.
CLO4 Explain the security and privacy considerations in IoT.
CLO5 Evaluate IoT technologies and their impact on various industries.
CLO6 Apply IoT knowledge to propose solutions for real-world scenarios.
CLO7 Design a IoT system application

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	**PLO**											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2			√									
CLO3				√								
CLO4			√									
CLO5				√								
CLO6				√								
CLO7			√									

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Introduction to Internet of Things (IoT): Definition and evolution of IoT, Key components and technologies,	Lecture, Discussion	Class Test, Quiz, Instant	CLO1, CLO2

	Applications and significance of IoT.		Test, Final Exam	
2.	IoT architecture layers: perception, transport, processing, application: Communication protocols: MQTT, CoAP, HTTP, WebSocket, Data exchange formats: JSON, XML, Protocol Buffers.	Lecture, Discussion	Class Test, Quiz, Instant Test, Final Exam	CLO2, CLO4
3.	Sensor Networks and Data Collection: Wireless sensor networks (WSNs), Types of sensors and actuators, Data acquisition techniques and challenges.	Lecture, Discussion & Problem Solving	Class Test, Quiz, Assessment, Instant Test, Final Exam	CLO1, CLO2, CLO3
4.	Data Processing and Analytics in IoT: Edge computing vs. cloud computing, Data preprocessing and filtering, Real-time analytics and batch processing.	Lecture, Discussion & Problem Solving	Class Test, Quiz, Assessment, Instant Test, Final Exam	CLO2, CLO5
5.	***Class Test 01***			CLO1, CLO2, CLO3, CLO4, CLO5
6.	Connectivity Technologies: Wireless communication technologies: Wi-Fi, Bluetooth, Zigbee, LoRa, NB-IoT, Cellular networks and 5G in IoT. IoT Security and Privacy: Security challenges in IoT, Authentication and authorization, Encryption, secure bootstrapping, and intrusion detection.	Lecture, Discussion & Problem Solving	Class Test, Assessment, Presentation, Instant Test, Final Exam	CLO1, CLO2, CLO4, CLO5
7.	IoT Prototyping and Development Platforms: Introduction to IoT development boards, IoT platforms: Arduino, Raspberry Pi, NodeMCU, Hands-on project: Setting up a basic IoT system	Lecture, Discussion & Problem Solving	Class Test, Presentation, Instant Test, Final Exam	CLO2, CLO6, CLO7
8.	Data Management and Storage in IoT: Data storage options: databases, NoSQL, time-series databases, Data lifecycle management, Scalability and data retention strategies. IoT Standards and Interoperability: Industry standards and alliances: IEEE, IETF, OCF, AllSeen Alliance, Interoperability challenges and solutions, IoT ecosystems and vendor lock-in	Lecture, Discussion & Problem Solving	Class Test, Assessment, Presentation, Instant Test, Final Exam	CLO3, CLO4
9.	IoT Applications in Smart Cities: Smart city concepts and challenges, Urban infrastructure monitoring, traffic management, waste management, Case studies of successful smart city implementations.	Lecture, Discussion & Problem Solving	Class Test, Assessment, Instant Test, Final Exam	CLO6, CLO7
10.	***Class Test 02***			CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7
11.	IoT Applications in Healthcare and Agriculture: Remote patient monitoring and telehealth, Precision agriculture and smart farming, Wearable devices and sensors for health monitoring.	Lecture, Discussion & Problem Solving	Assessment, Presentation, Instant Test, Final Exam	CLO6, CLO7
12.	Industrial IoT (IIoT) and Industry 4.0: Industry 4.0 principles and technologies, Predictive maintenance and asset tracking, Smart factories and supply chain optimization.	Lecture, Discussion & Problem Solving	Assessment, Presentation, Instant Test, Final Exam	CLO6, CLO7
13	Future Trends and Ethical Considerations: Emerging trends in IoT: AI integration, edge AI, blockchain, Ethical implications: privacy, data ownership, environmental impact, Discussion on IoT's role in shaping the future	Lecture, Discussion & Problem Solving	Instant Test, Final Exam	CLO1, CLO2, CLO3, CLO4, CLO5,

				CLO6
14.	Review	Lecture, Discussion, Problem Solving		CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7
15.&16.	***Final Term Exam & Feedback***			CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		g. Attendance:	5%
		h. Assignment/Presentation:	5%
		i. Quiz / Instant Test	5%
		j. Class Performance	5%
		k. Class Test / Mid Term	20%
Make-up Procedures	2.	**Final Exam**	**60%**
	Total:		**100%**

Learning Materials:

1. "Building the Internet of Things" by Maciej Kranz
2. "Internet of Things: Principles and Paradigms" by Rajkumar Buyya
3. "IoT Solutions in Microsoft's Azure IoT Suite: Data Acquisition and Analysis in the Real World" by Scott Klein and Bill Ramos
4. "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes and Gonzalo Salgueiro

BNQF Code: 06124102, Departmental Code: ICT-4102

Course Title: Wireless and Mobile Communication Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**): 0612-4101**

Rationale:

The purpose of this course is to increase students' practical knowledge and understanding in wireless and mobile communication associated with cellular radio system, multiple access techniques, error detection & correction, wireless networks, digital mobile communication standards etc.

Course Objectives:

1. To deepen the knowledge about wireless and mobile communication technologies and devices.
2. To know the basic elements used in cellular radio system.
3. To enhance students' practical knowledge on various modulation and demodulation techniques.
4. To gather practical knowledge about wireless networks and mobile communication systems.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Study various devices and technologies of wireless and mobile communication.

CLO2 Study and apply DSSS and FHSS Modulation and Demodulation Techniques.

CLO3 Study and apply the modulation techniques such as FDMA, TDMA, CDMA, etc.

CLO4 Study and apply Orthogonal Frequency Division Multiplexing (OFDM) modulation and demodulation.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLOs	PLOs											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1					√							
CLO2				√	√							
CLO3					√							
CLO4				√	√							

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Fundamental elements used in wireless communication.	Lecture, Discussion	Lab Test	CLO1
2.	Mobile and wireless device analysis	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO1
3.	Study radio wave propagation characteristics	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO1
4.	Concept of cellular radio system: cell cluster, frequency reuse	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO1
5.	Concept of cellular radio system: cell splitting, cell sectoring	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO1

6.	Handoff mechanism, roaming	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO1
7.	**Review and makeup class form week 1 to 6 and Mid-semester exam.**			CLO1
8.	Implementation and study of OFDM	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO4
9.	Block coding and convolutional coding	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO4
10.	Study and implementation of FDMA, TDMA technique	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO3
11.	Study and implementation of CDMA technique	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO3
12.	Implementation of DSSS, FHSS	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO2
13.	VoIP service for mobile communication	Lecture, Discussion, Lab assignment	Lab Test, Lab Report	CLO4
14.	**Review and makeup class form week 8 to 13 and Mid-semester exam.**			CLO2, CLO3, CLO4

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Report, Class Performance **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		i. Attendance:	5%
		j. Instant Test / Class Performance	10%
		k. Class Test	20%
		l. Report	5%
Make-up Procedures	2.	**Final Exam**	**60%**
		e. Viva	20%
		f. Final Lab Exam	40%
	Total:		**100%**

Learning Materials:

1. Wireless Communication Principle and Practice by T.S. Rappaport
2. Mobile Communication by Jochen Schiller
3. Wireless and Mobile Network Architectures by Yi bing Lin
4. Wireless Communications, Andrea
5. GSM System Survey-ERICSSON

BNQF Code: 06134104, Departmental Code: ICT-4104

Course Title: Machine Learning Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

An overview of data mining methods for preparing data, creating models, and mining data, including decision trees, neural networks, and clustering; creation of predictive models using data through probability estimation, regression, and classification; studies on applications; An analysis and comparison of data-mining software tools.

