Course Scheme - BS in Artificial Intelligence

Subject Category	Sr. #	Course Code	Name of Subject	Marks	Credit Hours		
					Theory	Practical	Total
First Semester							
General Ed.	1	BSSE101	Professional Practices	50	2	0	2
Computing Core	2	BSSE102	Programming Fundamentals	150	3	1	4
General Ed.	3	ENG101	Functional English	100	3	0	3
General Ed.	4	BSSE103	Introduction to Info. & Comm. Technologies	100	2	1	3
Natural Sciences	5	EL119	Applied Physics	100	3	0	3
Maths	-	MATH101	Foundation-I* (**Non-Credit 3+0**)	N/A	N/A	N/A	N/A
Total				**500**	**13**	**2**	**15**
Second Semester							
Computing Core	6	BSSE121	Object Oriented Programming	150	3	1	4
General Ed.	7	BSSE122	Economics & Management	50	2	0	2
Computing Core	8	BSSE123	Database Systems	150	3	1	4
Maths	9	MATH108	Applied Calculus	100	3	0	3
General Ed.	10	IS111 / SS104	Islamic Studies / Ethics	50	2	0	2
General Ed.	11	PS106	Pakistan studies	50	2	0	2
Maths	-	MATH102	Foundation-II* (**Non-credit 3+0**)	N/A	N/A	N/A	N/A
Total				**550**	**15**	**2**	**17**
Third Semester							
Computing Core	12	BSSE201	Data Structures & Algorithms	150	3	1	4
Computing Core	13	BSSE202	Computer Organization & Assembly Language	100	2	1	3
Computing Core	14	BSSE203	Digital Logic Design	100	2	1	3
Computing Core	15	BSSE204	Software Engineering	100	3	0	3
Maths	16	MATH212	Linear Algebra & Analytical Geometry	100	3	0	3
Total				**550**	**13**	**3**	**16**

*Only for Pre-Medical Group Students (Deficiency Courses of 6 credits of Mathematics in first two semesters)

			Fourth Semester				
Computing Core	17	BSSE221	Operating Systems	150	3	1	4
Computing Core	19	BSSE222	Analysis of Algorithms	100	3	0	3
Computing Core	18	BSSE223	Computer Networks	150	3	1	4
Maths	20	MATH214	Statistics & Probability	100	3	0	3
General Ed.	21	ENG201	Communication Skills	50	2	0	2
Total				**550**	**14**	**2**	**16**
			Fifth Semester				
AI Core	22	AI301	Programming for AI	100	2	1	3
AI Core	23	AI302	Machine Learning	100	2	1	3
AI Elective	24	BSSE303	AI Elective - I (**HCI**)	100	3	0	3
Computing Core	25	BSSE305	Information Security	100	3	0	3
General Ed.	26	BSSE306	Discrete Structures	100	3	0	3
General Ed.	27	ENT321	Introduction to Entrepreneurship and creativity	100	3	0	3
Total				**600**	**16**	**2**	**18**
			Sixth Semester				
AI Elective	28	AI321	AI Elective – II (**AOT**)	100	3	0	3
AI Elective	29	AI323	AI Elective – III (**SI**)	100	3	0	3
Computing Core	30	AI325	Artificial Intelligence	150	3	1	4
AI Core	31	BSSE326	Parallel and Distributed Computing	100	2	1	3
AI Core	32	AI327	Knowledge Representation & Reasoning	100	3	0	3
General Ed.	33	ENG301	Technical & Scientific Writing	50	2	0	2
Total				**600**	**16**	**2**	**18**

				Seventh Semester				
AI Core	34	AI401	Artificial Neural Networks	100	2	1	3
AI Elective	35	AI402	AI Elective – IV (**DM**)	100	2	1	3
AI Elective	36	AI404	AI Elective – V (**RL**)	100	3	0	3
AI Elective	37	AI406	AI Elective – VI (**NLP**)	100	3	0	3
Elective Support	38	BSSE408	Digital Marketing	50	2	0	2
Computing Core	39	AI498	Thesis/FYDP – I	100	0	3	3
Total				**550**	**12**	**5**	**17**
				Eighth Semester				
AI Core	40	AI421	Computer Vision	100	2	1	3
AI Elective	41	AI422	AI Elective – VII (**DL**)	100	3	0	3
General Ed.	42	BSSE424	Computational Sustainability	50	2	0	2
General Ed.	43	BSSE425	Internet of Things	50	2	0	2
Computing Core	44	AI499	Thesis/FYDP – II	100	0	3	3
Total				**400**	**9**	**4**	**13**
Grand Total				**4300**	**108**	**22**	**130**

AI Elective Courses

S. No.	Area	Subject Name	Theory	Practical
01	AI Elective-I	**BSSE303 – Human Computer Interaction**	3	0
		BSSE304 - Topics in Software Engineering	3	0
02	AI Elective-II	**AI321 – Theory of Automata**	3	0
		AI322 – Advance Statistics	3	0
03	AI Elective-III	**AI323 – Swarm Intelligence**	3	0
		AI324 – Fuzzy Systems	3	0
04	AI Elective-IV	**AI402 – Data Mining**	2	1
		AI403 – Data Science	2	1
05	AI Elective-V	**AI404 – Reinforcement Learning**	3	0
		AI405 – Knowledge based Systems	3	0
06	AI Elective-VI	**AI406 – Natural Language Processing**	3	0
		AI407 - Speech Processing	3	0
07	AI Elective - VII	**AI422 –Deep Learning**	3	0
		AI423 – Agent based Systems Modelling	3	0

HEC Guidelines wise statistics of Course Scheme

Subject Wise Statistics of Proposed Scheme with respect to NCEAC Guidelines					
Subject Category	**Proposed Scheme Credits (Courses)**	**NCEAC Guidelines Credits (Courses)**	**Course category**	**Proposed Scheme**	**NCEAC Guidelines**
General Ed.	28 (12)	30 (12)	Common Courses (Non Core)	~39%	~39%
Mathematics & Support	12 (4)	12 (4)			
Elective Support	2 (1)	3 (1)			
Computing Core	49 (14)	46 (14)	Computing & SE Courses (Computing & Core)	~61%	~61%
SE Core	18 (6)	18 (6)			
SE Elective	22 (7)	21 (7)			
Total Credits	**130 (44)**	**130 (44)**	**Theory Credits**		108
			Practical Credits		22
Total Marks			**4300**		
Even Practicals Credits		10	**Odd Practical Credits**		12

Curriculum Guidelines for BS(AI) – National Computing Council

General Structure for Computing Disciplines

Course Group	Credit Hours	Courses
Computing Core	46	14
Domain Core	18	6
Domain Elective	21	7
Mathematics & Support Courses	12	4
Elective Support Courses	3	1
General Education Requirement	30	12
TOTAL	**130**	**44**

Mapping of courses to PLOs of BS(AI)

S. No		Course Code	Course Title	PLO1 Academic Education	PLO2 Knowledge for Solving Computing Problems	PLO3 Problem Analysis	PLO4 Design/Development of Solutions	PLO5 Modern Tool Usage	PLO6 Individual and Team Work	PLO7 Communication	PLO8 Computing Professionalism and Society	PLO9 Ethics	PLO10 Lifelong Learning
1.	1st Semester	BSSE101	Professional Practices	✓							✓	✓	
2.		BSSE102	Programming Fundamentals		✓			✓					
3.		ENG101	Functional English	✓						✓			✓
4.		BSSE103	Introduction to Info. & Comm. Technologies	✓	✓			✓					
5.		EL119	Applied Physics		✓		✓						
6.	2nd Semester	BSSE121	Object Oriented Programming		✓			✓					
7.		BSSE122	Economics & Management	✓		✓					✓		
8.		BSSE123	Database Systems		✓		✓	✓					
9.		MATH108	Applied Calculus		✓								
10.		IS111 / SS104	Islamic Studies / Ethics	✓							✓	✓	
11.		PS106	Pakistan studies	✓							✓		✓
12.	3rd Semester	BSSE201	Data Structures & Algorithms		✓		✓	✓					
13.		BSSE202	Computer Organization & Assembly Language		✓			✓					
14.		BSSE203	Digital Logic Design		✓	✓	✓						
15.		BSSE204	Software Engineering		✓	✓							
16.		MATH212	Linear Algebra & Analytical Geometry		✓								
17.	4th Semester	BSSE221	Operating Systems		✓			✓					
18.		BSSE222	Analysis of Algorithms		✓	✓	✓						
19.		BSSE223	Computer Networks		✓		✓	✓					
20.		MATH214	Statistics & Probability		✓	✓							
21.		ENG201	Communication Skills						✓	✓			

S. No	Semester	Course Code	Course Title	Academic Education PLO$_1$	Knowledge for Solving Computing Problems PLO$_2$	Problem Analysis PLO$_3$	Design/Development of Solutions PLO$_4$	Modern Tool Usage PLO$_5$	Individual and Team Work PLO$_6$	Communication PLO$_7$	Computing Professionalism and Society PLO$_8$	Ethics PLO$_9$	Lifelong Learning PLO$_{10}$
22.	5th Semester	AI301	Programming for AI		✓		✓	✓					
23.		AI302	Machine Learning		✓			✓					
24.		BSSE303	Human Computer Interaction	✓	✓								
25.		BSSE305	Information Security		✓								
26.		BSSE306	Discrete Structures		✓		✓						
27.		ENT121	Introduction to Entrepreneurship and creativity						✓	✓	✓	✓	✓
28.	6th Semester	AI321	Theory of Automata		✓	✓	✓						
29.		AI323	Swarm Intelligence		✓		✓						
30.		AI325	Artificial Intelligence		✓		✓	✓					
31.		BSSE326	Parallel and Distributed Computing		✓	✓	✓	✓					
32.		AI327	Knowledge Representation and Reasoning		✓	✓	✓						
33.		ENG301	Technical and Scientific Writing	✓						✓			
34.	7th Semester	AI401	Artificial Neural Networks		✓		✓	✓					
35.		AI402	Data Mining		✓			✓					
36.		AI404	Reinforcement Learning		✓		✓						
37.		AI406	Natural Language Processing		✓								
38.		BSSE408	Digital Marketing	✓	✓		✓						
39.		AI498	*Thesis/FYDP - I	✓	✓	✓	✓	✓	✓	✓		✓	✓
40.	8th Semester	AI421	Computer Vision		✓	✓		✓					
41.		AI423	Deep Learning		✓								
42.		AI424	Computational Sustainability		✓		✓						
43.		AI425	Internet of Things		✓	✓	✓						
44.		AI499	*Thesis/FYDP - II		✓		✓	✓	✓	✓	✓	✓	✓
		TOTAL		10	36	6	14	9	4	6	6	5	5

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Professional Practices (BSSE101)**
Discipline	:	BS (SE/AI) (1st Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory: 20% Sessional, 30% Mid 50% Final
Credit Hours	:	02 + 00 **Marks :** 50
Contact Hours:		32 + 00

COURSE LEARNING OUTCOMES:
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Explain** moral responsibilities and obligations in their professional carrier.	C2	1
2	**Use** ethical methods to resolve ethical dilemma	C3	8
3	**Adopt** multi ethical ways in order to prevent dilemma in Professional life.	A3	9
4	**Apply** ethical and moral values in routine professional life.	A3	10

Program Learning Outcomes (PLOs):

1	Academic Education	☑	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☐	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☑
4	Design/Development of Solutions	☐	9	Ethics	☑
5	Modern Tool Usage	☐	10	Life-long learning	☑

Course outline:

Historical, social, and economic context of Computing (software engineering, Computer Science, Information Technology); Definitions of Computing (software engineering, Computer Science, Information Technology) subject areas and professional activities; professional societies; professional ethics; professional competency and life-long learning; uses, misuses, and risks of software; information security and privacy; business practices and the economics of software; intellectual property and software law (cyber law); social responsibilities, software related contracts, Software house organization. Intellectual Property Rights, The Framework of Employee Relations Law and Changing Management Practices, Human Resource Management and IT, Health and Safety at Work, Software Liability, Liability and Practice, Computer Misuse and the Criminal Law, Regulation and Control of Personal Information. Overview of the British Computer Society Code of Conduct, IEEE Code of Ethics, ACM Code of Ethics and Professional Conduct, ACM/IEEE Software Engineering Code of Ethics and Professional Practice. Accountability and Auditing, Social Application of Ethics.

Recommended Books:

- Professional Issues in Software Engineering by Frank Bott, Allison Coleman, Jack Eaton and Diane Rowland, CRC Press; Latest Edition (2000). ISBN-10: 0748409513.
- Computer Ethics by Deborah G. Johnson, Pearson; Latest Edition (January 3, 2009). ISBN-10: 0131112414.
- A Gift of Fire: Social, Legal, and Ethical Issues for Computing and the Internet (3rd Edition) by Sara Baase, Prentice Hall; Latest Edition (2008). ISBN-10: 0136008488.
- Applied Professional Ethics by Gregory R. Beabout, University Press of America (1993). ISBN-10: 0819193747.

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Programming Fundamentals (BSSE102)**
Discipline	:	BS (SE/AI) (1st Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	:	03 + 01 **Marks :** 100 + 50
Contact Hours	:	48 + 48

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Explain** concepts of functions, structures, pointers, OOP concepts in C++	C2	2
2	**Use** arrays, pointers, and OOP concepts to code C++ programs	C3	2
3	**Practice** robust computer programs using C++ programming language.	P3	5

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☑	10	Life-long learning	☐

Course outline:

BASIC OF C++ PROGRAMMING: Constants and variables, -keywords, Identifiers, variable types: Integer, long, float, double and character, Types of variables: automatic/local, static, external/global, Standard and user defined function.

INPUT AND OUTPUT FUNCTIONS: Introduction to Function, Difference between pre-defined/standard function and user defined function, Using more than one function, use of external variable, Prototype, function that return a value, Using arguments to pass Data to a function, Passing variables as arguments.

INPUT: single character, word and multiword, OUTPUT: single character and other data types, strings, Format specifiers, -field width specifiers, Escape sequence, printing strings, characters and graphic characters.

OPERATORS: Address operator (&), Arithmetic Operators, -operator precedence, Arithmetic Assignment operator, Special assignment operators, Relational Operators, -Increment and Decrement Operator.

DECISION-MAKING STATEMENTS & LOOPS: The if statement, The if-else statement, The else-if construct, Switch statement, goto statement, Conditional operator, For loop, Nested for loop, The while loop, The do while loop, Continue & break statement.

ARRAYS AND STRINGS: Define an Array, Initializing an array, Multidimensional arrays, Arrays as function arguments, Strings, null character, string functions.

POINTERS: Pointer variable, Returning multiple values from functions, Pointers and arrays, Pointers arithmetic, Pointers and strings, Double indirection: Pointers to pointers.

STRUCTURES UNION: Structures, Nested structures, Arrays of structures, Linked Lists, Routines, unions, Union of structures, Bit wise operator.

OBJECTS AND CLASSES: Objects and Classes, Member Functions and Data, Private and Public, Constructors and Destructors, Objects and the Real World When to use Objects.

OPERATOR OVERLOADING: The operator Keyword, Overloading Unary Operators, Overloading Binary Operators, Constructors as Conversion Routines, Converting between BASIC & user Defined Types, Thoughts on Overloading.

FILES: Standard file I/O, Character, string and formatted I/O, Block I/O, Binary and Text file modes, System level I/O, Random access, & redirection.

