CHOICE BASED CREDIT SYSTEM

EVALUATION SCHEME

AND

COURSE OF STUDY

IN

B.TECH.

(WORKING PROFESSIONAL)

COMPUTER SCIENCE AND ENGINEERING

(V SEMESTER & VI SEMESTER)

SCHEME OF EXAMINATION & SYLLABUS

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

FACULTY OF ENGINEERING AND TECHNOLOGY
GURUKULA KANGRI (DEEMED TO BE UNIVERSITY), HARIDWAR

Faculty of Engineering & Technology

In the year 2000 Faculty of Engineering & Technology was established with an aim of imparting technical education in the spiritual surroundings of the Gurukula System. Keeping in mind the importance of technocrats with strong moral character, superior knowledge, and devotion to the nation. FET was established with a motto of Building Technocrats with ethics. FET is known in India and abroad for students with virtuous moral character and Technical abilities. Currently, it is providing education in B. Tech. in Computer Science & Engineering, Electronics & Communication Engineering, Electrical Engineering, and Mechanical Engineering. FET is one of the richest faculty of Gurukula Kangri (Deemed to be University), with a huge number of books in the library, well-equipped electronics electrical and mechanical laboratories, latest software, and computers in computer labs. Football field, Tennis court, Volleyball court, Basketball arena, and open gym for the students with athletic interests.

Vision of F.E.T.

To provide affordable & quality education to engineering aspirants and nurture them to be highly skilled & innovative technocrats with ethics and nation building spirit.

Mission of F.E.T.

M1: (ETHICS & VALUES)
To educate and nurture engineering aspirants with values, updated engineering curriculum & latest technology to make them globally trusted and accepted.

M2: (RESEARCH)
Provide conducive environment for teaching, learning & research that can lead to patents, publications and make country proud.

M3: (AFFORDABILITY)
Provide cost effective education so that every section of society can be benefitted.

M4: (SKILLED)
Design industry oriented curriculum that can make engineering graduates ready to work for Indian Industries as well as MNCs.

Department of Computer Science & Engineering

The Department of Computer Science and Engineering (CSE) provides in-depth technical knowledge and opportunities for innovation and research with the latest computer facilities.

Vision And Mission

Vision of the department

To be a frontier in the field of Computer Science by imparting the knowledge in legible, lucid and perspicuous way and preparing the human resource of high moral and ethical values that can cater to contemporary societal needs.

Mission of the department

- **[M1]: (Contemporary excellence)**
  Provide a sound technical foundation in Computer Engineering through the comprehensive curriculum with a rich skill set and practical experience.
- **[M2]: (Holistic Learning)**
  To enable students to become valuable and creative contributors to society. To continue their education in different facets of technology to grow them professionally along with the spirit of moral values.
- **[M3]: (Social Responsibility & Sustainable Development)**
  To contribute to National Development by meeting the needs of society and industry, empowering weaker and underprivileged sections, and building the economy through research and frugal innovation, anchored in the principle of achieving more with less.
- **[M4]: (Ethics & Values)**
  To uphold the highest ethical standards, inculcate values; create willingness and capacity to work with one's hands, and a spirit of devotion to serve humanity.

Program Educational Objectives (Under Graduate Program)

- **PEO1:** To provide a cogent foundation in Basic Sciences, analytical skills and engineering fundamentals required to succeed in engineering field.
- **PEO2:** To provide knowledge of various domains catering to the contemporary requirements of the industry.
- **PEO3:** To train students with good scientific and practical engineering application skills to comprehend, analyze, design, and create feasible solutions for societal vows.
- **PEO4:** Inculcate analytical reasoning and critical thinking through effective teaching learning and hands-on training to develop an innovative spirit and pursue higher education for nation-building.
- **PEO5:** To encourage students to develop lifelong learning skills, self-motivation, and high moral and ethical values for a successful professional career.

Program Specific Outcomes (Under Graduate Program)

- **PSO1:** Graduates of Computer Science & Engineering will achieve the adequate understanding of the contents to analyze, design and implement sustainable solution in their domain.
- **PSO2:** Able to use problem-solving skills to develop efficient algorithmic solutions.