Course Objectives:

1.	To introduce key concepts in pattern recognition and machine learning; including specific algorithms for classification, regression, clustering, and probabilistic modeling.
2.	To give a broad view of the general issues arising in the application of algorithms to analyzing data, common terms used, and common errors made if applied incorrectly.
3.	To get an overview of the various machine learning techniques and can able to apply knowledge of Machine learning in project work

Course Learning Outcomes (CLO):	
After completing the course, students will be able to:	
CLO1	Practical knowledge on machine learning algorithms along with their strengths and weaknesses.
CLO2	Be able to formulate machine learning methods to different applications.
CLO3	Be able to apply machine learning algorithms in solving real-life problems.
CLO4	Understand the basic concepts of deep neural network model and design the same.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	**PLO**											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1								√		√		
CLO2		√			√							
CLO3									√			√
CLO4			√									

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Read the training data from a .CSV file: Write a python program to import and export data using Pandas library functions. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples.	Lecture, Discussion, Practice	Class Performance and Assignment	CLO1, CLO2, CLO3
2.	Demonstrate various data pre-processing techniques for a given dataset. For a given set of training data examples stored in a .CSV	Lecture, Discussion, Practice	Assignment	CLO1, CLO2

	file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.			
3.	Implement Dimensionality reduction using Principal Component Analysis (PCA) method. Write a Python program to demonstrate various Data Visualization Techniques.	Lecture, Discussion, Problem Solving	Class Performance	CLO1, CLO2
4.	Implement Simple and Multiple Linear Regression Models. Develop Logistic Regression Model for a given dataset.	Lecture, Discussion, Practice	Instant Test, Class Performance, Class Test	CLO1, CLO2
5.	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	Lecture, Discussion, Problem Solving	Class Test	CLO1, CLO2, CLO3
6.	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	Discussion, Practice	Assignment, Exam	CLO1, CLO2, CLO3
7.	Build KNN Classification model for a given dataset.	Lecture, Discussion	Class Test, Assignment	CLO1, CLO2
8.	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.	Lecture, Discussion, Problem Solving	Class Test, Assignment	CLO1, CLO2, CLO3, CLO4
9.	***Mid Term Exam***			
10.	Implement Random Forest ensemble method on a given dataset. Implement Boosting ensemble method on a given dataset.	Lecture, Discussion Problem Solving	Class Test, Exam	CLO1, CLO2, CLO4
11.	Write a python program to implement K-Means clustering Algorithm.	Lecture, Discussion Problem Solving	Class Test	CLO1, CLO2
12.	Analysis different algorithms and choose best machine learning algorithm to implement Heart/Kidney disease detection	Lecture, Discussion Problem Solving	Class Test	CLO1, CLO2, CLO3
13.	Analysis different algorithms and choose best machine learning algorithm to implement online fraud detection	Discussion, Problem Solving	Class Test	CLO1, CLO2, CLO3
14	Mini-project: students work in team on any socially relevant problem that needs a machine learning based solution, and evaluate the model performance.	Project Presentation & Lab Evaluation	Project Assessment	CLO2, CLO3
15.	Project finalization and presentation	Project Presentation & Lab Evaluation	Project Assessment	CLO2, CLO3
16.	***Final Term Exam & Feedback***			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Report, Class Performance	1.	**Before Final**	**40%**
		a. Attendance:	5%

Summative: Mid-Term and Final Term Exams		b. Instant Test / Class Performance	10%
		c. Class Test	20%
		d. Report	5%
Make-up Procedures	2.	**Final Exam**	**60%**
		a. Viva	20%
		b. Final Lab Exam	40%
	Total:		**100%**

Learning Materials:

1. *Vijayvargia, Abhishek, Machine Learning with Python: An Approach to Applied Machine Learning, BPB Publications, 1st edition,2018.*
2. *Aurelien Geron, Hands-On Machine Learning with Scikit-Learn and TensorFlow, Oreilly, March 2017.*
3. *Introduction to Artificial Neural Systems, 1st Edition by Zurada J.M., Publisher: West Publishing Company.*

BNQF Code: 06134108, Departmental Code: ICT-4108

Course Title: Big Data & Cloud Computing Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

The increasing volume and complexity of data generated in various industries necessitate advanced technologies for storage, processing, and analysis. Big Data and Cloud Computing are integral components in managing and extracting meaningful insights from large datasets. This lab aims to provide hands-on experience to students, enabling them to work with real-world big data and cloud computing tools, platforms, and techniques.

Course Objectives:

1. Provide students with practical exposure to popular Big Data and Cloud Computing platforms.
2. Familiarize students with tools such as Apache Hadoop, HBase etc.
3. Teach techniques for optimizing the performance of big data applications in cloud environments.
4. Explore methods for enhancing data processing speed and resource utilization.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1	Acquire hands-on proficiency in deploying and managing big data technologies,
CLO2	Design and implement scalable solutions for processing large datasets in distributed computing environments, demonstrating a deep understanding of architecture choices based on specific use cases.
CLO3	Develop expertise in optimizing the performance of big data applications
CLO4	Understand and implement security measures in big data and cloud computing contexts, ensuring data integrity, confidentiality, and compliance with industry regulations
CLO5	Demonstrate the ability to collaborate effectively in teams, communicate project progress, challenges, and solutions

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2			√									
CLO3			√									
CLO4				√								
CLO5									√			

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.	Lecture, Discussion	Class Test	CLO1

2.	Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files and Deleting files	Lecture, Discussion	Class Test	CLO1
3.	Implement of Matrix Multiplication with Hadoop Map Reduce	Lecture, Discussion	Class Test	CLO1, CLO2
4.	Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.	Lecture, Discussion	Class Test	CLO1, CLO2
5.	Installation of Hive along with practice examples.	Lecture, Discussion	Assignment	CLO2
6.	Installation of HBase, Installing thrift along with Practice examples	Lecture, Discussion	Exam	CLO2, CLO3
7.&8.	***Mid Term Exam***			CLO1, CLO2, CLO3
9.	Practice importing and exporting data from various databases. Software Requirements: Cassandra, Hadoop, Java, Pig, Hive and HBase.	Lecture, Discussion	Class Test, Exam	CLO3
10.	Pig Latin scripts to sort,group, join your data.	Lecture, Discussion	Class Test	CLO4
11.	Pig Latin scripts to project, and filter your data.	Lecture, Discussion	Exam	CLO5
12.	Hive Databases,Tables,Views	Lecture, Discussion	Assessment	CLO5
13	Hive Functions and Indexes	Lecture, Discussion	Assessment	CLO5
14.	Hive Functions and Indexes **Review and Makeup class (if any)**	Lecture, Discussion	Assessment	CLO5
15.&16.	***Final Term Exam & Feedback***			CLO3, CLO4, CLO5

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	10%
	2.	Mid Term	
		a. Class Test:	5%
		b. Assignment/Presentation:	5%
		c. Exam	30%
Make-up Procedures	3.	Final Term	
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam		a. Class Test	5%
		b. Assignment/ Presentation:	5%
		c. Exam	40%
	Total:		100%

Learning Materials:

a. *Explain the Cloud Like I'm 10, Todd Hoff.*

b. *Cloud Computing For Dummies, Daniel Kirsch, Judith Hurwitz*

c. *Big Data A Revolution That Will Transform How We Live, Work, And Think, Viktor Mayer Schönberger, Kenneth Cukier*

d. *Big Data Techniques and Technologies in Geoinformatics, Hasan A. Karimi*

BNQF Code: 06124114, Departmental Code: ICT-4114

Course Title: Internet of Things Sessional

Credit Hr.: 1.0, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** Basic Electrical Engineering Lab, Microprocessor and Embedded System Lab.

Rationale:

Internet of Things (IoT) lab course equips students with hands-on experience in designing, building, and deploying IoT systems. Through practical projects, students learn to connect physical devices, sensors, and actuators to the internet, enabling data collection and remote control. This course fosters innovation and problem-solving skills as students tackle real-world challenges. With IoT being integral to various industries, this lab prepares students for emerging career opportunities in smart cities, healthcare, manufacturing, and more. By gaining expertise in IoT technologies, students become adept at shaping the future of interconnected systems and contributing to technological advancements.