Practical Work to be carried out:

1. Basics of C++ Programming and IDE Environment
2. Variables and Constants
3. Data Types and Expressions
4. LOOPS
5. Decision making statements
6. Structures.
7. Functions.
8. Pointers.
9. Arrays
10. Objects and Classes.
11. Inheritance and Polymorphism
12. Strings.
13. Operator overloading.
14. Streams and Files.
15. Case Study/ Semester Project

Recommended Books:

- Peter Norton, Introduction to computers, Latest Edition.
- Robert Lafore, Object Oriented Programming in Turbo C++, Latest Edition.
- Deitel and Deitel, C++ How to Program, Prentice Hall Publications, Latest Edition

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	:	Introduction to Information & Communication Technologies (BSSE103)
Discipline	:	BS (SE/AI) (1st Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory: 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination

Credit Hours	:	02 + 01	**Marks :** 50 + 50
Contact Hours:		32 + 48	

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Explain** and identify the various components and concepts related to ICT. Do number systems conversions and arithmetic	C2	1
2	**Apply** ICT to solve real world problems.	C3	2
3	**Operate** necessary software for supporting, everyday usage of Computer and Communication Systems.	P3	5

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☑	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☑	10	Life-long learning	☐

Course outline:

COMPUTER SYSTEMS: Brief history of Computer, Four Stages of History, Computer Elements, Processor, Memory, Hardware, Software, Application Software its uses and Limitations, System Software its Importance and its Types, Types of Computer (Super, Mainframe, Mini and Micro Computer), Introduction to CBIS (Computer Based Information System), Methods of Input and Processing, Class2. Organizing Computer Facility, Centralized Computing Facility, Distributed Computing Facility, Decentralized Computing Facility, Input Devices. Keyboard and its Types, Terminal (Dump, Smart, Intelligent), Dedicated Data Entry, SDA (Source Data Automation), Pointing Devices, Voice Input, Output Devices. Soft- Hard Copies, Monitors and its Types, Printers and its Types, Plotters, Computer Virus and its Forms, Storage Units, Primary and Secondary Memories, RAM and its Types, Cache, Hard Disks, Working of Hard Disk, Diskettes, RAID, Optical Disk Storages (DVD, CD ROM), Magnetic Types, Backup System, Data Communications, Data Communication Model, Data Transmission, Digital and Analog Transmission, Modems, Asynchronous and Synchronous Transmission, Simplex. Half Duplex, Full Duplex Transmission, Communications, Medias (Cables, Wireless), Protocols, Network Topologies (Star, Bus, Ring), LAN, LAN, Internet, A Brief History, Birthplace of ARPA Net, Web Link, Browser, Internet Services provider and Online Services Providers, Function and Features of Browser, Search Engines, Some Common Services available on Internet.

Types of Computers, Parts of computers, hardware, input/output devices, storage devices, software, system software, operating systems, application software, computer users, graphical user interface,

interacting with your computer, Interpreter and Compilers.

DATA PROCESSING AND STORAGE: Data representation, bit and bytes, text codes, data processing, CPU, machine cycles, internal clock, factors affecting processing speed, modern CPU, parallel processing, organization and identification of data, backing up data, optimizing disk performance, files and databases.

WORKING WITH COMPUTER LOGIC: Number Systems, Decimal, Binary, Octal, Hexadecimal, Binary Addition, Multiplication and Division, Boolean algebra Concepts, Electronic logic gates, Truth table, Canonical forms, Karnaugh maps, Quine Mc-Clusky methods, Introduction to combinational logic design.

IMPACT OF ICT ON SOCIETY: How ICT effects the society, applications in education sector, finance, business, home, etc. Advantages and Disadvantages.

Practical Work to be carried out:

1. Understanding your operating system and troubleshooting basic problems
2. Efficiently using Internet and Search Engines
3. Getting familiar with MS Word
4. Working with Advanced features of MS Word
5. Technical Writing with MS Word
6. Working with MS PowerPoint
7. Enhancing presentations using animations and business models
8. Getting familiar with MS Excel
9. Working with formulae and functions in MS Excel
10. Using a sophisticated text editor for programming
11. Getting familiar with Git and GitHub
12. Team Collaboration using a Remote Access Software
13. Creating Google Forms
14. Getting familiar with basic HTML Syntax
15. Case Study

Recommended Books:

- Peter Norton, Introduction to computers, Latest Edition.
- *Brian K. Williams, Stacey C. Sawyer, Using information technology* : a practical introduction to computers & communications, Latest Edition

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	:	**Applied Physics (EL119)**
Discipline	:	BS (SE/AI) (1st Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Define** the basic concepts and fundamental laws of electrostatic and magnetism.	C2	2
2	**Explain** the comprehensive knowledge of semiconductor physics, optics and lasers	C2	2
3	**Define** the fundamental knowledge of modern physics	C2	2

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork		☐
2	Knowledge for Solving Computing Problems	☑	7	Communication		☐
3	Problem Analysis	☐	8	Computing Professionalism and Society		☐
4	Design/Development of Solutions	☐	9	Ethics		☐
5	Modern Tool Usage	☐	10	Life-long learning		☐

Course outline:

Electrostatics: Coulomb's law, electric field and potential, capacitance, dielectrics. Electrodynamics: Magnetic field and force, sources of magnetic field, electromagnetic induction, inductance. Solid-state physics: Crystal lattices, unit cells, energy bands, allowed and forbidden states, conductors, semiconductors, insulators. Semiconductors: Composition, purity, n- and p-type materials, carrier properties and distribution. Carrier action: Diffusion, drift, generation, recombination. Conductivity, mobility, p-junction diode, diode curve, forward-biased diode, reverse-biased diode, bipolar junction transistor and its biasing, MOSFET and its biasing, Hall effect. Optics: Optical absorption, photo-luminescence, photoconductivity, photoelectric effect, lasers, superconductivity. Heat and Thermodynamics in relation to cooling of electronics. Electric fields, Gauss' law, electric potential, capacitance and dielectrics, current and resistance, magnetic fields, sources of magnetic field, Faraday's law, inductance, direct current circuits, alternating current circuits, diode characteristics, transistor characteristics nature of light, geometric optics, laws of geometric optics, interference of light waves, diffraction, polarization.

Recommended Books:

- Halliday, Resnick and Walker, "Fundamentals of Physics" 10th Edition Extended
- Hugh D. Young and R.A. Freedman, University Physics. 12th Edition
- Raymond A Serway and John W. Jawett, Jr. Physics for Scientists and Engineers with modern Physics, 09th Edition.

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Functional English (ENG101)**
Discipline	:	BS (SE/AI) (1st Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Rewrite** varied contents including official letters, e-mails, and applications and summarize the texts using appropriate grammatical mechanisms and cohesive devices.	C2	7
2	**Apply** skimming, scanning and detailed reading and listening strategies to understand gist of the text/conversation.	C3	1
3	**Demonstrate** their skills using English language to express their point of view, show arguments and deliver a presentation in a real life situations.	C3	10

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☑	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☐	7	Communication	☑
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☑

Course outline:
READING: Interactive Reading, apply the skills of surveying skimming, scanning and detailed reading and identify topic sentence.

WRITING: Audience Related Writing, composition of sentences, Paragraph, short descriptive writing, précis and letter and application, identify contextual clues with the help of cohesive devices.

LISTENING: Collect gist and important points from a listening text or any other oral source viz. Lecture, speech or conversation.

SPEAKING: Taking part in different real life situations, answer question, argue and explain one's point of view, ask for information and turn taking techniques and presentation skills.

GRAMMAR: Mechanics of English Language, Punctuation, vocabulary, conversion of words, tenses and sentence structure

Recommended Materials: Dawn newspaper, Reader Digest, New Scientist and other interesting materials selected by teachers

Recommended Books:
- J, Thomson and A. v. Martinet and Practical English Grammar
- Sarwar Zakia, (Edt) 1991 English Study Skills A Spelt Publication Karachi.

- R.R. Jordon, 1980 Collins Study skills in English. William Collins Sons & Co. Glasgow Great Britain.
- Jones Rhodri, 1986, A New English Course (An Approach to GCSE English Language for Individual Study or Class Use).
- K. James at al, 1986, Listening Comprehension and Note-Taking Course (Collins Study Skills In English).
- Selected Text from Dawn, Readers Digest, New Scientist and other relevant material of teacher's Choice.

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	:	**Foundation-I (MATH 101)**
Discipline	:	BS (SE/AI) (1ˢᵗ Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	Matriculation
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 **Marks :** 100
Contact Hours	:	48

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Explain** real and complex numbers, functions and limits	C2	2
2	**Apply** the differential and integral calculus.	C3	2
3	**Practice** Limits, Functions and their derivatives.	C3	2

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☑	10	Life-long learning	☐

Course Learning Outcomes
After completion of this course the students should be able to identify real and complex numbers, functions and limits, apply the differential and integral calculus.

Contents:
Complex Numbers: Algebra of complex numbers, additive and multiplicative inverse of complex numbers.
Functions: Binary relations and functions.
Introduction to limit: Limits and continuity of functions.
Derivatives: Derivative of a function at a point, basic and elementary functions, implicit functions, parametric differentiation and chain rule. Geometrical and physical meaning of derivative.
Integral Calculus: Integration and its elementary rules**.** Methods of integration by substitutions, completing squares, parts and partial fractions.

Books Recommended:
- **Mathematics for class XI, SindhText Book Board, Jamshoro.**
- **Mathematics for class XII, SindhText Book Board, Jamshoro.**

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Object Oriented Programming (BSSE121)**
Discipline	:	BS (SE/AI) (2nd Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	:	03 + 01 **Marks :** 100 + 50
Contact Hours:		48 + 48

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Explain** principles of object oriented paradigm, class libraries, exception handling.	C2	2
2	**Use** objects and their relationships to build object oriented solutions	C3	2
3	**Follow** OOP concepts to develop Programs	P3	5

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☑	10	Life-long learning	☐

Course outline:

INTRODUCTION TO OBJECT ORIENTED PROGRAMMING: Objects, Classes, Messages, OOP principles, Encapsulation, Inheritance, Polymorphism, what is Java, History of Java, Features of Java, Class library, Java Environment, Byte code, JVM, Java Applications & Applets, Comments, White Spaces, Identifiers, Separators, Keywords, Reserved words, Variables, Data Types, Operators, Mathematical functions and constants, Expressions, Escape Sequences, Type Conversion and Casting.

\   **JAVA CONTROL STATEMENTS:** Java Selection statements (if, if-else, switch), Loop Statements (while, do-while, for), nested loops, break and continue statements.

ARRAYS AND STRINGS: Array Variables, defining arrays, Accessing Elements, Initializing arrays, Array Length, Multidimensional Arrays, Array of characters, Strings and common Operations on Strings.

INTRODUCING CLASSES INHERITANCE: General Form of a Class, Variables and Methods in Class Definition, Defining Methods, Declaring Objects, Returning a value, Parameter List, Constructors, Parameterized Constructors, this Keyword, Method overloading, Types of Arguments, Objects as parameters, Returning Objects, Access Specifies, Understanding static, Nested and Inner Classes, finalize method, Inheritance Basics, Member Access and Inheritance, Using Super, Multilevel Hierarchy, Method Overriding, Dynamic Method Dispatch, Abstract Classes.

PACKAGES AND INTERFACES: Understanding Packages, defining a package, Packages and Directory Structure, Understanding CLASSPATH, Standard Packages, Importing Packages, Interfaces, Implementing Interfaces, Extending Interfaces, Multiple Interfaces, Anonymous Classes.

EXCEPTION HANDLING: Exception Handling Basics, Exception Types, Uncaught Exceptions, Using Try and Catch, Multiple Catch Clauses, Nested Try Statements, throw statement, throws clause, finally Block, Built-in Exceptions.

MULTITHREADING INTRODUCING THE AWT AND JAVA GUI: Understanding threads, Class Thread, Thread Life Cycle, Priority, Synchronization, Run able Interface, AWT classes, Windows Fundamentals, Graphics Context, Color and Font Controls, Drawing Lines, Rectangles, Ovals etc, Labels, Buttons, Text Fields, Checkboxes etc, Event Handling, Layout Managers, Menu Bars, Dialog Boxes.

IMAGES, SOUND AND ANIMATION: Displaying Images, Image Observers, Media Tracker, Double Buffering, Playing Sound Clips, Sound API.

Practical Work to be carried out:

1. Installation of Java, Basic Program Structure, Identifiers and Primitive data types
2. Demonstrating various operators in Java
3. Working with iterative structures
4. Working with conditional structures
5. Implementation of arrays
6. Implementing the concepts of encapsulation
7. Implementing the concepts of inheritance
8. Implementing the concepts of Polymorphism
9. Exception and Error Handling.
10. Demonstrating Threads and Multi Threaded Programming logics
11. Understanding I/O Fundamentals
12. Building GUI components
13. Applying various Layouts managers
14. Java Event handling.
15. Java Database Connectivity

Recommended Books:

- H. M. Deitel, P.J. Deitel, "Java How To Program", Latest Edition , Prentice Hall
- Ivor Horton, "Beginning Java 2", Wrox Corp, Latest Edition.
- Patrick Naughton, Herbert Schildt, 'Java 2 : The Complete Reference", Latest Edition.,Osborne/McGrawHill
- Joseph L. Weber, ":Special Edition Using Java 2 Platform", Prentice Hall India, Latest Edition.

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	:	**Economics & Management (BSSE122)**
Discipline	:	BS (SE/AI) (2nd Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory: 20% Sessional, 30% Mid 50% Final
Credit Hours	:	02 + 00 **Marks :** 50
Contact Hours:		32 + 00

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Apply** fundamentals of software economics engineering by considering the basic but important terminologies.	C3	1
2	**Examine** cost estimation methods by giving careful attention towards economics lifecycle and uncertainty.	C4	3
3	**Apply** estimation methods to manage small to large business models	C3	8

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☑	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☐	7	Communication	☐
3	Problem Analysis	☑	8	Computing Professionalism and Society	☑
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:

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

INTEREST RATE AND ECONOMIC EQUIVALENCE: Interest: The Cost of Money, Economic Equivalence, Development of Formulas for Equivalence Calculation, Unconventional Equivalence Calculations

UNDERSTANDING MONEY AND ITS MANAGEMENT: Nominal and Effective Interest Rates Equivalence Calculations with Effective Interest Rates and with Continuous

PAYMENTS: Changing Interest Rates, Debt Management, Investing in Financial Assets

PRESENT-WORTH ANALYSIS: Project Cash Flows, Initial Project Screening Methods: payback, Screening and Discounted Cash

FLOW ANALYSIS: Variations of Present-Worth Analysis, Comparing Mutually Exclusive Alternatives

ANNUAL EQUIVALENT-WORTH ANALYSIS: Annual Equivalent-Worth Criterion, Capital Costs versus Operating Costs, Applying Annual-Worth Analysis, Life-Cycle Cost Analysis, Design Economics

RATE-OF-RETURN ANALYSIS: Rate of Return and Methods of Finding It, Internal Rate-of-Return Criterion, Mutually Exclusive Alternatives

COST CONCEPTS RELEVANT TO DECISION MAKING: General Cost Terms; Classifying Costs for Financial Statements, Cost Classifications for Predicting Cost Behavior, Future Costs for Business Decisions, Estimating Profit from Production

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

DEVELOPING PROJECT CASH FLOWS: Cost-Benefit Estimation for Engineering Projects, Developing Cash Flow Statements

PROJECT RISK AND UNCERTAINTY: Origins of Project Risk, Methods of Describing Project Risk: Sensitivity, Break-Even and Scenario Analysis

SPECIAL TOPICS IN ENGINEERING ECONOMICS: Replacement Decisions, Capital Budgeting, Decisions, Economic Analysis in the Service Sector

Recommended Books:

- Software Engineering Economics and Declining Budgets by Pamela T. Geriner, Thomas R. Gulledge, William P. Hutzler, Springer Verlag, (Latest Edition)
- Estimating Software Costs: Bringing Realism to Estimating, Capers Jones, McGrawHill Osborne Media; (Latest Edition)
- Software Cost Estimation and Sizing Methods, Issues, and Guidelines, Shari Lawrence Pfleeger, Rand Publishing, (Latest Edition)

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Database Systems (BSSE123)**
Discipline	:	BS (SE/AI) (2nd Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	:	03 + 01 **Marks :** 100 + 50
Contact Hours:		48 + 48

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Explain** the fundamental concepts of database systems, functional dependencies, true essence of data integrity and normalization.	C2	2
2	**Use** SQL statements including DDL, DCL, DML, TCL, DCL for database definition and manipulation.	C3	2
3	**Plan** conceptual, logical and physical database schemas using different data models.	C4	4
4	**Practice** programs using procedural language extension of SQL on ORACLE.	P3	5

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork		☐
2	Knowledge for Solving Computing Problems	☑	7	Communication		☐
3	Problem Analysis	☐	8	Computing Professionalism and Society		☐
4	Design/Development of Solutions	☑	9	Ethics		☐
5	Modern Tool Usage	☑	10	Life-long learning		☐

Course outline:

FILES AND DATABASE CONCEPTS

Basic database concepts, Database approach vs. file based system, Database Environment Roles, Advantages and Disadvantages of Database System, Three Level Architecture, Database Languages, Data Models and Conceptual Modeling, DBMS Functions, Multi-user DBMS Architecture, Data Dictionaries; Relational Model, Relational Integrity, Views, Codd Rule, Database Planning, Entity Relationship Modeling, Structural Constraints, ERD Model Problems, ERD Tools, Normalization, Anomalies, Functional Dependencies.