B. Tech (CSE) - Working Professional

1. Introduction

The B. Tech (CSE) working professional program has been designed for individuals who want to advance their careers in computer science engineering along with job. This program allows students to gain practical experience and develop fundamental engineering skills through hands-on learning opportunities. In a B.Tech working professional program(Working professional), eligible applicants get admission directly into the program's second year. This is as per AICTE guidelines because the eligible candidates already have the basic foundational knowledge of the subject from their prior relevant qualifications and so they can directly start studying in the second year of the B.Tech program.

The course spans 6 semesters over a period of 3 years and is tailored to meet the needs of students who are looking to fast-track their career growth in their respective fields. The curriculum has been carefully crafted to ensure that students gain the necessary knowledge and skills to enhance their prospects in their chosen field.

The engineering program is tailored for working professionals who already have experience in their field and relevant qualifications, providing them with the opportunity to enhance and expand their technological skills within their specific area of expertise.

B.Tech (CSE) working professional program covers essential engineering concepts, tools, techniques, and best practices. The course is designed in accordance with the Approval Process Handbook issued by AICTE, which guarantees its broad acceptance across India.

By enrolling in this course, students will acquire the essential skills needed to take advantage of the abundant opportunities in their field and accelerate their career growth.

Program Highlights

1. B. Tech Working Professional program spans 6 semesters and is intended to equip students with an extensive knowledge of cutting-edge technologies. The program places a strong emphasis on the fundamental principles of engineering and their practical application in relevant fields.

2. Prospective candidates must have completed a Diploma program/ Graduation for admission. Furthermore, they should have a minimum of one years of full-time work experience in Registered lndustry / Organization (Centra I / State) / Private/ Public Limited Company/ MSMEs located within 50 Km radial distance.

3. The B.Tech working professional program, adheres to the guidelines set by the All India Council for Technical Education (AICTE) in the Approval Process Handbook that is periodically released.

4. The B. Tech working professional employs a variety of assessment methods to continually evaluate student performance, including sessional examinations, quizzes, assignments, practical sessions, and semester examinations. The assessment results are shared with students to assist them in evaluating their performance throughout the learning process.

5. The program aims to spark technical curiosity and promote learning in the ever-evolving engineering landscape.

Eligibility Criteria

Qualification: -

1. To be eligible for admission into the B. Tech (CSE) working professional, candidates must possess a 3-year polytechnic diploma / Graduation (B. Sc).

2. Additionally, they must have at least 1 year of full-time work experience in Registered industry / Organization (Centra I / State) / Private/ Public Limited Company/ MSMEs located within 50 Km radial distance.

3. This program is tailored to professionals with relevant experience who want to expand their skills and knowledge and attain complete competence in essential industry-relevant domains.

Age Criteria: -

1. There are no age restrictions for admission to this course, making it accessible to individuals of all ages.

2. We encourage ambitious and motivated working professionals who want to advance their careers by obtaining a comprehensive understanding of engineering principles and fundamentals to apply for this course.

Admission Process

Admission will be based on Merit of the Qualifying examination.

ACADEMIC SESSION 2026-27

(Effective from the academic session 2026-27)

GURUKULA KANGRI (DEEMED TO BE UNIVERSITY), HARIDWAR
Faculty of Engineering & Technology
Computer Science & Engineering
B. Tech. Third Year (Working Professional)
Syllabus in accordance with AICTE Model Curriculum

SEMESTER-V

DSC/SEC/DSE/AEC	SUBJECT	PERIODS			EVALUATION SCHEME				Subject Total	Credits
					SESSIONAL EVALUATION			EXAM ESE		
		L	T	P	CT	TA	Total			
THEORY										
BCW-C511	Computer Network	3	0	0	20	10	30	70	100	4
BCW-C512	Cloud Computing	3	0	0	20	10	30	70	100	4
BCW-M001	Universal Human Values	3	0	0	20	10	30	70	100	0
BCW-P51X	Program Elective - 1	3	0	0	20	10	30	70	100	4
BCW-A560	MOOC	0	0	0	0	0	0	0	0	4
PRACTICAL										
BCW-C562	Cloud Computing Lab	0	0	2	10	5	15	35	50	1
BCW-P56X	Program Elective Lab	0	0	2	10	5	15	35	50	1
BCW-S560	Project II	0	0	2	10	5	15	35	50	4
		TOTAL CREDITS								
TOTAL		12	0	6	110	55	165	385	550	22

MOOC: List of MOOC courses shall be decided by the departmental committee in each semester depending upon the list from SWAYAM/NPTEL and other recognized online platforms. Students have to study from Online Platform doubt sessions shall be held by Internal teachers and exams shall be taken by university. If a student wishes he can give an exam of Online Platform for certification. SWAYAM courses to run every year from July onwards (Odd Semester) are declared in the month of May and for courses to run every year from January onwards (Even Semester) are declared in the month of December on website https://swayam.gov.in/.