Course Objectives:

1. Develop a strong foundational understanding of Internet of Things (IoT) concepts, architectures, and technologies.
2. Acquire practical skills in designing, implementing, and managing IoT systems and applications.
3. Gain hands-on experience in sensor integration, data acquisition, wireless communication, and cloud connectivity.
4. Explore real-world applications of IoT across industries such as healthcare, smart cities, agriculture, and industrial automation.
5. Foster critical thinking and problem-solving abilities through hands-on projects that showcase the integration of hardware, software, and data analysis in IoT solutions.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Design and implement IoT systems using sensors, actuators, and communication protocols.

CLO2 Develop applications to collect, process, and analyze IoT data.

CLO3 Configure and manage IoT platforms and cloud services.

CLO4 Secure IoT devices and networks against cyber threats.

CLO5 Collaborate effectively in multidisciplinary IoT projects.

CLO6 Demonstrate problem-solving skills through hands-on IoT projects.

CLO7 Design a IoT system application

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	**PLO**											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1			√								√	√
CLO2			√									
CLO3				√								
CLO4				√								
CLO5					√							
CLO6				√								
CLO7			√									

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**

1.	Introduction to IoT Concepts and Arduino: Setting up Arduino development environment, LED blinking, and understanding IoT basics.	Lecture and Hand on practice with Arduino. Student form team for the project and fill the team information.	Class Performance, Class Test. Report Writing. Final Term Exam	CLO1, CLO2
2.	Sensor Interfacing and Data Acquisition: Interfacing temperature and humidity sensors, collecting sensor data using Arduino.	Lecture and Hand on practice with Arduino and different sensors.	Instant Test, Class Performance, Class Test. Report Writing. Final Term Exam	CLO1, CLO2, CLO5
3.	IoT Communication Protocols: Using MQTT protocol for data communication between Arduino and a cloud platform, Implementing HTTP and WebSocket protocols for IoT communication.	Lab practice using Microcontroller, Sensors, Circuits, Devices etc., Problem solving exercise, Project Update	Instant Test, Class Performance, Class Test. Report Writing. Final Term Exam	CLO4
4.	IoT Cloud Platforms and Data Visualization: Sending sensor data to cloud platforms (e.g., ThingSpeak, Blynk), creating visualizations.	Lab practice using Microcontroller, Sensors, Circuits, Devices etc., Problem solving exercise, Project Update	Instant Test, Class Performance, Class Test. Report Writing. Final Term Exam	CLO3
5.	***Class Test 01***			CLO1, CLO2, CLO3, CLO4
6.	Home Automation with IoT: Controlling home appliances using IoT, building a simple home automation system.	Lab practice using Microcontroller, Sensors, Circuits, Devices etc., Problem solving exercise, Project Update	Instant Test, Class Performance, Class Test. Report Writing. Final Term Exam	CLO5, CLO6, CLO7
7.	IoT Data Analytics (Part 1) Experiment: Storing and retrieving IoT data from databases, basic data analysis techniques.	Lab practice using Microcontroller, Sensors, Circuits, Devices etc., Problem solving exercise, Project Update	Instant Test, Class Performance, Class Test. Report Writing. Final Term Exam	CLO2, CLO6
8.	IoT Data Analytics (Part 2): Performing advanced data analytics on IoT data, extracting insights and trends.	Lab practice using Microcontroller, Sensors, Circuits, Devices etc., Problem solving exercise, Project Update	Instant Test, Class Performance, Class Test. Report Writing. Final Term Exam	CLO2, CLO6
9.	IoT Security and Privacy: Implementing security measures for IoT devices, encrypting data, securing communication.	Lab practice using Microcontroller, Sensors, Circuits, Devices etc., Problem solving exercise, Project Update	Instant Test, Class Performance, Class Test. Report Writing. Final Term Exam	CLO4
10.	***Class Test 02***			CLO2, CLO4, CLO5, CLO6, CLO7
11.	IoT Applications in Agriculture: Designing a soil moisture monitoring system for precision agriculture.	Lab practice using Microcontroller, Sensors, Circuits, Devices etc., Problem solving exercise, Project Update	Instant Test, Class Performance, Report Writing. Final Term Exam	CLO5, CLO6, CLO7

12.	IoT Applications in Smart Cities: Building a smart street lighting system with real-time monitoring and control.	Lab practice using Microcontroller, Sensors, Circuits, Devices etc., Problem solving exercise, Project Update	Instant Test, Class Performance, Report Writing. Final Term Exam	CLO5, CLO6, CLO7
13	IoT Applications in Healthcare: Creating a wearable health monitoring device with sensor integration.	Lab practice using Microcontroller, Sensors, Circuits, Devices etc., Problem solving exercise, Project Update	Instant Test, Class Performance, Report Writing. Final Term Exam	CLO5, CLO6, CLO7
14.	Review and IoT Project Presentation: Students work on IoT project of their choice, apply concepts learned, and present their projects.	Discussion, Problem Solving		CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7
15.&16.	***Final Term Exam & Project Showcasing***			CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Report, Class Performance **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance:	5%
		b. Instant Test / Class Performance	10%
		c. Class Test	20%
		d. Report	5%
Make-up Procedures	2.	**Final Exam**	**60%**
		a. Viva	20%
		b. Final Lab Exam	40%
	Total:		**100%**

Learning Materials:

9. "Getting Started with Arduino" by Massimo Banzi
10. "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes and Gonzalo Salgueiro
11. "Raspberry Pi IoT Projects: Prototyping Experiments for Makers" by John C. Shovic
12. "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz

BNQF Code: 06124201, Departmental Code: ICT-4201

Course Title: Cyber Security

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

This course examines legal and ethical issues in the use of information technology. Upon completion of the course, students should understand privacy, intellectual property rights, contracts & licenses as well as common criminal issues, the legal obligations of a computer professional, computer ethics, and the importance of professional codes of conduct. This course aims to introduce the B.Sc. students to fundamental concepts of the ethical and legal standards governing information technology. It will satisfy a 100-level requirement for courses in computer science and engineering for undergraduate majors.

Course Objectives:

1. To identify concepts such as ethics, morals, character, ethical principles, and ethical relativism
2. To demonstrate an understanding of the importance of ethical issues that emerges from the widespread use of information technology.
3. To apply an ethical decision-making process when confronted with ethical dilemmas.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Learn the basics of security, approaches and principles.

CLO2 Understand the cryptographic techniques and authentication mechanism.

CLO3 Analyze the ethical issues associated with confidentiality and privacy as they relate to information technology.

CLO4 Identify organizations, laws, and regulations related to computer ethics, law, and policy.