INTRODUCTION TO MANAGING DATA

Characteristics of DBMS, Concept of RDMS & its characteristics, Codd's Law for RDBMS, Introduction to ORACLE Tools

STRUCTURED QUERY LANGUAGE (SQL)

Interacting SQL*Plus, Data Manipulation in DBMS, the ORACLE Data types, Two Dimension Matrix creation, Insertion of Data into tables

MANAGING TABLES

Select Statement and its supporting Clauses and with its various applications, Insertion of Data into Tables, Updating the Contents of Tables, Deletion Operations

MODIFYING THE STRUCTURE OF TABLE

Adding & Modifying new and existing columns, Restrictions on the Alter tables, Removing tables, Deleting & Dropping tables

DATA CONSTRAINTS

Column & Table level constraints, Primary & Foreign Key concepts, Application of other Data constraints

ORACLE FUNCTIONS

Character Function, Numeric Functions, Date Functions, Single row Function, and Group functions.

JOINING

Introduction to Joining, Equi-Join, Non-Equi join, self-joining, vertical joining (union, intersect and minus Clause)

INDICATES, VIEWS AND SEQUENCES

Creating & mapping indexes, Application of views, creating & managing views & sequences.

GRANTING PERMISSIONS

Permission on the objects, Granting permissions, Object privileges, Revoking permissions

PL/SQL

Introduction to PL/SQL, PL/SQL execution environment, Block structure, ORACLE transaction

ERROR HANDLING IN PL/SQL

Introduction, Declaring Exceptions, Implicit & Explicit Exceptions, Predetermined internal PL/SQL exceptions.

CURSORS

Introduction to Cursors, Explicit cursor, implicit cursor, creating & Managing Explicit / Implicit Cursors, Attributes, Explicit & Implicit cursor Attributes cursor for loops.

\   **STORED PROCEDURES/TRIGGERS**

Introduction, Internal structures, Deleting procedures, Advantages of procedures, Deleting stored procedures.

STORED FUNCTIONS

Introduction, Internal structures, Deleting functions, Advantages of Functions, Deleting stored functions.

Practical Work to be carried out:

1   Installation of ORACLE.
2   Data Modeling.
3   Normalization.
4   Demoralization.
5   Database Connectivity.
6   SQL Injections and Prepared Statements.
7   Joins.
8   Sub-Queries.
9   Views and Indexes.
10   Access Control.
11   PL/SQL, control structure and data types.
12   Cursors
13   Exception Handling.
14   Stored procedures and Stored functions.
15   Semester Project

Recommended Books:

- Database Systems: A Practical Approach to Design, Implementation, and Management, Book by Carolyn E. Begg and Thomas M. Connolly Latest Edition.
- Relational Database Management System: A Project-based Tutorial by Gerard Blokdyk, Latest Edition.
- Oracle 11g with PL/SQL Approach by Cadcim Technologies , Sham Tickoo & Sunil Raina Latest Edition

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Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
<u>Department of Software Engineering</u>

Title of Subject	:	<u>**Islamic Studies (IS111)**</u>
Discipline	:	BS (SE/AI) (2nd Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	02 + 00 **Marks :** 50
Contact Hours	:	32 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Discover** his/her identity in a multicultural world	C2	9
2	**Explain** solutions to his/her problems from own cultural practices, rather than be influenced by external ideologies.	C2	8
3	**Review** why Muslims fail to equip themselves with essential survival tools needed in the world today.	C2	1

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☑	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☐	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☑
4	Design/Development of Solutions	☐	9	Ethics	☑
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:
QURAN AND ULOOM UL QURAN
\ Basic Themes of Quran, Introduction to Sciences of Hadith, Introduction to Islamic Jurisprudence, Primary & Secondary Sources of Islamic Law. Surah Al-Hujurat., Surah Al-Furqan (These both surahs cover all topics related to ethical values of Islamic society including Taqwa,Taqwa, Simplicity, Lawful earning, Social Justice, Rights of Parents, elders, neighbors, Fear of Allah and Truthfulness), Excellence of Holy Quran (Aijazul Quran), History of collection and compilation of Holy Quran.
BASIC BELIEFS OF ISLAM
Tauheed, its importance, effects on the life of believer, shirk and its types, Existence of Angles, Holy Scriptures, Prophethood, its need and necessities, characteristics and Finality of Prophethood, Concept on life hereafter.
LIFE HISTORY OF HOLY PROPHET MUHAMMAD (ﷺ)
Life history at Makkah (Before Prophethood), Life history at Makkah (after Prophethood), Life history at Madina {including Brotherhood, Charter of Madina, Victory of Makkah and Last Sermon of Holy Prophet Muhammad (ﷺ), Importance of Hadith and Sunnah, Ten selected Ahadiths (Covering topics related to Proper usage of time, Hospitality, quality of shyness, love   and affection to humanity, facilitate to others and tolerance etc).
FUNDAMENTALS OF ISLAM
Testifying Kalima Shahadah, Prayer, its importance, pre-conditions, obligations and effects, Zakat, its aims & objectives, Requirements, Legal recipients, Nisab and benefits, Fasting, its philosophy, requirements and benefits, Pilgrimage, requirements, types, obligations, procedure and benefits, Jihad and its types.

ISLAM AND SCIENCE

Quran and Science, Importance of science and technology in Islam, Historical contribution of Islam and Muslims in the development of science, Verses of Holy Quran those cover different fields of science e.g. social, management and natural science.

Recommended Books:

- A.A. Umrani, Islam: The universal Religion, Naseem book depo, latest edition.
- A.Q. Natiq, Sirat-e-Mustaqeem, Urdu bazzar Karachi, latest edition.
- S.M. Saeed, Islam aurHamariZindagi, Naseem book depo, latest edition.
- M. Shabudden, Quran Science and Muslims, Al Maktabah Al Ashrafiya, Lahore, latest edition.

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	**:**	**Foundation-II (MATH 102)**
Discipline	**:**	BS (SE/AI) (2nd Semester)
Effective	**:**	23 Batch & onwards
Pre-requisite	**:**	Matriculation
Assessment	**:**	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	**:**	03 **Marks :** 100
Contact Hours	**:**	48

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Explain** matrix algebra, linear equations and matrices and determinant	C2	2
2	**Explain** Real Numbers Sets and algebra, Binary relations; functions and its types; algebraic and transcendental functions	C3	2
3	**Apply** elementary operations and two dimensional analytical geometry.	P3	5

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☑	10	Life-long learning	☐

Object   **:** After completion of this course the student should be able to perform the basic operations of matrix algebra, solve the system of linear equations, and evaluate the matrices and determinant along with elementary operations and two dimensional analytical geometry

Contents:

Sets: Real Numbers. Sets and algebra on sets. Binary relations; functions and its types; algebraic and transcendental functions.

Introductions to matrices and elementary row operations. Brief introduction of matrices. Types of matrices. Elementary row operations. Inverse of a matrix using elementary row operations.

Determinants: Introduction to determinants, properties of determinants of order n, inverse of a matrix and Cramer's rule.

System of linear equations. System of non-homogeneous and homogeneous linear equations. Gaussian elimination method, Gauss Jordan method. Application of system of linear equations.

Analytical Geometry of R^2: Distance formula, ratio formula. Equation of a line. Parallel and perpendicular lines.

Books Recommended:
- **Mathematics for class XI, Sindh Text Book Board, Jamshoro.**
- **Mathematics for class XII, Sindh Text Book Board, Jamshoro.**
- **S.M.Yusuf, Mathematical Methods, Ilmi Kitab Khana, Lahore.**

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	:	**Applied Calculus (MTH108)**
Discipline	:	BS (SE/AI) (2nd Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks:** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Evaluate** the functions and their derivatives.	C4	2
2	**Assess** the Integral calculus with applications	C4	2
3	**Apply** the vector calculus in the field of engineering	C3	2

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:

INTRODUCTION TO FUNCTIONS
Mathematical and physical meaning**,** graphs, and types of function.
INTRODUCTION TO LIMITS
Theorems of limits and their applications to functions. Right-hand and left-hand limits. Continuous and discontinuous functions and their applications.
DERIVATIVES
Introduction to derivatives. Geometrical is the physical meaning of derivatives. Partial derivatives and their geometric significance. Application problems (rate of change, marginal analysis).
HIGHER DERIVATIVES
Leibnitz theorem, Rolle's theorem,Mean value theorem. Taylors and Maclaurins series.
EVALUATION OF LIMITS USING L' HOSPITAL'S RULE
Indeterminate forms $(0/0)$, (∞/∞), $(o x \infty)$, $(\infty-\infty)$, 1^{∞}, ∞^0, 0^0.
APPLICATION OF DERIVATIVES
Asymptotes, curvature and radius of curvature, differentialsthe with application.
APPLICATION OF PARTIAL DERIVATIVES
Euler's theorem, total differentials; maxima and minima of function of two variables.
INTEGRAL CALCULUS
Methods of integration by substitution and by parts. Integration of rational and irrational algebraic functions. Definite integrals, improper integrals. Gamma and Beta functions; reduction formulae.
APPLICATION OF INTEGRAL CALCULUS
Cost function from marginal cost, rocket flights; area under the curve.

VECTOR CALCULUS

Vector differentiation and vector integration with their physical interpretation and applications. ∇operator, gradient, divergence and curl with their application.

Recommended Books:

- Benice, D.D., Brief calculus and its applications.
- Raymond, A.B., Applied calculus.
- Yousuf, S.M., Calculus and analytical Geometry, IlmiKitabKhana, Lahore, latest edition.

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	:	**Pakistan Studies (PS106)**
Discipline	:	BS (SE/AI) (2nd Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	02 + 00 **Marks :** 50
Contact Hours:		32 + 00

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Discuss** the Muslim Nationalism in South Asia and the creation of Pakistan.	C2	1
2	**Explain** the Constitutional, Political and Diplomatic History of Pakistan	C2	10
3	**Analyze** the Geo-strategic importance of Pakistan and contemporary challenges to Pakistan	C4	8

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☑	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☐	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☑
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☑

Course outline:

THE HISTORICAL BACKGROUND OF PAKISTAN
Evolution and growth of Muslim society in Subcontinent
Muslim Revivalist and Reformist Movements
The Factors that shaped the Muslim Nationalism in the Subcontinent
The Factors that led birth to Pakistan
Ideology of Pakistan with special reference to Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah
Role of Sindh in Making of Pakistan
HISTORY OF INTERNAL AND EXTERNAL AFFAIRS OF PAKISTAN
The Constitutional and Political Developments in Pakistan (1947-1973)
The Constitution of 1973; Salient Features and Amendments
Political Development in Pakistan (1973 to date)
Determinants of Foreign Policy of Pakistan
Pakistan's Relations with Big Powers
CONTEMPORARY PAKISTAN (ISSUES AND CHALLENGES)
Geo-Strategic Significance of Pakistan
Economic Potential and its Utilization
Challenges to National Security of Pakistan
Internal Political, Economic and Legal Problems
Futuristic Outlook of Pakistan

Recommended Books:

- Abdul Sattar, (2017), Pakistan's Foreign Policy 1947–2016 A Concise History (4th ed.), Karachi: Oxford University Press.
- Cohen Stephen, (2011), The Future of Pakistan. Washington: Brookings Institute Press.
- Hussian, Zahid, (2007), Front line Pakistan: The Struggle with Militant Islam, New York: I.B.Tauris.
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- Kazimi, M. R., (2008), A Concise History of Pakistan, Karachi: Oxford University Press.
- Khan, Hamid, (2017), Constitutional and Political History of Pakistan (3rd ed.), Karachi: Oxford University Press.
- Long, Roger D., (2015), A History of Pakistan, Karachi: Oxford University Press.
- Rais, RasulBakhsh, (2017), Islam, Ethnicity, and Power Politics: Constructing Pakistan's National Identity, Karachi: Oxford University Press.
- Riedel, Bruce, (2011), Deadly Embrace: Pakistan, America, and the Future of Global Jihad, Washington: Brookings Institute Press.
- Sayeed, K. B., (1960), Pakistan: The Formative Phase, Karachi: Oxford University Press.
- Talbot, Ian, (2014), Pakistan: A New History, Karachi: Oxford University Press.
- Wolpert, Stanley, (1997), Jinnah of Pakistan, Karachi: Oxford University Press.

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject **:**		**Ethics (SS104)**
Discipline	:	BS (SE/AI) (2nd Semester)
Effective	:	23SW & onwards
Pre-requisite	:	None
Assessment	**:**	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	02 + 00 Marks: 50
Contact Hours:		32 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	Describe stable and healthy civilized atmosphere.	C2	8
2	Discover uniformity of moral beliefs and behavior.	C2	9

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☐	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☑
4	Design/Development of Solutions	☐	9	Ethics	☑
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:
Ethics: Definition of Ethics, Position of ethics in different religions.
Islam: Introduction, Role of Beliefs and Arakans in character building, Rights of Non-Muslim, Ill effects of corruption and respect of law.
Hinduism: Introduction, Role of doctrines in character building, Religious books, Concept of Re-Birth and its influence in social life, Celebration days and their social effects, Comparative study of cast systems in the contemporary atmosphere.
Buddhism: Introduction, Doctrines, Eight Nobel Paths of Buddha and its benefits, Critical study on concept of Renunciation of material & worldly life.
Christianity: Introduction, Doctrines, Religious books, Celebration days.
Judaism: Introduction, Doctrines, Religious books, Ten Commandments of Moses and its importance in social life.
Moral values of different religions: Patience, Modesty, Moderation, Tawakal, Taqwa, Lawful earning, Sincerity, Positivity, Forgiveness and Softening.
Bad morals: lying, pride, selfishness, Fame, Greed, Extravagantness, Bribe, Social injustice, Religious biasness and Discrimination on the basis of race, color and faith

Text Books:
1. Dr. A Rasheed, Comparative Study of Religions Tahir sons Karachi, latest edition.
2. AadilFaraz, IkhlaqiyatMazahib-e-Aalamkinazar main, ApnaIdara Lahore latest edition.

Reference Books:
1. Jeoge D. Chryssides, the study of religions – an introduction to key ideas and methods, London, latest edition.
2. GhulamRasool Cheema MazahibAalamkaMutalia, Ilm o Irfan publishers Lahore latest edition.

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
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Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	:	**Data Structures and Algorithms (BSSE201)**	
Discipline	:	BS (SE/AI) (3rd Semester)	
Effective	:	23 Batch & onwards	
Pre-requisite	:	None	
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final	
		Practical: 50% Sessional, 50% Final Examination	
Credit Hours	:	03 + 01	**Marks :** 100 + 50
Contact Hours:		48 + 48	

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Classify** various data structures such as arrays, lists, trees, graphs etc.	C2	2
2	**Correlate** algorithms associated with each data structure.	C4	2
3	**Demonstrate** the implementation of algorithms programmatically	C3	4
4	**Construct** problem specific algorithms	P4	5

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☑	10	Life-long learning	☐

Course outline:
INTRODUCTION TO BASIC CONCEPTS
Data Structures, why we need Data Structure? Data Structure Philosophy, Elementary Data Organization, Data Structure Selection & Algorithm Development, Data Structure Operations, Space-Time Analysis.
OOP CONCEPTS AND INTRODUCTION TO JAVA
Introduction, Basic Java Programming, Objects, Classes, Messages, OOP principles, Encapsulation, Inheritance, Polymorphism, Class library, Java Environment, Byte code, JVM, Comments, White Spaces, Identifiers, Separators, Keywords, Reserved words, Variables, Data Types, Operators, Mathematical functions and constants, Expressions, Escape Sequences, Type Conversion and Casting.
APPLICATION OF ARRAYS
Array as an ADT, Representation of Arrays, Array Operations, Multi-Dimensional Arrays, Application of Records, Unions, Nested Structures, Arrays of Structures.
LINKED LISTS
Lists and Linked Lists, Dynamic Data Implementations of Linked Lists, Traversing Linked Lists, Searching Linked Lists, Inserting & Deleting Nodes, Advantages & Disadvantages of Dynamic Linked Lists.
STACKS, QUEUES & RECURSION
Definition & Examples, Representing Stacks, Arithmetic Expressions, Queue And Its Sequential Representation.
Recursive Definitions, When to Use Recursion, applications.

SORTING, SEARCHING TECHNIQUES & ALGORITHM EFFICIENCY ANALYSIS

Why sorting? Elementary sorts: selection, insertion, bubble sort. Quick sort, merge sort, heap sort, External sorting, Searching Algorithms, Hashing.

Big-O Notation, Control Structures and Run Time Performance, and Run Time Performance, Analyzing Run Time Performance of an Algorithm, Average, best and worst case analysis.

TREES & GRAPHS

Terminology of Trees; Binary Trees, Binary Search Trees, Prosperities, Binary Tree Traversal, Binary Expression Trees, Sorting with Binary Trees, General Trees.

Linked Representation of Graphs, Graph Traversals, Breadth and depth first searches, Shortest path.

Practical Work to be carried out:

- conditional and control structures in Java.
- Arrays
- Objects and classes.
- Linear Search Algorithms.
- Binary Search Algorithms
- Merge sort & Heap sort.
- Bubble sort, Quick Sort and insertion sort.
- Linked list.
- Queues.
- Stacks.
- Trees.
- Graph.
- Binary tree traversals.
- Recursion.
- Case Study

Recommended Books:

- Robert Lafore, "Data structures & Algorithms in java", Latest Edition.
- Weiss Mark Allen, "Data structures & Algorithms Analysis", Latest Edition.
- Herbert Schildt, "The Complete Reference Java2", Latest Edition.

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Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Computer Organization and Assembly Language (BSSE202)**
Discipline	:	BS (SE/AI) (3rd Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory: 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	:	02 + 01 **Marks :** 50 + 50
Contact Hours:		32 + 48

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Acquire** the basic knowledge of computer organization computer architecture and assembly language.	C2	2
2	**Use** I/O and memory organization concepts and management of memory units	C3	2
3	**Demonstrate** knowledge of computer architecture to develop assembly language programs	P3	5

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☑	10	Life-long learning	☐

Course outline:
INTRODUCTION
Introduction to computer systems: Information is bits + context, programs are translated by other programs into different forms, it pays to understand how compilation systems work, processors read and interpret instructions stored in memory, caches matter, storage devices form a hierarchy.
Register transfer language, inter register transfer, Logic micro-operations, shift micro-operations, instruction codes, Timing and control, Execution of instruction, I/O and Interrupts, Design of Computer.

CENTRAL PROCESSOR & MICROPROGRAM CONTROL ORGANIZATION
Processor Bus organization, ALU organization, Stack organization, Instructions formats, microinstruction formats Micro program sequencer, Micro program examples, Examples, Addressing modes, Address sequencing Data transfer and manipulation, Program control, Control memory, microprocessor organization, bit Slice Microprocessor, Control memory, Address sequencing, Micro program examples, Micro program sequencer, Micro instruction formats examples, Micro program sequencer, Micro instruction formats.

INPUT-OUTPUTUT ORGANIZATION
Peripheral devices, I/O interface, Asynchrony data transfer, Director memory access, Priority interrupt, I/O processor, Multiprocessor organization, Data communication processor.

MEMORY ORGANIZATION
Auxiliary memory, Cache memory, Virtual memory, Microcomputer memory, Memory hierarchy, Associative memory, memory management hardware, disk subsystem, Floppy Disk Drive adjustment, and alignments.

ASSEMBLY LANGUAGE

Assembly Language Syntax, Name field, Operation field, Operand field, Comment field, Program data, Program data, Variables, Byte variables word variables arrays, named constant a few basic instructions, mov, and xchg, add, sub, inc and dec, Translation of high-level language to assembly language, program structure, memory models, data segment, stack segment, code segment, putting it together, input and output instructions, INT 21h, a first program creating and running a program displaying a string, cause conversation program.

Practical Work to be carried out:

1. Introduction to Assembly Language
2. Fundamentals Concepts of Assembly Language (Instructions, Data Types, Reserved Words, Registers etc.)
3. Conditions
4. Loops
5. Arrays
6. Procedure
7. Stack and Floating Point Unit Stack
8. Conditional Loop
9. Shift and Rotate Instructions
10. Stack Parameters
11. Recursion
12. High Level Language Interface
13. Case Study/ Semester Project

Recommended Books:

- M. Morris Mano, "Computer Systems Architecture", Prentice Hall, Latest Edition.
- Hammacher, "Computer Organization", McGraw Hill, Latest Edition.
- Kai Hwang, "Computer Architecture and Parallel Processing", Latest Edition.
- M. Morris Mano, "Digital Logic & Computer Design", National Book Foundation Pakistan, Latest Edition.
- Gideon Langholz, Joan Francioni, and Abraham Kandel, "Element of Computer Organization", Latest Edition.
- Ytha Yu, "Assembly language programming and organization of IBM PC", Latest Edition.

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	:	**Digital Logic Design (BSSE203)**
Discipline	:	BS (SE/AI) (3rd Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	:	02 + 01 **Marks :** 50 + 50
Contact Hours:		32 + 48

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Familiarize** the basic concepts of digital logic design, Boolean algebra and simplification methods of expressions.	C2	2
2	**Analyze** combinational logic design, including gates, code convertors, basic concept of combinational and sequential circuits application using Boolean algebra and K-maps and multiple gates.	C4	3
3	**Construct** combinational and synchronous sequential digital circuits and their designs.	P4	4

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐	
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐	
3	Problem Analysis	☑	8	Computing Professionalism and Society	☐	
4	Design/Development of Solutions	☑	9	Ethics	☐	
5	Modern Tool Usage	☐	10	Life-long learning	☐	

Course outline:

Number Systems, Logic Gates, Boolean Algebra, Combination logic circuits and designs, Simplification Methods (K-Map, Quinn Mc-Cluskey method), Flip Flops and Latches, Asynchronous and Synchronous circuits, Counters, Shift Registers, Counters, Triggered devices & its types. Mealy machines and Moore machines. Binary Arithmetic and Arithmetic Circuits, Memory Elements, State Machines. Introduction Programmable Logic Devices (CPLD, FPGA) Lab Assignments using tools such as Verilog HDL/VHDL, MultiSim.

Practical Work to be carried out:

1. To verify the Truth Table of the logic AND, OR, NAND & NOR gate.
2. To prove rules of Boolean Algebra.
3. To prove Associative, Distributive, Commutative law. To prove DeMorgans Theorem.
4. To Design a two-bit comparator circuit, To Design a Exclusive-OR circuit.
5. To Design a Half adder logic circuit, To Design a Full adder logic circuit.
6. To Design a Half Subtractor logic, To Design a Full Subtractor logic circuit.
7. To verify the Truth table of RS NAND Latch, RS clocked Flip Flop.
8. To verify the Truth table of of JK, and D Type Flip Flop.
9. To Construct the two- input multiplexer circuit.

10. To Construct one-line to two-line decoder/demultiplexer.
11. To Design a Code Converter.
12. To develop OR & AND logic using Diodes, To develop NOT logic using TTL.
13. To Develop NOR gate through RTL.
14. To Develop NAND gate through DTL.

Recommended Books:

- Louis Nashelsky, "Introduction to Digital Computer Technology", Jhon Wiley and Sons, Latest Edition.
- M. Morris Mano, "Digital Logic and Computer Design", National Book Foundation, (Prentice - Hall, INC), Latest Edition..
- D. J. Woolons, "Introduction to Digital Computer Design", Mc Giraw Hill, Latest Edition.
- Thomas C. Bartee, "Digital Computer Fundamentals", Mc Giraw Hill, Kogakusha, Latest Edition.
- Leonard R.Marino, "Principles of Computer Design", Computer Science Press, Latest Edition.

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Software Engineering (BSSE204)**
Discipline	:	BS (SE/AI) (3rd Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Explain** the processes, concepts and standards related to the discipline of software engineering	C2	2
2	**Apply** testing principles to small-scale software systems	C3	2

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:
Introduction to software engineering, Nature and importance of software, Software failure software reliability, Software Myths, Umbrella Activities, SDLC Case Study, Software Process Model: Waterfall, V & V, Software, Process Model: Incremental and Iterative, Software Process Models: Spiral, Prototype and RAD. Agile process models, Scrum and XP Programming. Introduction to Requirement Engineering. Software Project Management, Case Study. UML Diagrams and its importance, Use case modeling. UML Diagrams: Class Diagrams, Activity Diagrams.
Software Testing. Capability Maturity Model. Software Quality Management
Software Metrics and Measurements. Estimation of Software Projects. Software Risk Management and Case Studies

Recommended Books:
- Software Engineering 10th Ed by Ian Sommerville, Addison Wesley; (2016).
- Software Engineering a Practitioner's approach by Roger S. Pressman, Publisher: McGraw-Hill Science/Engineering/Math Edition 8th.
- Software Engineering: A Practitioner's Approach by Pressman, McGraw-Hill Science/Engineering/Math; 7th Edition (2009). ISBN-10: 0073375977.

Approval

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Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Linear Algebra & Analytics (MATH112)**
Discipline	:	BS (SE/AI) (3rd Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Test** the basic operation of matrix algebra and solution of system of linear equations.	C4	2
2	**Devise** the concepts of two and three dimensional geometry	C4	2
3	**Analyze** area and volume of bounded regions by using multiple integrals	C4	2

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:
INTRODUCTIONS TO MATRICES AND ELEMENTARY ROW OPERATIONS
Brief introduction of matrices. Types of matrices. Introduction to elementary row operations. Echelon and reduced echelon forms. Rank of a matrix. Inverse of a matrix using elementary row operations.
SYSTEM OF LINEAR EQUATIONS
System of non-homogeneous and homogeneous linear equations. Gaussian elimination method, Gauss Jordan method. Consistence criterion for solution of homogeneous and non-homogeneous system of linear equations. Application of system of linear equations.
DETERMINANTS
Introduction to determinants. Properties of   determinants of order n. Rank of a matrix by using determinants.
ANALYTIC GEOMETRY OF 3-DIMENSIONS
Introduction; Coordinates in R3.
LINE
Coordination of a point dividing a line segment in a given ratio. Straight line, in R^3. Vector form of a straight line, parametric equations of a straight line, equation of a straight line in symmetric form, direction ratios and direction cosines, angle between two straight lines; distance of a point from a line.
PLANE
Equation of a plane, angle between two planes, the intersection of two planes, a plane and a straight line; skew lines. Cylindrical and spherical coordinates.
SPHERE
General equation of a sphere. Latitude and longitude directions; direction of Qibla.

MULTIPLE INTEGRALS

Evaluation of double and triple integrals in Cartesian and polar coordinates.

Recommended Books:

- D.D. Benice, Brief Calculus and its Applications.
- R.A. Barnett, Applied Calculus.
- S.M. Yusuf, Calculus and Analytical Geometry.
- S.M. Yusuf, Mathematical Methods

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Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Operating Systems (BSSE221)**
Discipline	:	BS (SE/AI) (4th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	:	03 + 01 **Marks :** 100 + 50
Contact Hours:		48 + 48

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Describe** the core concepts of operating system, memory, process and file management.	C2	2
2	**Determine** the applications and principles on which the operating systems' core functions are built.	C3	2
3	**Perform on** modern operating systems using learned knowledge and skills.	P4	5

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☑	10	Life-long learning	☐

Course outline:

Operating systems basics

Understand the characteristics of different structures of the Operating Systems and identify the core functions of the Operating Systems, system calls, process concept and scheduling, inter-process communication

BASIC ELEMENTS

Evolution of the Microprocessor, Instruction Execution.

INTERRUPTS

Interrupts and the Instruction Cycle, Interrupt Processing, Multiple Interrupts.

MEMORY

The Memory Hierarchy, Cache Memory, Direct Memory Access.

OPERATING SYSTEM

Objectives and Functions, The Evolution of Operating Systems, Developments Leading to Modern Operating Systems.

VIRTUAL MACHINES

Virtual Machine Architecture.

MULTIPROCESSOR AND MULTICORE ORGANIZATION
OS Design Considerations for Multiprocessor and Multicore.
PROCESSES
Process Definition, Process States, Process Description, Process Control, OS Execution.
PROCESSES AND THREADS
Types of Threads, Multicore and Multithreading.
Principles of Concurrency.
Mutual Exclusion, Hardware Support, Semaphores.
MULTI-PROCESS SYNCHRONIZATION
Producer/Consumer Problem.
MESSAGE PASSING
Readers/Writers Problem.
DEADLOCKS
Principles of Deadlock, Deadlock Prevention, Detection and Avoidance, An Integrated Deadlock Strategy.
MEMORY MANAGEMENT
Memory Partitioning, Paging, Segmentation, Virtual Memory, Hardware and Control Structures for Virtual Memory.
Fetch Policy, Placement Policy, Replacement Policy, Resident Set Management, Cleaning Policy, Load Control.

Practical Work to be carried out:

1. Installation Procedure of Windows
2. To become familiar with Command Prompt
3. Working with Batch Files and Windows Power Shell
4. Getting familiar with Control Panel and Task Scheduler
5. Working with Windows File Protection and User Privileges
6. Becoming familiar with Network Manager and Windows File Sharing
7. Installing a Desktop Sharing Environment using SSH
8. Creating Ghost Installations and working with Utility Software.
9. Installing a Linux Environment/Setting up a Virtual Environment for Linux
10. Getting familiar with Ubuntu GUI.
11. Familiarization with some of the most frequently used Linux Commands
12. Introduction to Shell Scripting
13. Simulating CPU Scheduling Algorithms
14. Simulating Memory Management Techniques
15. Case Study/ Semester Project

Recommended Books:

- Operating Systems: Internals and Design Principles William Stallings, Latest Edition
- Operating Systems: D. R. Choffnes, Harvey Deitel, and Paul Deite Latest Edition
- Incorporating Unix and Windows Colin Ritchie, Latest Edition

Approval

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Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Analysis of Algorithms (BSSE222)**
Discipline	:	BS (SE/AI) (4th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Determine** informally the time and space complexity of simple algorithms and complexity classes. **Explain** "best", "expected", and "worst" case behavior of an algorithm	C2	2
2	**Use** big O, Omega, and Theta notation formally to give asymptotic upper bounds on time and space complexity of algorithms, Solve problems using graph algorithms, including single-source and all-pairs shortest paths, and at least one minimum spanning tree algorithm.	C3	3
3	**Trace** and/or implement a string-matching algorithm	C4	4

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork		☐
2	Knowledge for Solving Computing Problems	☑	7	Communication		☐
3	Problem Analysis	☑	8	Computing Professionalism and Society		☐
4	Design/Development of Solutions	☑	9	Ethics		☐
5	Modern Tool Usage	☐	10	Life-long learning		☐

Course outline:
INTRODUCTION
Role of algorithms in computing, Analysis of nature of input and size of the input.
ASYMPTOTIC NOTATIONS
Big-O, Big Ω, Big Θ, little-o, little-ω, Sorting Algorithm analysis, loop invariants, Recursion, and recurrence relations.
ALGORITHM DESIGN TECHNIQUES
Brute Force Approach, Divide-and-conquer approach, Merge, Quick Sort, Greedy approach.
DYNAMIC PROGRAMMING
Elements of Dynamic Programming, Search trees; Heaps; Hashing.
GRAPH ALGORITHMS
Shortest paths, sparse graphs, String matching.
INTRODUCTION TO COMPLEXITY CLASSES

Recommended Books:

- Introduction to Algorithms (3rd edition) by Thomas H. Corman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein.
- Algorithm Design, (1st edition, 2013/2014), Jon Kleinberg, Eva Tardos,
- Algorithms, (4th edition, 2011), Robert Sedgewick, Kevin Wayne.