Mapping Course Learning Outcomes(CLOs) with PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1			√									
CLO2				√								
CLO3				√								
CLO4								√				

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Introduction to Security, Principles of security, Types of attacks	Lecture, Discussion	Class Test	CLO1, CLO2

2.	Substitution & Transposition techniques	Lecture, Discussion	Class Test	CLO2
3.	Cryptographic Techniques	Lecture, Problem Solving	Assignment	CLO2
4.	User Authentication Mechanism	Lecture, Problem Solving	Exam	CLO3
5.	Computer and Information Ethics	Lecture, Discussion Problem Solving	Class Test, Exam	CLO3
6.	Developing the ethical analysis skills and professional values	Lecture, Problem Solving	Exam	CLO4
7.	*Mid Term Exam 1 & Feedback*			
8.	Internet and their Impacts in Society	Lecture, Discussion Problem Solving	Class Test, Exam	CLO4, CLO5
9.	Overview of Cyber Law	Lecture, Discussion Problem Solving	Class Test	CLO4
10.	Building blocks of Cyber Space	Lecture, Discussion	Exam	CLO3, CLO4
11.	Cyber Crimes against Individuals	Lecture, Discussion Problem Solving	Exam	CLO5
12.	Cyber Stalking/Harassment	Lecture, Problem Solving	Exam	CLO4
13.	Identity Theft & Fraud; Cyber Terrorism	Lecture, Problem Solving	Exam	CLO5
14.	*Mid Term Exam 2 & Feedback*			

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	10%
	2.	Mid Term	20%
	3.	Class Test	5%
	4.	Assignment/Presentation:	5%
Make-up Procedures	5.	Final Term	60%
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam			
	Total:		100%

Learning Materials:

1. *Jon C. Graff, "Cryptography and E-Commerce", 1st Ed., John Wiley & Sons, 2000.*
2. *Norris L. Johnson, Michael Cross, Tony Piltzecker, "Security+", 1st Ed., Syngress, 2002.*

BNQF Code: 06124203, Departmental Code: ICT-4203

Course Title: Satellite Communication and Radar

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

The course goal is to provide the student with the basic understanding of the unique challenges of designing, developing, fielding, maintaining, and operating satellite communications systems. This will enable the students to know how to place a satellite in an orbit and about the earth & space segment. The emphasis is also on modern radar systems and signal processing techniques, for both civilian and defense applications.

Course Objectives:

1. To understand the Satellite fundamentals and types of satellite along with their applications.
2. To provide them with a sound understanding of how a satellite communication system along with its other subsystems operates to successfully transfer information from one earth station to another.
3. To expose them to examples of applications and trade offs which typically occur in engineering system design, and to ask them to apply the knowledge in design problems.
4. To understand the working principle of different RADAR systems and their applications.
5. To study different RADARs and its supporting system.
6. To understand and model the characteristics of radar echoes from different types of targets and clutter.
7. To understand and identify theoretical accuracy of radar measurements and pulse compression techniques.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1	Determine the azimuth and elevation angles and visibility of a geostationary satellite from an earth station.
CLO2	Calculate link budgets for an uplink and a downlink, and determine carrier to noise ratio (C/N) at an earth terminal receiver.
CLO3	Calculate the baseband signal-to-noise ratio or bit error rate for a satellite link.
CLO4	Design a communications satellite system to meet specified objectives for signal to noise ratio (S/N) in an analog baseband or BER in a digital link using appropriate multiple access techniques.
CLO5	Able to discriminate different Radars, find applications and use of its supporting systems.
CLO6	Calculate and simulate receiver noise and losses.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2		√										
CLO3		√										
CLO4			√									
CLO5		√										
CLO6		√										

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy				
Week	**Contents**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLO**
1.	Introduction to Satellite Communication: Different types of satellites, Satellite orbit, station keeping, orbital mechanics, orbital perturbation	Lecture, Discussion	Class Test	CLO1
2.	Equation of orbit, orbital elements, look angle determination, limits of visibility, eclipse, sub satellite point, sun transit outage,	Lecture, Discussion	Class Test	CLO1
3.	Space craft technology- power, attitude and orbit control, thermal, propulsion, telemetry, tracking and command, communication and antenna subsystems,	Lecture, Discussion	Class Test	CLO1, CLO4
4.	Launching procedures and launch vehicles	Lecture, Discussion	Class Test	CLO1, CLO4
5.	Satellite Link Design: Basic transmission theory, satellite uplink and down link analysis and design, Transponders, Uplink and downlink power budget, Overall link budget link budget and Eb / No calculation	Lecture, Discussion	Assignment	CLO5
6.	Performance impairments, system noise, inter modulation and interference, propagation characteristics and frequency consideration system reliability and design life time	Lecture, Discussion Problem Solving	Exam	CLO2, CLO3
7.&8.	***Mid Term Exam***			CLO1, CLO2, CLO4, CLO5
9.	Satellite Access: Types- FDMA concepts- inter modulation and back off- SPADE system TDMA concept- frame and burst structure-	Lecture, Discussion Problem Solving	Class Test, Exam	CLO3
10.	Transmitter classification, Elements of transmitter, AM and FM transmitters, SSB transmitter, stabilized master oscillator.	Lecture, Discussion Problem Solving	Class Test	CLO6
11.	Satellite switch TDMA- CDMA concept- DS & FH CDMA system- comparison of multiple access scheme.	Lecture, Discussion	Exam	CLO6
12.	Earth Station Technology: Earth Station Design for Low System Noise Temperature, Large Earth Station Antennas.	Lecture, Discussion Problem Solving	Assessment	CLO6
13	RADAR: The radar equation, CW, Pulsed Doppler Radar and MTI, Tracking radar, Receiver noise and losses, Radar clutter, Matched filters,	Lecture, Discussion Problem Solving	Assessment	CLO6

14.	Radar detection and parameter estimation in clutter and noise background, pulse compression and coding techniques, Radar signal choice and ambiguity function, introduction to polarimetric radar and synthetic aperture radar, Radar applications. **Review and Makeup class (if any)**	Lecture, Discussion Problem Solving	Assessment	CLO2, CLO3, CLO6
15.&16.	***Final Term Exam & Feedback***			CLO2, CLO3, CLO6

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	Attendance:	10%
	2.	Mid Term	
		a. Class Test:	5%
		b. Assignment/Presentation:	5%
		c. Exam	30%
Make-up Procedures	3.	Final Term	
Repeat Course, Mid-Term Incomplete Exam, Final Term Incomplete Exam		a. Class Test	5%
		b. Assignment/ Presentation:	5%
		c. Exam	40%
	Total:		100%

Learning Materials:

1. *T. Pratt, C. W. Bostian, Satellite Communications, second edition, Wiley-India, 2006*
2. *D.C. Agarwal, Satellite Communication, Khanna Publishers, 2008*
3. *Merrill Skolnik, Introduction to RADAR Systems, third edition, McGraw Hill, 2001*

BNQF Code: 06134209, Departmental Code: ICT-4209

Course Title: Data Science and Its Application

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** Structured Programming, Algorithm, Statistics.

Rationale:

This course introduces students to the fundamentals of data science and its practical applications in engineering. Students will learn data collection, preprocessing, analysis, visualization, and interpretation techniques. The course focuses on using various tools and programming languages commonly used in data science projects. Through hands-on projects and case studies, students will apply data science concepts to solve real-world engineering problems.

Course Objectives:

1. Develop proficiency in data analysis tools and techniques.
2. Acquire skills in cleaning, transforming, and visualizing diverse datasets.
3. Learn statistical methods and machine learning algorithms for predictive modeling.
4. Understand data-driven decision-making and its applications in various industries.
5. Gain practical experience in applying data science concepts to real-world problems.
6. Explore ethical considerations and responsible practices in data science.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Understand the basic concepts and principles of data science and its role in engineering applications.

CLO2 Collect, clean, and preprocess data for analysis, considering data quality and ethical considerations.

CLO3 Apply statistical and machine learning techniques to analyze data and extract meaningful insights.

CLO4 Visualize data effectively using appropriate graphs, charts, and visualization tools.

CLO5 Interpret data analysis results and make informed decisions based on data-driven insights.

CLO6 Use programming languages (such as Python or R) to perform data manipulation, analysis, and visualization.