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	:	**Computer Networks (BSSE223)**	
Discipline	:	BS (SE/AI) (4th Semester)	
Effective	:	23 Batch & onwards	
Pre-requisite	:	None	
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final	
		Practical: 50% Sessional, 50% Final Examination	
Credit Hours	:	03 + 01	**Marks :** 100 + 50
Contact Hours:		48 + 48	

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Describe** basics of networks, key terminologies and technologies of computer network, internetworking devices, layered network architectures and routing protocols.	C2	2
2	**Analyze** features, services and operations of various network, transport and application layer protocols of communication stack.	C4	2
3	**Solve** network layer logical addressing problems efficiently	C3	4
4	**Manipulate**, configure, and troubleshoot network devices. Apply techniques related to the design and analysis of computer networks using simulation tools.	P3	5

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☑	10	Life-long learning	☐

Course outline:

COMPUTER NETWORKING

Network Concepts: Computer networks, Applications, Network configurations (peer to peer, client, and server), Network topologies (star, ring, bus, mesh, hybrid), Network classifications w.r.t. geographical distance and media (LAN, MAN, WAN), Circuit and Packet Switching.

Network Hardware: Medium used in different networks, Coaxial cable (all types of RG-9, RG-58, RG-59 etc.). Hub, Switch, Router, Gateway, etc.

NETWORK ACCESS SCHEMES

Ethernet technology and frame-format, Tokin Ring and dual ring working principle. Optical Fiber (single mode and multi-mode, working principle of light inside OF).

NETWORK ARCHITECTURE & MANAGEMENT

OSI- Layer, DoD Model, TCP/IP Model.

PROTOCOL COMMUNICATION

TCP/IP protocols suite, UDP, TCP, ICMP, SNMP, ARP, RARP, HTTP, SMTP, POP, FTP, TFTP, MIME and other protocols (All protocols working along with frame formats). IP Addressing and classes, Sub

netting (network addresses, subnet network mask, subnet addresses, host addresses, loop back address broadcast address), IPV6.

ROUTING AND ROUTING PROTOCOLS

Static and dynamic routing, Routing algorithms, Open shortest path first, distance vector, Flooding, Link state routing, Split Horizon, Count to infinity problem, Interior gateway routing, exterior gateway routing, Border gateway routing, RIP version 1 and 2.

Introduction to FDDI, Ad Hoc Networks, DBDQ management, ATM, X.25, SONET.

Practical Work to be carried out:

- cable specification, installation, and troubleshooting.
- peer-to-peer network.
- use of Ping, Traceroute and tracert.
- configuration of a switch using packet tracer software.
- Configure a network topology using packet tracer software
- command line interface (CLI) and examining router interfaces, setting passwords, and saving configuration files of routers.
- configure the STATIC routes between two routers and to configure the DEFAULT routes between two routers to allow data transfer without the use of dynamic routing protocols.
- configure the distance vector routing protocol on two routers.
- configure the RIP dynamic routing protocol on two routers.
- subnetting concepts.
- Solving network layer logical addressing problems
- Analyzing network traffic using Wireshark software
- network programming using sockets.
- Creating applications using datagram sockets.
- Creating applications using stream sockets.
- Case Study/ Semester Project

Recommended Books:

- Computer Networks and Internets with Internet Applications, Comer, Douglas E., Prentice-Hall Inc, Latest Edition.
- CCNA INTRO self-study guide, CISCO, Latest Edition.
- Data Communication and Networking, BEHROZ A. FOROUZAN. Latest Edition.

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Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No. 20.16**	**Dated: 22-2-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Communication Skills (ENG201)**
Discipline	:	BS (SE/AI) (4th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	02 + 00 **Marks :** 50
Contact Hours:		32 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Sketch** varied texts including formal letters, CV, cover letter for jobs, and Technical Reports using mechanisms of academic writing integrated with paraphrasing and summarizing techniques.	C3	7
2	**Describe** and infer the texts critically and apply the knowledge in real life situations by participating in public speaking acts and group discussions.	C2	6

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☑
2	Knowledge for Solving Computing Problems	☐	7	Communication	☑
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:
READING
Text Analysis, critical thinking
Skimming, scanning and detailed reading
WRITING
Academic Writing/Technical Report Writing
Drafting letters with different types of messages with different registers and purposes, prepare CV's and covering letters according to job requirement
LISTENING
Listening Comprehension
Formal and informal lectures and presentations take notes and collect specific information
SPEAKING
Speaking in real life situations
Conversational strategies, elements of public speaking: Giving lectures and presentation on specific topics
Ask questions and explain point of view in discussion
(Demonstrate turn taking technique)

Recommended Books:

- Rise B. Axelrod and Charles R. Cooper,1996 The Concise Guide to Writing technique.
- Chilver.J,1992, English For Business(A functional approach 2nd Edition).DP Publiacations Ltd,London,Great Britian.
- Yate Martin,2004,The Ultimate Job Search Letters Book.Great Britain

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Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Probability and Statistics (MATH214)**
Discipline	:	BS (SE/AI) (4th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Describe** different statistical methods to obtain the measure of central values of a data and their interpretation	C2	2
2	**Apply** Probability and its rules. Different probability distributions and their uses	C3	2
3	**Analyze** Estimations and hypotheses along with regression and correlation analysis	C4	3

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork		☐
2	Knowledge for Solving Computing Problems	☑	7	Communication		☐
3	Problem Analysis	☑	8	Computing Professionalism and Society		☐
4	Design/Development of Solutions	☐	9	Ethics		☐
5	Modern Tool Usage	☐	10	Life-long learning		☐

Course outline:
Introduction to Statistics and Data Analysis, Statistical Inference, Samples, Populations, and the Role of Probability. Sampling Procedures. Discrete and Continuous Data. Statistical Modeling. Types of Statistical Studies. Probability: Sample Space, Events, Counting Sample Points, Probability of an Event, Additive Rules, Conditional Probability, Independence, and the Product Rule, Bayes' Rule. Random Variables and Probability Distributions. Mathematical Expectation: Mean of a Random Variable, Variance and Covariance of Random Variables, Means and Variances of Linear Combinations of Random Variables, Chebyshev's Theorem. Discrete Probability Distributions. Continuous Probability Distributions. Fundamental Sampling Distributions and Data Descriptions: Random Sampling, Sampling Distributions, Sampling Distribution of Means and the Central Limit Theorem. Sampling Distribution of S2, t-Distribution, FQuantile and Probability Plots. Single Sample & One- and Two-Sample Estimation Problems. Single Sample & One- and Two-Sample Tests of Hypotheses. The Use of PValues for Decision Making in Testing Hypotheses (Single Sample & One- and TwoSample Tests), Linear Regression and Correlation. Least Squares and the Fitted Model, Multiple Linear Regression and Certain, Nonlinear Regression Models, Linear Regression Model Using Matrices, Properties of the Least Squares Estimators.

Recommended Books:
- M. Anwar Solangi; Statistical Methods and Estimations

- Ronald Walpole, Introductory Statistics
- Sher Muhammad Choudhry, Introduction to Statistics vol. I & II

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Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Human Computer Interaction (BSSE303)**
Discipline	:	BS (SE/AI) (5th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00
Contact Hours:		48 + 00

Marks: 100

COURSE LEARNING OUTCOMES:

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

CLOs	Description	Taxonomy level	PLO
1	**Describe** various interaction mechanisms and purpose of a variety of interfaces along with their application areas.	C2	1
2	**Categorize** modules that cover the entire user-centered design and evaluation process - from understanding user needs, to designing interactive systems that meet those needs.	C4	2

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☑	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:

INTRODUCTION

The Human vision, Human Memory, reasoning and problem solving. Interaction models, frameworks and interaction styles, Contexts for HCI, Psychology of usable things, Processes for User-Centered Design, Metrics and Measures for Evaluation, Usability heuristics and principles of Usability testing, Physical capabilities, Cognitive and social models for interaction design,

PARADIGMS FOR INTERACTION

Using design rules, Principles of good interaction design, Accessibility, Principles of GUI, Visual design elements, Data gathering, Task analysis, Prototyping, Help and user documentation, Internationalization.

USABILITY

Usability inspection methods, Usability testing methods, New Interaction Technologies, Usability in practice, Visual Design and Typography, Icon Design, Ubiquitous, Augmented and Virtual Reality.

EVALUATION TECHNIQUES AND SOCIAL ISSUES

Styles of evaluation, Evaluating the design and implementation, designing user support systems. Non-speech Sound, Handwriting Recognition Gesture recognition, Computer vision and Ubiquitous computing applications research.

Recommended Books:
1. Designing the User Interface: Strategies for Effective Human-Computer Interaction, Ben Shneiderman and Catherine Plaisant, 6th Ed, Pearson Inc, Latest Edition.
2. HUMAN-COMPUTER INTERACTION, Latest Edition Dix, Finlay, Abowd and Beale.
3. User Interface Design and Evaluation Amazon by Debbie Stone, Caroline Jarret, Mark Woodroffe, and Shailey Minocha, Latest Edition.

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Board of Faculty:	**Resolution No.20.16**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Topics in Software Engineering (BSSE406)**
Discipline	:	BS (SE/AI) (5th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	Economics and Management (BSSE122)
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	:	03 + 00 **Marks:** 100 + 00
Contact Hours:		48 + 00

COURSE LEARNING OUTCOMES:

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

CLOs	Description	Taxonomy level	PLO
1	**Describe** the concepts and standards related to freelancing, digital marketing, UI/UX design techniques, Digital markers.	C2	1
2	**Develop** solutions to digital & business marketing	C3	2
3	**Analyze** real world issues found in E-Commerce, Digital platforms	C4	4
4	**Determine** sustainable factors in promoting business and digital marketing	C3	8

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☑	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☑
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:

Freelancing Fundamentals

Introduction to Freelancing, How to start freelancing, Different fields in freelancing Freelancing websites, Professional attitude in Freelancing, Profile building on Freelancer.com & PeoplePerHour & Upwork & Fiver & Linkedin, Writing a proposal and cover letter, Delivery and Deadlines, Order completion and cancellation, Response and rate, Buyer requests, Mastering the art of upsell, Keeping in touch with buyers, Tips for great experience with new buyers, How to maximize your productivity, Understanding the levels system, Important factors to rank your gig, Communication Skills, Payment Methods In Pakistan.

Facebook Fast Track Training

Intro to Facebook pages & admin tools, HOL Getting started with Facebook HOL Managing your page, Facebook pages and post best practices, Content Rules, HOL Tools & services for creative content, Growing your audience with Insights, Getting started with Instagram, Facebook ads – Campaign objectives, Facebook ads – Targeting audience, Facebook ads – Optimization and reporting.

UI/X Design

Introduction to UI/UX, Business Card Design, Flyer Design, T-Shirt Design, Stationery Design,

Social Media Kit Design, Hoarding Design, Website Design / Responsive Design, Mobile App, Logo Designing, Typography, Illustrations, Book Cover Design, PODCAST Design, Canva Design, eBook Design (Trainer Choice).

Facebook & Business Marketing

Types of Facebook Pages, How to write effective posts for your business. Choosing Which Page suits your Business. Optimization of Essential Details. Creating Call to Action Button. How to Assign Page Roles. Integration of Instagram business profile. Preferred Page Audience. What is Facebook Business Manager. How to use Facebook Business Manager. Setting up Facebook Business Manager, Adding Your Facebook Business Page(s), Adding Your Facebook Ads Account. Adding People to help you in managing your business assets. Connecting your business partners or ad agency. Introduction and Setting up Facebook Pixel. Increasing Security on your account. Facebook ads – Campaign objectives, Facebook ads – Targeting audience. Facebook ads – Optimization and reporting, Messenger Automation.

Introduction to Business Marketing, Marketing Funnel, Content marketing what and why? Funnel goals (Top-Middle-Bottom Funnel Goals), Search Engine Optimization (SEO), Blogging, Social Media Marketing, Content engagement and marketing nurture, Content Advertising.

Miscellaneous

What is Canva and How it works? Canva for Digital Marketers, Instagram Stories, Selling Instagram Stories at Fiverr, Facebook Post Designing, Selling FB Post Designs at Fiverr, Youtube Thumbnail Designing, Selling Youtube Thumbnail Service at Fiverr, Editing Short Videos, Selling Short Videos at Fiverr, Web Graphics for Blog Posts, Selling Web Graphics for Blog Posts at Fiverr.

Linkedin for your Freelance Career, Why is Linkedin Important? Setting up Linkedin Profile, Optimizing Linkedin Profile, Managing Connects, Blogging at Linkedin, Benefits of Blogging at Linkedin, Getting Clients, Quora for your Freelancing Career, Why is Quora Important? Quora Profile Setup, Searching Related Questions and Queries, Selling your services on Quora.

Recommended Books:

1. E-Commerce, Kenneth Laudon and Carol Guercio Traver, Latest Edition, Pearson.
2. PHP 5 E-commerce Development, Michael Peacock, Packt Publishing.
3. Introduction to E-Commerce, Jeffrey F. Rayport, McGraw-Hill, Latest Edition.
4. Advanced Social Media Marketing: How to Lead, Launch, and Manage a Successful Social Media Program, Apress, Latest Edition.

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Board of Faculty:	**Resolution No.20.16**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Information Security (BSSE305)**
Discipline	:	BS (SE/AI) (5th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Explain** the concept and knowledge of IS and implementation of cryptography and related techniques using information security concepts	C2	2
2	**Analyze** enterprise level security by using different hardware and software Security solutions.	C4	2
3	**Use** Information security solution for an organization to cope with their security issues.	C3	2

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork		☐
2	Knowledge for Solving Computing Problems	☑	7	Communication		☐
3	Problem Analysis	☐	8	Computing Professionalism and Society		☐
4	Design/Development of Solutions	☐	9	Ethics		☐
5	Modern Tool Usage	☐	10	Life-long learning		☐

Course outline:

Introduction to Information Security and Information Security Foundation, Need for security

Legal, ethical and Professional issues in information security, Planning for security

Risk Management, Security technology: Access control, Firewalls and VPNs, Intrusion detection and prevention systems, Cryptography, Unintentional programming oversights, Malicious code, countermeasures, Browser attacks, Web attacks, E-mail attacks, Security in operating systems

Network security attacks and security counter measures, Security in databases

Cloud security tools and techniques, Physical security

Recommended Books:

- Corporate Computer and Network Security by Raymond Panko, Prentice Hall, Latest Edition.
- CISSP, Shon Harris, McGraw-Hill Osborne Media, Latest Edition.
- Cryptography and Network Security, William Stallings, Prentice Hall, Latest Edition.

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Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
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Board of Faculty:	**Resolution No.20.16**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	:	**Discrete Structures (BSSE306)**
Discipline	:	BS (SE/AI) (5th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours	:	48 + 00

COURSE LEARNING OUTCOMES:

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

CLOs	Description	Taxonomy level	PLO
1	**Demonstrate** the basics of discrete structures along with their properties and applications.	C3	2
2	**Test** problems involving Relations, Combinatorics, Graphs, Recurrence Relations, Trees, Mathematical Logic.	C4	4

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tools Usage	☐	10	Life-long Learning	☐

Course outline:

Mathematical reasoning, propositional and predicate logic, rules of inference, proof by induction, proof by contraposition, proof by contradiction, proof by implication, set theory, relations, equivalence relations and partitions, partial orderings, recurrence relations, functions, mappings, function composition, inverse functions, recursive functions, Number Theory, sequences, series, counting, inclusion and exclusion principle, pigeonhole principle, permutations and combinations. Algorithms, Searching and Sorting Algorithms, elements of graph theory, planar graphs, graph coloring, Graph Algorithms, euler graph, Hamiltonian path, rooted trees, traversals.

Recommended Books:

- Kenneth H. Rosen, Discrete Mathematics and Its Applications, Latest Edition.
- Pace G.J.; Mathematics of Discrete Structures for Computer Science, Latest Edition.
- Susanna S. Epp, Discrete Mathematics with Applications, Latest Edition

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Academic Council: **Resolution No.**   **Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Introduction to Entrepreneurship and Creativity (ENT321)**
Discipline	:	BS (SE/AI) (5th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Infer** knowledge and practical skills for managing business investments and fundraising for startups.	C2	8
2	**Apply** entrepreneurship processes to address startup challenges.	C3	10
3	**Apply** e-business strategies for firm growth as team member or team lead.	C3	6

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☑
2	Knowledge for Solving Computing Problems	☐	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☑
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☑

Course outline:
Introduction to Entrepreneurship, Nature and Importance of Entrepreneurship, types of entrepreneur, process of entrepreneurship.

Recognizing Opportunities and Generating Ideas, finding gaps, process of generating creative ideas, Encouraging and protecting new ideas, protecting ideas from being lost and stolen, Feasibility Analysis, Industry and Competitor Analysis, Writing a Business Plan, Developing an Effective Business Model, Setting up the company, Process of financial management, Building a New-Venture Team, Getting Funding or Financing, Local Venture Capitalist or Business Angel, The Importance of Intellectual Property, E-business strategy, Preparing for and Evaluating the Challenges of Growth, Strategies for Firm Growth, Franchising, Selling, mergers

Recommended Books:
- Entrepreneurship: Successfully Launching New Ventures, 4th Edition. Bruce R. Barringer, Oklahoma State University R. Duane Ireland, Texas A&M University © (2012) |Pearson
- Innovation and Entrepreneurship, (2014) by Peter F. Drucker Harper Collins publishers UK
- "Patterns of Entrepreneurship", (2009) by Jack M Kaplan

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Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	:	**Programming for Artificial Intelligence (AI301)**
Discipline	:	BS (Artificial Intelligence) (5th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	:	02 + 01 **Marks :** 50 + 50
Contact Hours:		32 + 48

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Comprehend** the fundamental constructs of programming language for data analysis and representation.	C2	2
2	**Apply** the Object-oriented concepts in the programming language	C3	2
3	**Solve** and **analyze** programming and data analysis problems	C4	4
4	**Solve** programming and data analysis problems using standard libraries and/or toolboxes of the programming language.	P3	5

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☑	10	Life-long learning	☐

Course outline:

INTRODUCTION TO A PROGRAMMING LANGUAGE (PYTHON)

Introduction and history of neural networks, Basic architecture of neural networks, Perceptron and Adaline (Minimum Error Learning) for classification. Basics of deep learning, learning networks, Shallow vs. Deep learning etc.; Machine learning theory – training and test sets, evaluation, etc. Selected topics from: Gradient descent (Delta) rule, Hebbian, Neo-Hebbian and Differential Hebbian Learning, Drive Reinforcement Theory, Kohonen Self Organizing Maps, Associative memory, Bi-directional associative memory (BAM), Energy surfaces, The Boltzmann machines, Backpropagation Networks, Feedforward Networks; Theory of Generalization; Multi-layer perceptrons, error backpropagation; Deep convolutional networks, Computational complexity of feed forward and deep convolutional neural networks; Unsupervised deep learning including auto-encoders; Deep belief networks; Restricted Boltzman Machines; Deep Recurrent Neural Networks (BPTT, LSTM, etc.); GPU programming for deep learning CuDNN; Generative adversarial networks (GANs); Sparse coding and auto-encoders; Data augmentation, elastic distortions, data normalization; Mitigating overfitting with dropout, batch normalization, dropconnect; Novel architectures, ResNet, GoogleNet, etc

Practical Work to be carried out:
- Python basics
- Python data structures
- Jupyter Notebook
- Python libraries for analyzing and plotting
- Cases studies

Recommended Books:
- Severance, C.R., 2016. "Python for everybody: Exploring data using Python 3." CreateSpace Independent Publ Platform.
- Miller, B.N., Ranum, D.L. and Anderson, J., 2019. "Python programming in context." Jones & Bartlett Pub.

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Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Machine Learning** (AI302)
Discipline	:	BS (Artificial Intelligence) (5th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	:	02 + 01 **Marks :** 50 + 50
Contact Hours:		32 + 48

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Describe** basic machine learning concepts, theories and applications.	C2	2
2	**Apply** supervised and unsupervised learning techniques to solve classification and clustering problems of moderate complexity.	C3	2
3	**Demomstrate** reinforcement learning algorithms to environments with complex dynamics using modern tools	P3	5

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork		☐
2	Knowledge for Solving Computing Problems	☑	7	Communication		☐
3	Problem Analysis	☐	8	Computing Professionalism and Society		☐
4	Design/Development of Solutions	☐	9	Ethics		☐
5	Modern Tool Usage	☑	10	Life-long learning		☐

Course outline:

INTRODUCTION TO Machine Learning
AI vs ML
What is ML? Why it is used?
Taxonomy of ML Algorithms

SUPERVISED ML
Supervised ML problem setup
Objective Function
Data Pre-processing
Model Evaluation

LAZY LEARNER
K-Nearest Neighbors (KNN)
KNN calculations
Effect of varying number of "K" on classification

PERCEPTRON
Linear classification
Perceptron learning rule

Geometric Intuition

KERNEL METHODS
Widest margin theory
SVM
SVM dual optimization

DECISION TREES
Tree Intuition / Representation
ID3 Algorithm
Data splitting measure / Best Attribute selection
Tree induction example

REGRESSION
Linear Regression
Cost function
Gradient Descent
OLS method

BIOLOGICALLY INSPIRED NETWORK
Logistic Regression
Logistic / Sigmoid function
Log loss calculation
GD / backpropagation
Artificial Neural Network
Basic intuition
Learning weights
Activation functions

UNSUPERVISED LEARNING
K-Means Clustering

Practical Work to be carried out:
- Hands on various Supervised and Unsupervised ML algorithms
- Performance and confusion matrix
- Decision trees
- Neural networks

Recommended Books:
- Machine Learning, Tom Mitchell, McGraw Hill, 1st or latest edition.
- Pattern Recognition, Konstantinos Koutroumbas and Sergios Theodoridi, Academic Press, 4th or latest edition.
- Pattern Classification, R. Duda et al., Wiley Interscience latest edition.
- Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer Books, latest edition
- Machine learning: a probabilistic perspective, Murphy, Kevin P. latest edition.
- Introduction to machine learning, Alpaydin, Ethem. 3rd or latest edition

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	:	**Theory of Automata (AI321)**	
Discipline	:	BS (Artificial Intelligence) (6th Semester)	
Effective	:	23 Batch & onwards	
Pre-requisite	:	None	
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final	
Credit Hours	:	03 + 00	**Marks :** 100
Contact Hours:		48 + 00	

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Explain** and manipulate the different concepts in automata theory and formal languages such as formal proofs, automata, regular expressions, Turing machines etc. **Prove** properties of languages, grammars and automata with rigorously formal mathematical methods	C2	2
2	**Design** of automata, RE and CFG **Transform** between equivalent NFAs, DFAs and Res	C3	4
3	**Differentiate** and manipulate formal descriptions of languages, automata and grammars with focus on regular and context-free languages, finite automata and regular expressions.	C4	3

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☑	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course Outline:

Finite State Models: Language definitions preliminaries, Regular expressions/Regular languages, Finite automata (FAs), Transition graphs (TGs), NFAs, Kleene's theorem, Transducers (automata with output), Pumping lemma and non-regular language Grammars and PDA: CFGs, Derivations, derivation trees and ambiguity, Simplifying CFLs, Normal form grammars and parsing, Decidability, Context sensitive languages, grammars and linear bounded automata (LBA), Chomsky's hierarchy of grammars. Turing Machines Theory: Turing machines, Post machine, Variations on TM, TM encoding, Universal Turing Machine, Defining Computers by TMs.

Recommended Books:
- Introduction to computer theory, Daniel I. A. Cohen, 2nd Edition
- Automata, Computability and Complexity: Theory and Applications, by Elaine Rich, 2011

- An Introduction to Formal Languages and Automata, by Peter Linz, 4th edition, Jones & Bartlett Publishers, 2006
- Theory of Automata, Formal Languages and Computation, by S. P. Eugene, Kavier, 2005, New Age Publishers

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Advance Statistics (AI321)**
Discipline	:	BS (Artificial Intelligence) (6th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Describe** what part of statistics is meant for data scientist and what the applications of statistics in data science are.	C2	2
2	**Apply** Statistical techniques in real life problems.	C3	2
3	**Analyze**, Correlate, Forecast data by using different statistical techniques	C4	3

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork		☐
2	Knowledge for Solving Computing Problems	☑	7	Communication		☐
3	Problem Analysis	☑	8	Computing Professionalism and Society		☐
4	Design/Development of Solutions	☐	9	Ethics		☐
5	Modern Tool Usage	☐	10	Life-long learning		☐

Course Outline:

Introduction to Statistics, Use of Statistics in Data Science, Experimental Design, Statistical Techniques for Forecasting, Interpolation/ Extrapolation, Introduction to Probability, Conditional Probability, Prior and Posterior Probability, Random number generation (RNG), Techniques for RNG, Correlation analysis, Chi Square Dependency tests, Diversity Index, Data Distributions Multivariate Distributions, Error estimation, Confidence Intervals, Linear transformations, Gradient Descent and Coordinate Descent, Likelihood inference, Revision of linear regression and likelihood inference, Fitting algorithms for nonlinear models and related diagnostics, Generalized linear model; exponential families; variance and link functions, Proportion and binary responses; logistic regression, Count data and Poisson responses; log-linear models, Overdispersion and quasi-likelihood; estimating functions, Mixed models, random effects, generalized additive models and penalized regression; Introduction to SPSS, Probability/ Correlation analysis/ Dependency tests/ Regression in SPSS.

Recommended Books:

- Probability and Statistics for Computer Scientists, Michael Baron, Latest Edition
- Probability for Computer Scientists, David Forsyth, Latest Edition
- Discovering Statistics using SPSS for Windows, Andy Field, Latest Edition

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Swarm Intelligence (AI323)**
Discipline	:	BS (Artificial Intelligence) (6th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Explain** fundamentals of swarm intelligence.	C2	2
2	**Solve** optimization problems using swarm intelligence	C3	4

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:
an overview of Swarm Intelligence (SI) topic, including both behavioral swarm Intelligence and computational swarm intelligence, and applications of SI. different swarm intelligence algorithms that are inspired by natural systems such as ant colonies, bird flocking, animal herding, bacterial growth, fish schooling and microbial intelligence. swarm intelligence algorithms to visualize and to solve real problems such as optimization problems.

Agent-based modeling: Bottom-up modeling method. individual agents. System theory and complex systems. Multi-agent systems.

Behavioral swarm intelligence: Modeling flocking behavior. Boids model. Flocking behavior applications, such as agents queuing and homing.

Computational swarm intelligence (CSI): Optimization theory and multi-objective optimization. Particle swarm optimization (PSO) Ant colony optimization (ACO). Bees colony algorithm (BCO). Bats algorithm

Selected applications: Different selected application where the students can apply the swarm intelligence algorithms to solve real problems, such as: Multi-Robot Path planning and Task Scheduling.

Recommended Books:

- Andries P. Engelbrecht, Fundamentals of computational swarm intelligence, Wiley (2015), ISBN: 978-0-470-09191-3.
- Anand Nayyar, Dac-Nhuong Le, Nhu Gia Nguyen, Advances in Swarm Intelligence for Optimizing Problems in Computer Science, 1st Edition, (2018), Chapman and Hall/CRC, ISBN 9781138482517.
- Jun Sun, Choi-Hong Lai and Xiao-Jun Wu, Particle Swarm Optimization - Classical and Quantum perspectives, CRC Press (2019), ISBN 9780367381936

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Fuzzy Systems (AI324)**
Discipline	:	BS (Artificial Intelligence) (6st Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Explain** principles of basic fuzzy mathematics, models, systems and Controllers.	C2	2
2	**Design** and Use fuzzy control and adaptive controls	C3	4

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork		☐
2	Knowledge for Solving Computing Problems	☑	7	Communication		☐
3	Problem Analysis	☐	8	Computing Professionalism and Society		☐
4	Design/Development of Solutions	☑	9	Ethics		☐
5	Modern Tool Usage	☐	10	Life-long learning		☐

Course outline:

INTRODUCTION, DEFINITIONS AND CONCEPTS
Intelligent Control
Fuzzy Logic
Fuzzy Control
Fuzzy Mathematics
Applications
Rule Base
Fuzzy Sets
Fuzzy System
Classic versus Fuzzy Control System Design
An Example of Fuzzy Control

FUZZY MATHEMATICS
Fuzzy Sets and Membership Functions
Mathematical Operations on Fuzzy Sets
Fuzzy Relations
Linguistic Variables
Fuzzy Rules

Approximate Reasoning
FUZZY SYSTEMS
Fuzzy Rule Base
Fuzzy Inference Engine
Fuzzifier
Defuzzifier
Mathematical Representations of Fuzzy Systems
The Approximation Properties of Fuzzy Systems

DESIGN OF FUZZY SYSTEMS USING INPUT-OUTPUT DATA
Look-up Table Scheme
Gradient Descent Training
Batch Algorithm
Clustering

DESIGN OF FUZZY CONTROLLERS
Trial and Error Approach
Control surface of a fuzzy controller
Stable Fuzzy Controllers
Optimal Fuzzy Controllers
Robust Fuzzy Controllers
Fuzzy System as Sliding Mode Control
Fuzzy Sliding Mode Control
Fuzzy Supervisory Control
Fuzzy Gain Scheduling
TSK Fuzzy Systems

ADAPTIVE FUZZY CONTROL
Indirect Adaptive Fuzzy Controller
Direct Adaptive Fuzzy Controller
Self-organizing Fuzzy Logic Control

Recommended Books:
- L. X. Wang, "A Course in Fuzzy Systems and Control", Prentice-Hall, 1997.
- K. M. Passino, "Fuzzy Control", Addison-Wesley, 1998.
- L. Reznik, "Fuzzy Controllers", 1997.
- M. Margaliot and G. Langholz, "Fuzzy Modeling and Control", 2000.
- H. Ying, "Fuzzy Control & Modeling", 2000.
- K. Tanaka and H. Wang, "Fuzzy Control Systems", 2001.
- G. Chen and T. T. Pham, "Introduction to Fuzzy Sets, Fuzzy Logic, and Fuzzy Control Systems", 2001.
- K. Michels et. al., " Fuzzy Control, Fundamentals, Stability and Design", 2005.

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Artificial Intelligence (AI325)**
Discipline	:	BS (Artificial Intelligence) (6th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	:	03 + 01 **Marks :** 100 + 50
Contact Hours:		48 + 48

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Understand** basic principles of artificial intelligence, intelligent agents, forward and backward chaining algorithms, etc.	C2	2
2	**Categorize** various expert systems, natural language processing systems and machine learning to make intelligent programs	C4	2
3	**Solve** various path finding, Travel salesperson and logical problems using artificial intelligence techniques	C3	4
4	**Make** programs to solve complex real-world problems to meet the technological change.	P3	5

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☑	10	Life-long learning	☐

Course outline:

INTRODUCTION
Artificial Intelligence Definitions, Introductory study of AI techniques, Agents, Types of AI Agents, intelligent Agents, Environment types & properties.

PROBLEM SOLVING METHODS AND SEARCHING TECHNIQUES
Problem & its types in AI, Problem Spaces & State Spaces, General Search Algorithm, Search directions, Search Strategies, Evaluation Parameters of Search Algorithms, Informed and Uninformed Searching & Techniques, Heuristics, Problem Reduction Searching.