CLO7 Work collaboratively in teams to complete data science projects and solve engineering challenges.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√											
CLO2			√									
CLO3				√								
CLO4				√								
CLO5				√								
CLO6					√							
CLO7									√			

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Introduction to data science and data pre-processing: Introduction, roadmap, data representation, independent and	Lecture, Discussion	Class Test, Assessment,	CLO1, CLO2,

	target variables, Data cleaning, Data types and sources, Data collection methods and challenges, Data cleaning, transformation, and handling missing values.		Instant Test, Final Exam	CLO3
2.	Introduction to data science and data pre-processing: data in different scales, Working with Python basics, spiliting train and test data, working with data; Comparison of Python, R and Matlab usage in data science. Role of data science in engineering applications, Ethical considerations in data science	Lecture, Discussion	Class Test, Assessment, Instant Test, Final Exam	CLO3
3.	Basic Statistics: Random variables, sampling; Distribution and statistical measures, Hypothesis testing, Statistics case studies using Google Colab, Descriptive statistics and data distributions,Data visualization using matplotlib and seaborn, Correlation analysis.	Lecture, Discussion & Problem Solving	Class Test, Assignment, Quiz, Instant Test, Final Exam	CLO3, CLO4, CLO6
4.	Overview of linear algebra: linear algebra and matrix computation; example case study for data science, Functions, Derivatives and Convexity.	Lecture, Discussion & Problem Solving	Class Test, Assignment, Quiz, Instant Test, Final Exam	CLO3, CLO5
5.	***Class Test 01***			CLO1, CLO2, CLO3, CLO4, CLO5, CLO6
6.	Modelling Techniques and Regression: Mathematical modelling process, linear regression, example case study for data science, Logistic regression, Regression case studies using Google Colab.	Lecture, Discussion & Problem Solving	Class Test, Assessment, Presentation, Instant Test, Final Exam	CLO5, CLO6, CLO7
7.	Data Visualization and Visual analytics: Introduction, functional approach, Activity on line plot; Using Python for data visualization, Probability and probability distributions, Hypothesis formulation and testing, Analysis of variance (ANOVA).	Lecture, Discussion & Problem Solving	Class Test, Assignment, Assessment, Instant Test, Final Exam	CLO4, CLO5, CLO6, CLO7
8.	Applying data science to business and industry: data driven insights into business process, deploying analytics, business intelligence and data science; using Python for data science, using collaborative data visualization platform, visualizaing with open source; Using Python for data visualization	Lecture, Discussion & Problem Solving	Class Test, Assessment, Presentation, Instant Test, Final Exam	CLO4, CLO5, CLO6
9.	Reviw mathematical modelling for data science, Using numerical methods in data science; Using Python for mathematical modeling, Introduction to supervised and u Advanced data visualization techniques,Dashboards and interactive visualizations, Interpreting results and making recommendationsnsupervised learning, decision trees, Clustering techniques.	Lecture, Discussion & Problem Solving	Class Test, Assignment, Assessment, Instant Test, Final Exam	CLO3, CLO5, CLO6
10.	***Class Test 02***			CLO3, CLO4, CLO5, CLO6, CLO7
11.	Application of data science: using data science in Journalism and case study	Lecture, Discussion & Problem Solving	Assignment, Assessment, Presentation, Final Exam	CLO5, CLO6, CLO7
12.	Application of data science: environmental data science and case study.	Lecture, Discussion & Problem Solving	Assignment, Assessment, Presentation, Final Exam	CLO5, CLO6, CLO7
13	Application of data science: using data science in e-commerce and case study.	Lecture, Discussion & Problem Solving	Assignment, Assessment, Presentation, Final Exam	CLO5, CLO6, CLO7

14.	Review	Lecture, Discussion, Problem Solving		CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7
15.&16.	***Final Term Exam & Feedback***			CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance:	5%
		b. Assignment/Presentation:	5%
		c. Quiz / Instant Test	5%
		d. Class Performance	5%
		e. Class Test / Mid Term	20%
Make-up Procedures	2.	**Final Exam**	**60%**
	Total:		**100%**

Learning Materials:

1. Introducing Data Science, Davy Cielen, Anro DB Meysman, Mohamed Ali
2. Practical Statistics for Data Scientists, Peter Bruce, Andrew Bruce & Peter Gedeck
3. Python Data Science Handbook, Jake VanderPlas
4. Doing Data Science by Cathy O'Neil and Rachel Schutt

BNQF Code: 06124211, Departmental Code: ICT-4211

Course Title: Human Machine Interaction

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

This course introduces the concepts and practices behind the next generation of user interfaces. User interface design paradigms, 3D user interfaces, adaptive interfaces, user modeling, speech recognition and conversational interfaces, wearable computers, multimodal interfaces, and perceptual interfaces are among the main topics covered in this course.

Course Objectives:

5. Introduce students to the fields of human factors, HMI, UCD, and usability testing and evaluation.
6. Acquire an understanding of human-computer interaction theory and research.
7. To understand how design choices affect users' perspectives and actions.
8. Become familiar with user-centered design and evaluation processes.
9. Have the skill to design and develop systems with the end user in mind.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Explain, choose and distinguish the capabilities of both humans and computers from the viewpoint of human information processing.

CLO2 Analyze and determine HMI system user models, user support, socio-organizational issues, and stakeholder requirements.

CLO3 Choose, evaluate, and defend the HCI design principles, guidelines, and standards for designing HMI systems.

CLO4 Create, evaluate, select, and implement cutting-edge HMI methods and tools for solving real-world problems; demonstrate proficiency with, and report on, such interaction design.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLOs	PLOs											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1			√									
CLO2				√								
CLO3				√								
CLO4			√									

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Understanding and conceptualizing interaction	Lecture, Discussion	Class Test	CLO1
2.	Overview of human-machine interaction strategies from a number of perspectives including that of the engineer, cognitive psychologist, and end-user.	Lecture, Discussion	Class Test	CLO1, CLO2
3.	Iterative design, rapid prototyping, low-fidelity interactive prototyping	Lecture,	Class Test	CLO2

		Discussion		
4.	Comparative evaluation of multiple interfaces,	Lecture, Discussion	Class Test	CLO1, CLO2
5.	Evaluation of user interface, heuristic evaluation	Lecture, Discussion	Assignment	CLO2, CLO3
6.	System model, interface model, user model	Lecture, Discussion	Exam	CLO3
7.	**Review and makeup class form week 1 to 6 and Mid-semester exam.**			CLO1, CLO2, CLO3
8.	consistency, simplicity, learnability, efficiency, safety, ergonomics, aesthetics	Lecture, Discussion	Class Test, Exam	CLO3
9.	kinds of impairments, assistive technology, universal design, accessibility APIs;	Lecture, Discussion	Class Test	CLO3
10.	Translation, text direction, sort order, formatting, color conventions, icons	Lecture, Discussion	Exam	CLO3, CLO4
11.	Experiments, experiment design techniques, field study, survey	Lecture, Discussion	Class Test	CLO4
12.	recognize human emotions through combination of spoken language, gestures, facial expressions; Case studies	Lecture, Discussion	Assessment	CLO3, CLO4
13.	Designing Software for Collaboration, Augmented Reality, Wearable	Lecture, Discussion	Assessment	CLO2, CLO4
14.	**Review and makeup class form week 8 to 13 and Mid-semester exam.**			CLO2, CLO3, CLO4

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Continuous Assessment: Class Test, Assignment, Presentation, Quiz **Summative:** Mid-Semester and Semester Final Exam	1.	Attendance:	5%
	2.	Mid Semester Exam	20%
	3.	Class Test/ Assignment/Presentation/ Sudden Test/ Quiz/ Tutorial	15%
	4.	Semester Final Examination	60%
Make-up Procedures			
Repeat Course, Mid-Semester Incomplete Exam, Semester Final Incomplete Exam			
	Total:		100%

Learning Materials:

1. Andy Downton, "Engineering the Human-Computer Interface (Essex Series in Telecommunications and Information Systems)", McGraw Hill, 1993.
2. Human-Computer Interaction: An Empirical Research Perspective, by I. Scott MacKenzie.
3. The Handbook of Human-Machine Interaction A Human-Centered Design Approach, by Guy André Boy.
4. Interaction Design: Beyond Human - Computer Interaction 3rd Edition, by Yvonne Rogers , Helen Sharp, Jenny Preece.