KNOWLEDGE REPRESENTATION AND REASONING
Logical knowledge Representations in AI, Propositional logic, Inference Rules in Propositional Logic, Resolution & resolution refutation in Propositional Logic, Predicate logic, Inference rules & Resolution in Predicate Logic, Structural knowledge representation in AI, Weak structures, Strong structures.

EXPERT SYSTEMS

Introduction, Structure of ES, Components of ES, Types of ES, Expert System Shells, Development of Expert Systems.

NATURALLANGUAGE UNDERSTANDING AND PROCESSING

Natural Language Generation, Natural Language Understanding, Application areas of NLP, NLP for text, NLP for spoken language, Problems in NLP, Syntactic Analysis, Semantic Analysis.

MACHINE LEARNING

Introduction, Learning Agents, Machine Learning Paradigms.

NEURAL NETWORKS

Artificial Neural Networks, Characteristics of ANN, Topologies of ANN, Basic Learning Laws of ANN

Practical Work to be carried out:

1	To understand the basics of Python
2	To understand Recursion and Data structures in Python
3	To become familiar with SimpleAI library in Python
4	To learn searching algorithms using SimpleAI library
5	To become familiar with nltk toolkit in python
6	To learn tokenization, parsing, classification and semantic reasoning using nltk toolkit
7	Learning to use python speech recognition tool
8	To understand Machine learning concepts using Microsoft Azure
9	To learn making predictions using Microsoft Azure
10	Practicing different supervised learning algorithms in Microsoft Azure
11	To understand vize.ai API for custom image recognition
12	To learn making predictions for custom images in vize.ai
13	To understand Face++ API for face recognition
14	To learn Face++ API for human body detection
15	Case study

Recommended Books:

- Russell S.; Norvig P.; "Artificial intelligence – A Modern Approach", Latest Edition, Prentice Hall.
- Luger G.F.; Artificial Intelligence – Structures and Strategies for Complex Problem Solving", Latest Edition, Pearson Higher Education.
- Coppin B.; "Artificial Intelligence Illuminated", Latest Edition, Jones and Bartlett Publishers USA.

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	:	**Knowledge Representation and Reasoning (AI327)**	
Discipline	:	BS (Artificial Intelligence) (6th Semester)	
Effective	:	23 Batch & onwards	
Pre-requisite	:	None	
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final	
Credit Hours	:	03 + 00	**Marks :** 100
Contact Hours:		48 + 00	

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Understand** the fundamentals and challenges of knowledge representation and reasoning in deterministic situations and under uncertainty	C2	2
3	**Analyze** different situations and apply appropriate knowledge representation frameworks frameworks.	C4	3
4	**Development** of hybrid approaches by synergizing the existing framework to solve complex decision-making problems.	C3	4

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork		☐
2	Knowledge for Solving Computing Problems	☑	7	Communication		☐
3	Problem Analysis	☑	8	Computing Professionalism and Society		☐
4	Design/Development of Solutions	☑	9	Ethics		☐
5	Modern Tool Usage	☐	10	Life-long learning		☐

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

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

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Parallel and Distributed Computing (BSSE326)**
Discipline	:	BS (SE/AI) (6th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	:	02 + 01 **Marks :** 50 + 50
Contact Hours:		32 + 48

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Explain** concepts of cloud computing and get familiar with different cloud computing technologies.	C3	2
2	**Analyze** the role of various technologies and architectures (web services, JSPs, Servlets, Spring Framework) for enterprise level distributed applications	C4	3
3	Devise cloud environment on different platform and **deploy** applications	C4	4
4	**Design** and develop cloud applications	P4	5

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork		☐
2	Knowledge for Solving Computing Problems	☑	7	Communication		☐
3	Problem Analysis	☑	8	Computing Professionalism and Society		☐
4	Design/Development of Solutions	☑	9	Ethics		☐
5	Modern Tool Usage	☑	10	Life-long learning		☐

Course outline:
Asynchronous/synchronous computation/communication, concurrency control, fault tolerance, GPU architecture and programming, heterogeneity, interconnection topologies, load balancing, memory consistency model, memory hierarchies, Message passing interface (MPI), MIMD/SIMD, multithreaded programming, parallel algorithms & architectures, parallel I/O, performance analysis and tuning, power, programming models (data parallel, task parallel, process-centric, shared/distributed memory), scalability and performance studies, scheduling, storage systems, synchronization, and tools (Cuda, Swift, Globus, Condor, Amazon AWS, OpenStack, Cilk, gdb, threads, MPICH, OpenMP, Hadoop, FUSE).

Practical Work to be carried out:

- Remote Method Invocation (RMI) Callbacks
- RMI-IIOP

- Multithreading
- MVC architecture for Enterprise level applications
- cloud computing using Microsoft Azure
- SQL Server Integration Services
- Amazon web services (AWS)
- Develop distributed applications using Amazon web services
- Amazon's AWS Identity Management and Security in the Cloud
- Amazon's RESTFul WebServices
- Case Study/ Semester Project

Recommended Books:
- Cloud Computing: Concepts, Technology & Architecture 2013 (The Prentice Hall Service Technology Series by Thomas Erl), Latest Edition
- Cloud Computing: From Beginning to End Paperback by Mr. Ray J Rafaels, Latest Edition
- Distributed systems: Principles and Paradigms by Andrew S. Tanenbaum, Latest Edition

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No.20.16**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Technical & Scientifics Writing (ENG301)**
Discipline	:	BS (SE/AI) (6th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	02 + 00 **Marks :** 50
Contact Hours:		32 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Develop** presentation skills; demonstrate professional skills in discussion and offer explanations using examples.	C3	1
2	**Write** different types of texts such as Technical Report, letters with different types of messages involving different registers and purposes, CV and Covering letter.	C3	7

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☑	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☐	7	Communication	☑
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:

READING
Text Analysis, critical thinking
Skimming, scanning and detailed reading

WRITING
Academic Writing/Technical Report Writing
Drafting letters with different types of messages with different registers and purposes, prepare
CV's and covering letters according to job requirement

LISTENING
Listening Comprehension
Formal and informal lectures and presentations take notes and collect specific information

SPEAKING
Speaking in real life situations
Conversational strategies, elements of public speaking: Giving lectures and presentation on

specific topics
Ask questions and explain point of view in discussions
(Demonstrate turn taking technique)

Recommended Books:

- Rise B. Axelrod and Charles R. Cooper,1996 The Concise Guide to Writing technique.
- Chilver.J,1992, English For Business(A functional approach 2nd Edition).DP Publications' Ltd,London,Great Britian.
- Yate Martin,2004,The Ultimate Job Search Letters Book.Great Britian
- Herta A Murphy 1997 Effective Business Communications (7th Edition)

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Artificial Neural Networks (AI401)**
Discipline	:	BS (Artificial Intelligence) (7th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	:	02 + 01 **Marks :** 50 + 50
Contact Hours:		32 + 48

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Understand** the mathematical foundations of neural network models	C2	2
2	**Design** and implement neural network systems to solve real world problems	C3	4
3	Critically **evaluate** model performance and interpret results	P5	5

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☑	10	Life-long learning	☐

Course outline:

Introduction to Artificial Neural Network, Single Layer Perceptron, Multilayer Feedforward Neural Network, Recurrent Neural Network, Self-Organizing Map, Principal Component Analysis, Convolutional Neural Network, Back-Propagation Neural Network, Developing Console Application Using Artificial Neural Network, Recurrent Neural Network (GUI), Hopfield networks, Boltzmann Machines, Principal Component Analysis (PCA), Performance Evaluation

Practical Work to be carried out:

1. Hands-on Keras, and TensorFlow:
   - Single and Multilayer feed forward networks
   - Convolutional neural network
   - Recurrent neural network
   - Principal component analysis
   - Performance evaluation
2. Case Study/ Semester Project

Recommended Books:

- Bishop, Pattern Recognition and Machine Learning. Chapters 1, 3, 5.
- Goodfellow et al., Deep Learning. Chapters 5, 6, 7, 9, 10

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Title of Subject	:	**Data Mining (AI402)**
Discipline	:	BS (Artificial Intelligence) (7th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	Database Systems, Data Warehousing
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	:	02 + 01 **Marks:** 50 + 50
Contact Hours:		32 + 48

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Apply** preprocessing techniques on any given raw data. Select and apply proper data mining algorithm to discover interesting patterns	C3	2
2	**Analyze** and extract patterns to solve problems and point out how to deploy solution	C4	2
3	**Implement** systematically supervised, semi supervised and unsupervised models and algorithms with respect to their accuracy	P3	5

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork		☐
2	Knowledge for Solving Computing Problems	☑	7	Communication		☐
3	Problem Analysis	☐	8	Computing Professionalism and Society		☐
4	Design/Development of Solutions	☐	9	Ethics		☐
5	Modern Tool Usage	☑	10	Life-long learning		☐

Course outline:

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

Practical Work to be carried out:

- Supervised learning
- Unsupervised learing
- Classification: Decision Trees, Naïve Bayesian
- Web Mining
- Python toolkits

Recommended Books:

- Jiawei Han & Micheline Kamber, Jian Pei (2011). Data Mining: Concepts and Techniques, 3rd Edition.

- Pang-Ning Tan, Michael Steinbach, and Vipin Kumar (2005). Introduction to Data Mining.
- Charu C. Aggarwal (2015). Data Mining: The Textbook
- D. Hand, H. Mannila, P. Smyth (2001). Principles of Data Mining. MIT Press.

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Knowledge Based Systems (AI402)**
Discipline	:	BS (Artificial Intelligence) (7th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	Database Systems, Data Warehousing
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks:** 50 + 50
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	Discuss knowledge acquisition techniques and representation methods	C2	2
2	Use the various search mechanisms to solve a problem	C3	2
3	Apply artificial intelligence methods to handle uncertainty and improve Prediction in Inference Techniques	C3	4

PROGRAM LEARNING OUTCOMES (PLOs):

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:

Introduction to Intelligence & Artificial Intelligence, Characteristics of AI Programs
Applications of Artificial Intelligence, Discuss Search Strategies, Introduction to Knowledge Based System, Knowledge Representation and Logic Representation Techniques, Productions and Rule based systems, Knowledge Acquisition, Base techniques of knowledge-based systems, Introduction to Expert Systems, Case-based reasoning (CBR), Inference Chaining and Controls, Knowledge Based Systems Software Lifecycle
Classification, Handling, and Confidence of Uncertainty

Recommended Books:

1. Russell, S. and Norvig, P. Artificial Intelligence: A Modern Approach. Third edition. Prentice Hall. 2010. ISBN-10: 0136042597, ISBN-13: 978-0136042594.
2. Puppe, F. Systematic Introduction to Expert Systems: Knowledge Representations and Problem-Solving Methods. Springer. 2011. ISBN-10: 3642779735, ISBN-13: 978-3642779732.
3. Witten, I. H., Frank, E., and Hall, M. A. Data Mining: Practical Machine Learning Tools and Techniques. Third edition. 2011. ISBN-10: 0123748569 | ISBN-13: 978-0123748560.

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	**:**	**Reinforcement Learning (AI404)**
Discipline	**:**	BS (Artificial Intelligence) (7th Semester)
Effective	**:**	23 Batch & onwards
Pre-requisite	**:**	None
Assessment	**:**	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	**:**	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Explain** basic principles of RL, related theory and terminology.	C3	2
2	To understand and **analyze** multi-agent RL	C4	3
3	**Create** RL based systems for different computing problems.	C5	4

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☑	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:
RL task formulation (action space, state space, environment definition). Defining RL environments. Tabular based solutions (dynamic programming, Monte Carlo, temporal-difference). Linear value function approximation. Non-linear value function approximation (Deep Q-networks: Double DQN, Dueling DQN, PER). Policy gradient from basic (REINFORCE) towards advanced actor-critic algorithms (proximal policy optimization, deep deterministic policy gradient, etc.). Multi-agent reinforcement learning. Imitation learning (behavioral cloning). Meta-learning. Ethics & safety in AI

Recommended Books:
- Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019
- Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012): 3.
- Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach."Pearson Education Limited, 2016.

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Natural Language Processing (AI406)**
Discipline	:	BS (Artificial Intelligence) (7th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Discuss** fundamental concepts and ideas in natural language processing (NLP)	C2	2
2	**Apply** word-level, syntactic, and semantic processing from both a linguistic and an algorithmic perspective	C3	2

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:

INTRODUCTION & HISTORY OF NLP
Parsing algorithms, Basic Text Processing, Minimum Edit Distance, Language Modeling, Spelling Correction, Text Classification, Deterministic and stochastic grammars, CFGs.

REPRESENTING MEANING /SEMANTICS
Semantic roles, Semantics and Vector models, Sentiment Analysis, Temporal representations,

REGULAR EXPRESSIONS
Basic Regular Expression Patterns, Finite-State Automata. POS tagging and morphology, Information retrieval, Vector space model, Precision and recall.

WORD AND SENTENCE TOKENIZATION
Tokenization, Detecting and correcting spelling errors, Corpus-based methods Information extraction, Relation Extraction (dependency, constituency grammar), Language translation

BASIC NLP PROLEMS
Tagging Problem, Parsing, Statistical parsing, Context free grammars, Ambiguity.

N-GRAMS
Counting words in corpora, Simple N-grams, Evaluating N-grams, Smoothing, and Interpolation.

MACHINE TRANSLATION
Machine translation, Challenges in machine translation, Classical machine translation, Phrase

based Translation

LOG-LINEAR MODELS
Log-linear models, discriminative methods, MEMMs, and CRFs Text classification, categorization, Bag of words model, Question and Answering, Text Summarization

Recommended Books:
- Jurafsky, D., Martin, J. H., Kehler, A., Vander Linden, K., & Ward, N. (2000).Speech and language processing:
- An introduction to natural language processing, computational linguistics, and speech recognition (Vol. 2). Upper Saddle River: Prentice Hall.
- Foundations of Statistical Natural Language Processing, Manning and Schütze, MIT Press. Cambridge, MA: May 1999

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Speech Processing (AI407)**
Discipline	:	BS (Artificial Intelligence) (7th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Describe** the statistical framework used for automatic speech recognition and speech recognition as an optimization problem in probabilistic terms. **Understand** the weakness of the simplified speech recognition systems and demonstrate knowledge of more advanced methods to overcome these problems.	C2	2
3	**Relate** individual terms in the mathematical framework for speech recognition to particular modules of the system.	C4	3
4	**Build** a large vocabulary continuous speech recognition system, using a standard software toolkit.	C3	4

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☑	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:
Signal analysis for ASR, Statistical pattern recognition (Bayes decision theory, Learning algorithms, Evaluation methods, Gaussian mixture model, and EM algorithm), Hidden Markov Models (HMM) Context-dependent models, Discriminative training, Language models for LVCSR (large vocabulary continuous speech recognition), Decoding, Robust ASR (Robust features Noise reduction, Microphone arrays), Adaptation (Noise adaptation, Speaker adaptation/normalization, Language model adaptation), Speaker recognition, History of speech recognition, Advanced topics (Using prosody for ASR, Audio-visual ASR, Indexing, Bayesian network), Speech recognition applications (including privacy implications)

Recommended Books:
- John N. Holmes, Wendy J. Holmes, "Speech Synthesis and Recognition", Taylor & Francis (2001), 2nd edition

- Xuedong Huang, Alex Acero and Hsiao-Wuen Hon, "Spoken language processing: a guide to theory, algorithm, and system development", Prentice Hall (2001).
- Lawrence R. Rabiner and Biing-Hwang Juang, "Fundamental of Speech Recognition", Prentice Hall (1993).
- B. Gold, N. Morgan, "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", John Wiley and Sons (1999).