BNQF Code: 06134213, Departmental Code: ICT-4213

Course Title: Robotics

Credit Hr.: 3.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** None

Rationale:

Robotics explores distributed and adaptive control, architecture, software engineering, real-time systems, information processing and learning, mechanics and dynamics, geometrical reasoning, and AI. Context and environment affect robots' computational and mechanical abilities. A designer of an embedded computational system for sensory and motor processes must understand these areas. Introductory robotics courses focus on planning and evaluating simple robots. Sensory and motor systems that help us understand and change our environment will be studied. We'll study kinematics, dynamics, actuators, sensors, signal processing, associative memory, feedback control theory, supervised and unsupervised learning, and task planning.

Course Objectives:

1. Introduce students to basic electrical and mechanical engineering concepts to help them understand robotics design and development challenges.
2. Engage students in a design task that hones their analytical, planning, presentation, and teamwork skills.
3. Help students learn the theory behind robot design and get practical experience using that knowledge through guided projects and labs.
4. To intuitively explain what sensors and actuators do and how they can be used according to the specifications of the problem and the nature of the environments.
5. Write appropriate robot programs by understanding the nature of the sensors, and actuators.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Discuss the moral implications of employing robots to address societal problems with authority.

CLO2 Provide an intuitive description of how sensors and actuators work and how they can be applied in various contexts depending on the problem at hand and the characteristics of the environment.

CLO3 Program the robot correctly by learning its sensors' and actuators' functions.

CLO4 Implement state-of-the-art algorithms for solving robotic tasks.

CLO5 Implement hardware and software to build a robot that can perform a task.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLOs	PLOs											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		√										
CLO2			√									
CLO3					√							
CLO4			√									
CLO5					√							

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO

1.	Definition and Classification of Robots, Laws of Robotics, Applications of Robots, Basic Components of Robot Systems, Robotics Paradigms, Introduction to Motion, Recognition, and Control subsystems.	Lecture, Discussion	Class Test	CLO1
2.	Links and Joints, Kinematic Chain, Mechanisms and Machines, Degrees of Freedom, Robot End Effectors.	Lecture, Discussion	Class Test	CLO1, CLO2
3.	Description of Position, Orientation and Frames, Homogeneous Transformations.	Lecture, Discussion	Class Test	CLO2
4.	Link Parameters and Link Co-ordinate Systems, D-H Homogeneous Transformation Matrices, Forward and Inverse Kinematics of Serial Manipulators.	Lecture, Discussion	Class Test	CLO1, CLO2
5.	Recursive Newton-Euler Formulation of Serial Manipulator, Lagrangian Formulation of Serial Manipulator.	Lecture, Discussion	Assignment	CLO2, CLO3
6.	Link Differential Transformation Matrix, Manipulator Jacobian Matrix, Conventional and Screw Based Jacobian of Serial Manipulator.	Lecture, Discussion	Exam	CLO3
7.	**Review and makeup class form week 1 to 6 and Mid-semester exam.**			CLO1, CLO2, CLO3
8.	Introduction to computer vision, Perspective camera model, Principles of Lenses, CCD and CMOS sensors, Infrared Sensors, Ultrasonic Sensors, LiDAR Sensor, Camera Modules	Lecture, Discussion	Class Test, Exam	CLO4
9.	Introduction to Face Recognition, Object Detection, Visual Servoing.	Lecture, Discussion	Class Test	CLO3
10.	Trajectory Planning, Control of Manipulators, Motor Control, Robot Sensors, Low Level Robot Vision, and Robot Programming.	Lecture, Discussion	Exam	CLO3, CLO4
11.	Open loop and Closed loop systems, First Order and Second Order Systems, PID Controller.	Lecture, Discussion	Class Test	CLO5
12.	Robot path planning and navigation algorithms, localization algorithms.	Lecture, Discussion	Assessment	CLO3, CLO5
13.	Bluetooth, RFID, GPRS, GPS technologies.	Lecture, Discussion	Assessment	CLO4, CLO5
14.	**Review and makeup class form week 8 to 13 and Mid-semester exam.**			CLO3, CLO4, CLO5

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Continuous Assessment: Class Test, Assignment, Presentation, Quiz **Summative:** Mid-Semester and Semester Final Exam	1.	Attendance:	5%
	2.	Mid Semester Exam	20%
	3.	Class Test/ Assignment/Presentation/ Sudden Test/ Quiz/ Tutorial	15%
	4.	Semester Final Examination	60%
Make-up Procedures			
Repeat Course, Mid-Semester Incomplete Exam, Semester Final Incomplete Exam			
	Total:		100%

Learning Materials:

1. Modeling and Control of Robot Manipulators - Sciavicco and Siciliano, McGraw-Hill
2. Introduction to Robotics: Mechanics and Control - John J. Craig, Pearson Prentice Hall.
3. Robot Analysis - Lung-Wen Tsai, Wiley & Sons Inc.
4. Introduction to AI Robotics by Robin Murphy.
5. Introduction to Robotics: Mechanics and Control by John J. Craig
6. Corke, P., Robotics, Visionand Control: Fundamental Algorithms in Matlab, 2017, Springer.

BNQF Code: 06124204, Departmental Code: ICT-4204

Course Title: Cyber security Sessional

Credit Hr.: 1.0, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites: None

Rationale:

The rationale of a Cryptography and Network Security lab course is to provide students with practical hands-on experience in implementing and analyzing cryptographic techniques and network security mechanisms. While theoretical knowledge is crucial, practical application is essential to reinforce understanding and develop proficiency in securing network systems.

Course Objectives:

1. Analyze network security on different OS.
2. Analyze and implement network security issues on different environments.
3. Analyze vulnerabilities of network security using different tools.
4. Analyze and understand the potential attacks and recovery process

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Develop and Implement Network security process.

CLO2 Develop various network security system using modern tools.

CLO3 Analyze and Observe characteristics of different network-based attacks.

CLO4 Analyze and capture the network-based attackers.

CLO5 Design and Analyze Real world Network Security issues

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1					√							
CLO2					√							
CLO3					√							
CLO4				√								
CLO5				√								

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Topic 1: Introduction to Cryptography and Network Security • Setting up the lab environment for cryptographic experiments • Exploring the basics of encryption and decryption techniques • Understanding network security concepts	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1

	and protocols			
2.	Topic 2: Classical Cryptography Lab • Implementing classical ciphers such as Caesar cipher and Rail Fence cipher • Breaking classical ciphers using cryptanalysis techniques • Analyzing the strengths and weaknesses of classical ciphers	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1
3.	Topic 3: Symmetric Encryption Lab • Implementing symmetric encryption algorithms like DES and AES • Performing encryption and decryption operations using symmetric ciphers • Testing the security and performance of different symmetric encryption modes	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1, CLO2
4.	Topic 4: Public-Key Cryptography Lab • Generating public and private keys for asymmetric encryption • Implementing algorithms like RSA for key exchange and encryption • Encrypting and decrypting messages using public-key cryptography	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO1, CLO2
5.	Lab Review Based on Lab 1 – Lab 4	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2, CLO3
6.	**Lab Assessment** Based on Lab1 - Lab6	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2, CLO3
7.	**Review and Makeup class and *Mid Term Exam 1***			
8.	Topic 5: Hash Functions and Message Authentication Codes (MAC) Lab • Implementing hash functions like SHA-256 and MD5 • Generating message digests and verifying integrity using hash functions • Creating and verifying MACs for message authentication	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2, CLO3
9.	Topic 6: Cryptographic Protocols Lab • Implementing SSL/TLS protocols for secure communication	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO2, CLO3

	• Configuring and testing IPsec for secure network connections • Building secure VPN tunnels using cryptographic protocols			
10.	Topic 7: Network Security Lab • Configuring network firewalls for access control and intrusion prevention • Detecting and mitigating network attacks using Intrusion Detection and Prevention Systems (IDPS) • Analyzing network traffic for security vulnerabilities and threats	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO3
11	Topic 8: Web Security Lab • Identifying and fixing security vulnerabilities in web applications (e.g., XSS, CSRF) • Configuring secure communication using HTTPS and SSL/TLS certificates • Testing web application security using penetration testing tools	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO4
12.	Topic 9: Wireless Network Security Lab • Configuring secure wireless networks using encryption and authentication protocols • Analyzing wireless network traffic for security breaches and vulnerabilities • Implementing wireless intrusion detection and prevention mechanisms	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO5
13.	Topic 10: Security Assessment and Forensics Lab • Conducting vulnerability assessments and penetration testing on network systems • Investigating security incidents and performing digital forensics analysis • Creating incident response plans and recovery strategies	Lecture, Discussion, Lab Assignment	Performance Test, Lab Report	CLO5
14.	**Review and Makeup class and *Mid Term Exam 2***			

Assessment Strategy	Course Evaluation Process and Mark Distributions		
Exam **Continuous Assessment:** Class Test, Assignment, Presentation	1.	Attendance:	10%
	2.	Mid Term	
		a. Quiz:	10%
		b. Viva:	10%
		c. Performance Test:	10%
		d. Lab Report:	10%
Make-up Procedures	3.		
		a. Quiz:	
		b. Viva:	
		c. Performance Test:	
		d. Lab Report:	
	Total:		100%

Learning Materials:

BNQF Code: 06134212, Departmental code: ICT-4212

Course Title: Data Science and Its Application Sessional

Credit Hr.: 1.0, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**):** Structured Programming, Data Structure, Algorithm, OOP.

Rationale:

The Data Science and Its Application lab course offers hands-on experience to complement theoretical knowledge. It bridges the gap between concepts and practical skills by immersing students in real-world data analysis, visualization, and interpretation tasks. Through interactive projects, students develop proficiency in using data science tools and techniques, fostering critical thinking and problem-solving abilities. This lab equips them with essential skills for data-driven decision-making, preparing them to excel in data-centric roles across various industries.

Course Objectives:

1. Apply data preprocessing techniques for cleaning, transforming, and structuring datasets.
2. Utilize statistical and machine learning tools to analyze and interpret real-world data.
3. Create data visualizations to effectively communicate insights and patterns.
4. Collaborate in teams to solve practical data science challenges and present findings.
5. Gain hands-on experience in using programming languages (e.g., Python, R) for data manipulation and analysis

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Apply data preprocessing techniques to clean and transform real-world datasets.

CLO2 Utilize programming languages to implement data analysis and visualization tasks.

CLO3 Demonstrate proficiency in using statistical and machine learning methods for data interpretation.

CLO4 Create informative data visualizations and effectively communicate insights.

CLO5 Collaborate in teams to solve data-driven engineering challenges through hands-on projects.

CLO6 Present and communicate findings from data analysis in a clear and concise manner

CLO7 Design a Data Science oriented system application.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLO	PLO											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1			√									
CLO2					√							
CLO3					√							
CLO4					√							
CLO5				√								
CLO6									√			
CLO7					√							

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Introduction to Data Science Tools and Environment: Setting up Python, Google Colab and Jupyter Notebook	Lecture and Hand on practice with Microsoft	Class Test. Report Writing.	CLO1, CLO2,

	environment for data analysis. Data Collection and Preprocessing:: Collecting data from various sources and cleaning/preprocessing it for analysis.	Excel, Google Colab, Python. Student form team for the project and fill the team information.	Final Term Exam	CLO3
2.	Exploratory Data Analysis (EDA): Analyzing data distributions, creating histograms, scatter plots, and identifying outliers.	Lecture and Hand on practice with Microsoft Excel, Google Colab, Python. Project Update	Instant Test, Class Performance, Class Test. Report Writing. Final Term Exam	CLO3, CLO4
3.	Data Visualization with Matplotlib and Seaborn: Creating various types of data visualizations using Matplotlib and Seaborn libraries.	Work using Jupyter notebook and Google Colab, Problem solving exercise, Project Update	Instant Test, Class Performance, Class Test. Report Writing. Final Term Exam	CLO3, CLO4
4.	Hypothesis Testing and Statistical Analysis: Formulating hypotheses, conducting t-tests, ANOVA, and interpreting results.	Review exercises, Solve computational problems using Google Colab / Python, Project Update	Instant Test, Class Performance, Class Test. Report Writing. Final Term Exam	CLO3
5.	***Class Test 01***			CLO1, CLO2, CLO3, CLO4
6.	Linear Regression: Implementing linear regression model using real-world dataset and evaluating the model. .	Review exercises, Solve computational problems using Google Colab / Python, Project Update	Instant Test, Class Performance, Class Test. Report Writing. Final Term Exam	CLO3, CLO4, CLO5, CLO6
7.	Logistic Regression and Classification: Applying logistic regression for binary classification tasks, evaluating model accuracy	Review exercises, Solve computational problems using Google Colab / Python, Project Update	Instant Test, Class Performance, Class Test. Report Writing. Final Term Exam	CLO3, CLO5, CLO6
8.	Decision Trees and Random Forests: Building decision tree and random forest models for predictive analysis.	Review exercises, Solve computational problems using Google Colab / Python, Project Update	Instant Test, Class Performance, Class Test. Report Writing. Final Term Exam	CLO3, CLO5, CLO6
9.	Clustering Techniques: Implementing K-means clustering algorithm on dataset and analyzing clusters.	Review exercises, Solve computational problems using Google Colab / Python, Project Update	Instant Test, Class Performance, Class Test. Report Writing. Final Term Exam	CLO3, CLO4, CLO5, CLO6
10.	***Class Test 02***			CLO3, CLO4, CLO5, CLO6
11.	Dimensionality Reduction with PCA: Applying Principal Component Analysis (PCA) to reduce dataset dimensions	Review exercises, Solve computational problems using Google Colab / Python, Project Update	Instant Test, Class Performance, Report Writing. Final Term Exam	CLO3, CLO6
12.	Text Mining and Sentiment Analysis: Analyzing text data,	Review exercises, Solve computational problems	Instant Test, Class	CLO3,

	performing sentiment analysis using NLTK or spaCy.	using Google Colab / Python, Project Update	Performance, Report Writing. Final Term Exam	CLO5, CLO6
13	Data Visualization with Tableau: Creating interactive dashboards and visualizations using Tableau.	Review exercises, Solve computational problems using Google Colab / Python, Project Update	Instant Test, Class Performance, Report Writing. Final Term Exam	CLO4, CLO5, CLO7
14.	Review and Final Project Presentation: Students work on a data science project, apply learned techniques, and present findings.	Discussion, Problem Solving		CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7
15.&16.	***Final Term Exam & Project Showcasing***			CLO1, CLO2, CLO3, CLO4, CLO5, CLO6, CLO7

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Report, Class Performance **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance:	5%
		b. Instant Test / Class Performance	10%
		c. Class Test	20%
		d. Report	5%
Make-up Procedures	2.	**Final Exam**	**60%**
		a. Viva	20%
		b. Final Lab Exam	40%
	Total:		**100%**

Learning Materials:

1. Programming with Python, T.R. Padmanabhan, Springer, 2016
2. "Python for Data Analysis" by Wes McKinney
3. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow"
4. "Data Science for Business" by Foster Provost and Tom Fawcett

BNQF Code: 06124214, Departmental Code: ICT-4214

Course Title: Human Machine Interaction Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**): None**

Rationale:

This course introduces the practical knowledge and practices behind the next generation of user interfaces. User interface design paradigms, 3D user interfaces, adaptive interfaces, user modeling, speech recognition and conversational interfaces, wearable computers, multimodal interfaces, and perceptual interfaces are among the main topics covered in this course.