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Data Science (BSSE323)**
Discipline	:	BS (SE/AI) (6th/7th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	**Database Systems (BSSE204)**
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	:	03 + 01 **Marks:** 100 + 50
Contact Hours:		48 + 48

COURSE LEARNING OUTCOMES:

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

CLOs	Description	Taxonomy level	PLO
1	**Explain** the fundamental concepts of Big Data and its programming paradigm.	C2	2
2	**Practice** Hadoop/MapReduce Programming, Framework, and Ecosystem	C3	3
3	**Manipulate** Apache Spark Programming, Machine Learning Algorithms	C3	4
4	**Practice** data science algorithms using modern tools	P3	5

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☑
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☑	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☑	10	Life-long learning	☐

Course outline:

Big Data Wrangling: Getting Exploratory Insights into your Big Data Lakes

Setting the Perspective: Background, History and Landscape Evolution of Big Data Analytics, Tools, Infrastructures and Technologies. Platforms for Big Data, Hadoop as a Platform, Hadoop Distributed File Systems (HDFS), MapReduce Framework, Resource Management in the cluster (YARN), Data Analysis, Data Cleaning and Preparation, The Role of Meta Data in Data Lake Management

Business Intelligence (BI) and Big Data Visualization

Unleash the power of Data Visualization in Business Analytics of Big Data: Relationship between Big Data and BI, Basic BI evolution, BI evolution from small to big data use cases. BI history, Basic BI concepts for dashboarding.

Big Data Management Systems with NoSQL Data Stores

NoSQL Databases: Hallmark data silos for big data management and storage. Theoretical foundations and Practical Exposure of MongoDB (Document Store), Redis (Key-Value Store), Cassandra (Columnar Store), and Neo4J (Graph Store)

Machine Learning for Big Data

Machine Learning Basics: Basic Concepts of Classification, Regression and Cluster Analysis, Evolution of Machine Learning Algorithms, Use cases in Business Industries for Small and Big Data. Operationalizing Machine Learning Models: Architecture and Strategy

Infrastructure Development for Real-Time Big Data Analytics

Standard technologies and infrastructures for Big Data Analytics in real-time. Lambda and Kappa Architecture, Apache Spark's Streaming, Apache Storm and Apache Kafka.

Recommended Books:

1. White, Tom. "Hadoop: The definitive guide." O'Reilly Media, Inc., 2012.
2. Karau, Holden, Andy Konwinski, Patrick Wendell, and Matei Zaharia. "Learning spark: lightning-fast big data analysis." O'Reilly Media, Inc., 2015.
3. Miner, Donald, and Adam Shook. "MapReduce design patterns: building effective algorithms and analytics for Hadoop and other systems." O'Reilly Media, Inc., 2012.

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Digital Marketing (BSSE408)**
Discipline	:	BS (SE/AI) (7th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	
Assessment	:	Theory: 20% Sessional, 30% Mid 50% Final
Credit Hours	:	02+00 **Marks:** 50+00
Contact Hours:		32 +00

COURSE LEARNING OUTCOMES:

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

CLOs	Description	Taxonomy level	PLO
1	**Describe** the concepts and standards related to freelancing, digital marketing, UI/UX design techniques, Digital markers.	C2	1
2	**Develop** solutions to digital & business marketing	C3	2
3	**Analyze** real world issues found in E-Commerce, Digital platforms	C4	4

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☑	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:

Introduction to Business Marketing, Marketing Funnel, Content marketing what and why? Funnel goals (Top-Middle-Bottom Funnel Goals), Search Engine Optimization (SEO), Blogging, Social Media Marketing, Content engagement and marketing nurture, Content Advertising.

Introduction to Email Marketing. Goal, Email Marketing Facts. Important Terms, Email Marketing use cases. Customer Journey Steps. The role of Email Marketing. Creating your first email auto-responder account. Email Campaign creation (writing your emails). Optimizing email opens and click rates.

What is Canva and How it works? Canva for Digital Marketers, Instagram Stories, Selling Instagram Stories at Fiverr, Facebook Post Designing, Selling FB Post Designs at Fiverr, Youtube Thumbnail Designing, Selling Youtube Thumbnail Service at Fiverr, Editing Short Videos, Selling Short Videos at Fiverr, Web Graphics for Blog Posts, Selling Web Graphics for Blog Posts at Fiverr.

Recommended Books:

1. E-Commerce, Kenneth Laudon and Carol Guercio Traver, Latest Edition, Pearson.
2. Introduction to E-Commerce, Jeffrey F. Rayport, McGraw-Hill, Latest Edition.
3. Advanced Social Media Marketing: How to Lead, Launch, and Manage a Successful Social Media Program, Apress, Latest Edition.

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No.20.16**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Deep Learning (AI422)**
Discipline	:	BS (Artificial Intelligence) (8th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Apply** deep learning algorithms to real-world problems	C3	2
2	**Analyze** results from deep learning to select appropriate solutions	C4	3
3	Code the novel neural network architectures from scratch and evaluating the performance on application specific standard benchmarks	C3	5

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork		☐
2	Knowledge for Solving Computing Problems	☑	7	Communication		☐
3	Problem Analysis	☑	8	Computing Professionalism and Society		☐
4	Design/Development of Solutions	☐	9	Ethics		☐
5	Modern Tool Usage	☑	10	Life-long learning		☐

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

Recommended Books:

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

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Agent Based Intelligent Systems (AI423)**
Discipline	:	BS (Artificial Intelligence) (8th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	03 + 00 **Marks :** 100
Contact Hours:		48 + 00

Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

CLO	Description	Taxonomy Level	PLO
1	**Explain** basic principles of Agent based Intelligent Systems, related theory and terminology.	C3	2
2	To understand and **analyze** NLP and NLP based techniques	C4	3
3	**Create** agent-based systems for different computing problems.	C5	4

PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☑	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:

INTRODUCTION
Agent based modelling Definitions, Agents, concept of Rationality, Structure and Types of Agents, intelligent Agents, Environment types & properties.

INTELLIGENT AGENT SYSTEMS
Problem Solving, Searching - Heuristics -Constraint Satisfaction Problems - Game playing.

NATURAL LANGUAGE PROCESSING
NLP basic, NLP applications and research areas, NLG, NLU, NLP problems and possible solutions, Analysis levels in NLP, NLP system and algorithms.

AGENTS AND UNCERTAINITY
Acting under uncertainty – Probability Notation-Bayes Rule and use - Bayesian Networks-Other Approaches-Time and Uncertainty-Temporal Models- Utility Theory - Decision Network – Complex Decisions.

INTELLIGENT AGENTS & NEURAL NETWORKS
  Artificial Neural Networks, Characteristics of ANN, Topologies of ANN, Basic Learning Laws of

Recommended Books:
- Russell S.; Norvig P.; "Artificial intelligence – A Modern Approach", Latest Edition, Prentice Hall.
- Michael Wooldridge, "An Introduction to Multi Agent System", John Wiley Latest Edition.
- Coppin B.; "Artificial Intelligence Illuminated", Latest Edition, Jones and Bartlett Publishers USA.

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Computational Sustainability (BSSE424)**
Discipline	:	BS (SE/AI) (8th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	IICT(BSSE103), Software Engineering(BSSE204)
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	02+00 **Marks:** 50+00
Contact Hours:		32 +00

COURSE LEARNING OUTCOMES:

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

CLOs	Description	Taxonomy level	PLO
1	**Explain** a range of computational methods and tools used for sustainable design, optimization and decision-support in software architecture.	C2	2
2	**Determine** sustainability performance assessment and its application.	C3	3
3	**Devise** multi-objective design optimization and trade-off analysis in order to meet multi-disciplinary sustainability goals in the society.	C4	8

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☑	8	Computing Professionalism and Society	☑
4	Design/Development of Solutions	☐	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:

Introduction to Computational Sustainability

Sustainability Performance Assessment

Triple-bottom-line assessment framework; Ecological footprints (energy, water, materials, waste); Low carbon, healthy and productivity performance outcomes of building design.

Performance Based Sustainable Design

Performance-based design methods; Passive design; Bio-climatic architecture; Computational methods for sustainable design.

Decision Support System for Sustainable Design

Multi-criteria assessment methods, and decision-support strategies and processes for sustainable design.

Optimisation Model

Introduction to multi-objective design optimization methods, including Pareto optimization, etc.

Life-Cycle Environmental Assessment System

Life-cycle assessment methods, processes and applications, including ISO guidelines.

Recommended Books:

1. The Future of Computing Performance: Game Over or Next Level?
   By Samuel H. Fuller et al. The National Academies Press (2011)
2. Assessing and Measuring Environmental Impact and Sustainability

By Jiri J Klemes. Elsevier Science (2015)

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	:	**Internet of Things (BSSE425)**
Discipline	:	BS (SE/AI) (8th Semester)
Effective	:	23 Batch & onwards
Pre-requisite	:	None
Assessment	:	Theory**:** 20% Sessional, 30% Mid 50% Final
Credit Hours	:	02 + 00 **Marks :** 50
Contact Hours:		32 + 00

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Explain** fundamental concepts in Internet of Things (IoT) networking.	C2	2
2	**Design** and program solutions for energy-efficient networks of IoT devices	C3	4
3	**Judge** the suitability of a networking stack for an IoT application.	C4	3

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☑	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course outline:

Core concepts and networking protocols for IoT applications,
application areas for Internet of Things with resource-constrained devices (such as sensors and actuators),
networking protocols for collecting sensor data from resource-constrained,
connected devices to cloud systems,
practical programming of resource-constrained,
networked devices using the Contiki-NG operating system,
evaluation of networking protocols using simple simulation,
additional topics: higher layers in IoT protocols, IoT security.

Recommended Books:

- Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry by Maciej Kranz, 2016
- Internet of Things: Principles and Paradigms 1st Edition by Rajkumar Buyya (Editor), Vahid Dastjerdi, Amir (Editor), 2016

Approval

Industry Advisory Board:	**Resolution No. 11.3**	**Dated: 05-01-2023**
Board of Studies:	**Resolution No. 22.3**	**Dated: 18-01-2023**
Board of Faculty:	**Resolution No.20.16**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

Mehran University of Engineering and Technology, Jamshoro
Department of Software Engineering

Title of Subject	**:**	**Computer Vision (AI421)**
Discipline	**:**	BS (Artificial Intelligence) (8th Semester)
Effective	**:**	23 Batch & onwards
Pre-requisite	**:**	None
Assessment	**:**	Theory**:** 20% Sessional, 30% Mid 50% Final
		Practical: 50% Sessional, 50% Final Examination
Credit Hours	**:**	02 + 01 **Marks :** 50 + 50
Contact Hours:		32 + 48

Course Learning Outcomes (CLOs):

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

CLO	Description	Taxonomy Level	PLO
1	**Understanding** the single view geometry concepts	C2	2
2	**Understanding** the multiple view geometry concepts	C2	2
3	**Apply** concepts of CV for solving real world problems	C3	4

PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Academic Education	☐	6	Individual and Teamwork	☐
2	Knowledge for Solving Computing Problems	☑	7	Communication	☐
3	Problem Analysis	☐	8	Computing Professionalism and Society	☐
4	Design/Development of Solutions	☑	9	Ethics	☐
5	Modern Tool Usage	☐	10	Life-long learning	☐

Course Outline:

INTRODUCTION TO COMPUTER VISION

Problems faced, History and Modern Advancements.

IMAGE PROCESSING

Image filtering, Image pyramids and Fourier transform, Hough transform.

CAMERA MODELS

Setting up a camera model from parameters, Camera looking at a plane, Relationship of plane and horizon line, Rotation about camera center.

Concatenation, Decomposition and Estimation of transformation from point correspondences, Points and planes in 2D/3D, Transformations in 2D/3D, Rotations in 2D/3D.

EDGE DETECTION

corner detection. Feature descriptors and matching (HoG features, SIFT, SURF).

APPLICATIONS OF COMPUTER VISION TRADITIONAL METHODS

Image Stitching: Making a bigger picture from smaller pictures. Single View Geometry: Converting a single image into a 3D model.

APPLICATIONS OF CV USING DEEP LEARNING

Image Detection (Localization, Historical Techniques, RCNN, FRCNN, YOLO, Retina), Image

Segmentation (UNet, SegNet, MaskRCNN), Image Generation (GANN)

Practical Work to be carried out:
- Image editing
- Image stitching
- Image filtering
- Edge Detection
- Feature Enhancement
- 3D model development

Recommended Books:
- Computer Vision: Algorithms and Applications, by Richard Szeliski. Reference Book:
- Multiple View Geometry in Computer Vision, by Richard Hartley and Andrew Zisserman.
- Computer Vision: A Modern Approach, by David Forsyth and Jean Ponce.
- Digital Image Processing, by Rafael Gonzalez and Richard Woods.

Approval

Industry Advisory Board:	**Resolution No. 10.3**	**Dated: 21-09-2022**
Board of Studies:	**Resolution No. 21.3**	**Dated: 07-10-2022**
Board of Faculty:	**Resolution No.20.10**	**Dated: 22-02-2023**
Academic Council:	**Resolution No.**	**Dated:**

MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO
DEPARTMENT OF BASIC SCIENCES AND RELATED STUDIES

Title of Subject : Foundation-I   (MATH 101)
Discipline : BS (CS)
Semester : 1st semester
Effective : 21 Batch onwards
Pre-requisites : Matriculation
Assessment : 20% sessional work   Mid-sem. Exam: 20%   End-Sem Exam: 60%
Marks : TH: 100   PR: 00
Credit Hours : TH: 03   PR: 00
Min. Contact Hours : TH: 45   PR: 00

Course Learning Outcomes

After completion of this course the students should be able to identify real and complex numbers, functions and limits, apply the differential and integral calculus.

Contents:

Complex Numbers: Algebra of complex numbers, additive and multiplicative inverse of complex numbers.

Functions: Binary relations and functions.

Introduction to limit: Limits and continuity of functions.

Derivatives: Derivative of a function at a point, basic and elementary functions, implicit functions, parametric differentiation and chain rule. Geometrical and physical meaning of derivative.

Integral Calculus: Integration and its elementary rules**.** Methods of integration by substitutions, completing squares, parts and partial fractions.

Books Recommended:

- **Mathematics for class XI, SindhText Book Board, Jamshoro.**
- **Mathematics for class XII, SindhText Book Board, Jamshoro.**

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Approval: Board of Studies (BSRS):03/2021   Res. No. 02, dated: 31-12-2021
                   Board of FOST&H,
                   Academic Council: 102, 13-04-2022

PROPOSED SYLLABUS

MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO
DEPARTMENT OF BASIC SCIENCES AND RELATED STUDIES

Title of Subject	: Foundation-II (MATH 102)		
Discipline	: BS (CS)		
Semester	: 2nd semester		
Effective	: 21 Batch onwards		
Pre-requisites	: Matriculation		
Assessment	: 20% sessional work	Mid-sem. Exam: 20%	End-Sem Exam: 60%
Marks	: TH: 100	PR: 00	
Credit Hours	: TH: 03	PR: 00	
Min. Contact Hours	: TH: 45	PR: 00	

Object   : After completion of this course the student should be able to perform the basic operations of matrix algebra, solve the system of linear equations, and evaluate the matrices and determinant along with elementary operations and two dimensional analytical geometry

Contents: **Sets:** Real Numbers. Sets and algebra on sets. Binary relations; functions and its types; algebraic and transcendental functions.

Introductions to matrices and elementary row operations. Brief introduction of matrices. Types of matrices. Elementary row operations. Inverse of a matrix using elementary row operations.

Determinants: Introduction to determinants, properties of determinants of order n, inverse of a matrix and Cramer's rule.

System of linear equations. System of non-homogeneous and homogeneous linear equations. Gaussian elimination method, Gauss Jordan method. Application of system of linear equations.

Analytical Geometry of R^2: Distance formula, ratio formula. Equation of a line. Parallel and perpendicular lines.

Books Recommended:
- **Mathematics for class XI, Sindh Text Book Board, Jamshoro.**
- **Mathematics for class XII, Sindh Text Book Board, Jamshoro.**
- **S.M.Yusuf, Mathematical Methods, Ilmi Kitab Khana, Lahore.**

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Approval: Board of Studies(BSRS):03/2021   Res. No. 02, dated: 31-12-2021
Board of FOST&H,
Academic Council: 102, 13-04-2022