Course Objectives:

1. Introduce students to the fields of human factors, HMI, UCD, and usability testing and evaluation.
2. Acquire an understanding of human-computer interaction theory and research.
3. To understand how design choices affect users' perspectives and actions.
4. Become familiar with user-centered design and evaluation processes.
5. Have the skill to design and develop systems with the end user in mind.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1	Explain, choose and distinguish the capabilities of both humans and computers from the viewpoint of human information processing.
CLO2	Analyze and determine HMI system user models, user support, socio-organizational issues, and stakeholder requirements.
CLO3	Choose, evaluate, and defend the HCI design principles, guidelines, and standards for designing HMI systems.
CLO4	Create, evaluate, select, and implement cutting-edge HMI methods and tools for solving real-world problems; demonstrate proficiency with, and report on, such interaction design.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLOs	PLOs											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1				√								
CLO2					√							
CLO3				√								
CLO4					√							

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Understanding and conceptualizing interaction	Lecture, Discussion	Class Test	CLO1
2.	Study of Iterative design, rapid prototyping	Lecture, Discussion	Class Test	CLO1, CLO2
3.	Study of low-fidelity interactive prototyping	Lecture, Discussion	Class Test	CLO2

4.	Comparative evaluation of multiple interfaces, heuristic evaluation	Lecture, Discussion	Class Test	CLO1, CLO2
5.	Study of System model,	Lecture, Discussion	Assignment	CLO2, CLO3
6.	Study of interface model, user model	Lecture, Discussion	Exam	CLO3
7.	**Review and makeup class form week 1 to 6 and Mid-semester exam.**			CLO1, CLO2, CLO3
8.	Study the kinds of impairments, assistive technology,	Lecture, Discussion	Class Test, Exam	CLO3
9.	Study of universal design, accessibility APIs;	Lecture, Discussion	Class Test	CLO3
10.	Translation, text direction, sort order, formatting, color conventions, icons	Lecture, Discussion	Exam	CLO3, CLO4
11.	Experiments, experiment design techniques	Lecture, Discussion	Class Test	CLO4
12.	recognize human emotions through combination of spoken language, gestures, facial expressions;	Lecture, Discussion	Assessment	CLO3, CLO4
13.	Designing Software for Collaboration, Augmented Reality, Wearable	Lecture, Discussion	Assessment	CLO2, CLO4
14.	**Review and makeup class form week 8 to 13 and Mid-semester exam.**			CLO2, CLO3, CLO4

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Report, Class Performance **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance:	5%
		b. Instant Test / Class Performance	10%
		c. Class Test	20%
		d. Report	5%
Make-up Procedures	2.	**Final Exam**	**60%**
		a. Viva	20%
		b. Final Lab Exam	40%
	Total:		**100%**

Learning Materials:

1. Andy Downton, "Engineering the Human-Computer Interface (Essex Series in Telecommunications and Information Systems)", McGraw Hill, 1993.
2. Human-Computer Interaction: An Empirical Research Perspective, by I. Scott MacKenzie.
3. The Handbook of Human-Machine Interaction A Human-Centered Design Approach, by Guy André Boy.
4. Interaction Design: Beyond Human - Computer Interaction 3rd Edition, by Yvonne Rogers , Helen Sharp, Jenny Preece.

BNQF Code: 06134216, Departmental Code: ICT-4216

Course Title: Robotics Sessional

Credit Hr.: 1.00, **Contact Hr.:** 3.00, **Course Type:** Core
Pre-requisites (if any**): 0613-4217**

Rationale:

Robotics explores distributed and adaptive control, architecture, software engineering, real-time systems, information processing and learning, mechanics and dynamics, geometrical reasoning, and AI. Context and environment affect robots' computational and mechanical abilities. A designer of an embedded computational system for sensory and motor processes must understand these areas. Introductory robotics courses focus on planning and evaluating simple robots. Sensory and motor systems that help us understand and change our environment will be studied. We'll study kinematics, dynamics, actuators, sensors, signal processing, associative memory, feedback control theory, supervised and unsupervised learning, and task planning.

Course Objectives:

1. Introduce students to basic electrical and mechanical engineering concepts to help them understand robotics design and development challenges.
2. Engage students in a design task that hones their analytical, planning, presentation, and teamwork skills.
3. Help students learn the theory behind robot design and get practical experience using that knowledge through guided projects and labs.
4. To intuitively explain what sensors and actuators do and how they can be used according to the specifications of the problem and the nature of the environments.
5. Write appropriate robot programs by understanding the nature of the sensors, and actuators.

Course Learning Outcomes (CLO):

After completing the course, students will be able to:

CLO1 Discuss the moral implications of employing robots to address societal problems with authority.

CLO2 Provide an intuitive description of how sensors and actuators work and how they can be applied in various contexts depending on the problem at hand and the characteristics of the environment.

CLO3 Program the robot correctly by learning its sensors' and actuators' functions.

CLO4 Implement state-of-the-art algorithms for solving robotic tasks.

CLO5 Implement hardware and software to build a robot that can perform a task.

Mapping Course Learning Outcomes (CLOs) with the PLOs

CLOs	PLOs											
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1				√								
CLO2					√							
CLO3					√							
CLO4					√							
CLO5					√							

Course Content and Mapping CLOs with the Teaching-Learning& Assessment Strategy

Week	Contents	Teaching-Learning Strategy	Assessment Strategy	CLO
1.	Study the Laws of Robotics, Applications of Robots, Basic Components of Robot Systems.	Lecture, Discussion	Class Test	CLO1
2.	Study of Position, Orientation and Frames, Homogeneous Transformations.	Lecture,	Class Test	CLO1,

		Discussion		CLO2
3.	Study of Recursive Newton-Euler Formulation of Serial Manipulator, Lagrangian Formulation of Serial Manipulator.	Lecture, Discussion	Class Test	CLO2
4.	Study of Link Differential Transformation Matrix, Manipulator Jacobian Matrix, Conventional and Screw Based Jacobian of Serial Manipulator.	Lecture, Discussion	Class Test	CLO1, CLO2
5.	Study of sensors: Infrared Sensors, Ultrasonic Sensors, LiDAR Sensor, Camera Modules	Lecture, Discussion	Assignment	CLO2, CLO3
6.	Introduction to Face Recognition, Object Detection algorithms	Lecture, Discussion	Exam	CLO3
7.	**Review and makeup class form week 1 to 6 and Mid-semester exam.**			CLO1, CLO2, CLO3
8.	Study Control of Manipulators, Motor Control, Robot Sensors, Low Level Robot Vision	Lecture, Discussion	Class Test, Exam	CLO4
9.	Study of Robot Programming.	Lecture, Discussion	Class Test	CLO3
10.	Open loop and Closed loop systems, First Order and Second Order Systems,	Lecture, Discussion	Exam	CLO3, CLO4
11.	Study of PID Controller.	Lecture, Discussion	Class Test	CLO5
12.	Robot path planning and navigation algorithms, localization algorithms.	Lecture, Discussion	Assessment	CLO3, CLO5
13.	Study of Bluetooth, RFID, GPRS, GPS technologies.	Lecture, Discussion	Assessment	CLO4, CLO5
14.	**Review and makeup class form week 8 to 13 and Mid-semester exam.**			CLO3, CLO4, CLO5

Assessment Strategy	**Course Evaluation Process and Mark Distributions**		
Exam **Continuous Assessment:** Class Test, Report, Class Performance **Summative:** Mid-Term and Final Term Exams	1.	**Before Final**	**40%**
		a. Attendance:	5%
		b. Instant Test / Class Performance	10%
		c. Class Test	20%
		d. Report	5%
Make-up Procedures	2.	**Final Exam**	**60%**
		a. Viva	20%
		b. Final Lab Exam	40%
	Total:		**100%**

Learning Materials:

1. Modeling and Control of Robot Manipulators - Sciavicco and Siciliano, McGraw-Hill
2. Introduction to Robotics: Mechanics and Control - John J. Craig, Pearson Prentice Hall.
3. Robot Analysis - Lung-Wen Tsai, Wiley & Sons Inc.
4. Introduction to AI Robotics by Robin Murphy.
5. Introduction to Robotics: Mechanics and Control by John J. Craig
6. Corke, P., Robotics, Visionand Control: Fundamental Algorithms in Matlab, 2017, Springer.