****Project II – A project group shall consist of not more than 4 students. A group can choose any mentor from the department, in case the project is multidisciplinary, mentors from other departments can be consulted. Project should have real-world application and should focus on betterment of societal needs and nation building.***

Program Elective – I

BCW-P513	Object Oriented Programming Using CPP
BCW-P514	Computer Graphics
BCW-P515	Machine Learning I: Foundations and Supervised Learning
BCW-P516	Data Analytics -1
	Program Elective – I LABS
BCW-P563	Object Oriented Programming Using CPP Lab
BCW-P564	Computer Graphics Lab
BCW-P565	Machine Learning I: Foundations And Supervised Learning Lab
BCW-P566	Data Analytics -1 Lab

ACADEMIC SESSION 2026-27

(Effective from the academic session 2026-27)

GURUKULA KANGRI (DEEMED TO BE UNIVERSITY), HARIDWAR
Faculty of Engineering & Technology
Computer Science & Engineering
B. Tech. Third Year (Working Professional)
Syllabus in accordance with AICTE Model Curriculum

SEMESTER-VI

DSC/SEC/DSE/AEC	SUBJECT	PERIODS			EVALUATION SCHEME				Subject Total	Credits
					SESSIONAL EVALUATION			EXAM		
		L	T	P	CT	TA	Total	ESE		
THEORY										
BCW-C611	Software Engineering	3	0	0	20	10	30	70	100	4
BCW-C612	Fundamentals of Algorithms and Computational Thinking	3	0	0	20	10	30	70	100	4
BCW-P61X	Program Elective II	3	0	0	20	10	30	70	100	4
BCW-A660	MOOCS	0	0	0	0	0	0	0	0	4
PRACTICAL										
BCW-P66X	Program Elective Lab	0	0	2	10	5	15	35	50	1
BCW- S660	Project III	0	0	2	10	5	15	35	50	4
		TOTAL CREDITS								
TOTAL		9	0	6	80	40	120	280	400	21

MOOC: List of MOOC courses shall be decided by the departmental committee in each semester depending upon the list from SWAYAM/NPTEL and other recognized online platforms. Students have to study from Online Platform doubt sessions shall be held by Internal teachers and exams shall be taken by university. If a student wishes he can give an exam of Online Platform for certification. SWAYAM courses to run every year from July onwards (Odd Semester) are declared in the month of May and for courses to run every year from January onwards (Even Semester) are declared in the month of December on website https://swayam.gov.in/.

****Project III – A project group shall consist of not more than 4 students. A group can choose any mentor from the department, in case the project is multidisciplinary, mentors from other departments can be consulted. Project should have real-world application and should focus on betterment of societal needs and nation building.***

Program Elective II

	Program Elective Subject List- II
BCW-P613	Machine Learning II: Unsupervised Learning And Applications
BCW-P614	Software Project Management
BCW-P615	Full Stack Web Development
BCW-P616	Data Analytics -2
	Program Elective Practical List- II
BCE-P663	Machine Learning II: Unsupervised Learning And Applications Lab
BCE-P664	Software Project Management Lab
BCE-P665	Full Stack Web Development Lab
BCE-P666	Data Analytics -2 Lab

Course Code: BCW-C511
Course Name: COMPUTER NETWORK

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	None
Objectives:	• To understand the protocol layering and physical level communication. • To analyze the performance of a network. • To understand the various components required to build different networks. • To learn the functions of network layer and the various routing protocols. • To familiarize the functions and protocols of the Transport layer
Course Coordinator	Mr.Ashwani

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	Goals and Applications of Networks, Network structure and architecture, The Layered Architecture: Protocol Layering, The OSI Reference Model and the TCP/IP protocol stack, History of Computer Networking and the Internet, Network Topology, Physical Layer Transmission Media, Switching methods, ISDN, Terminal Handling. Wireless Transmission: Radio transmission, Microwave transmission, Infrared and light wave transmission.	**08**	1,2,3	1
Module-2	**The Data Link Laye**r: Design Issues: Services provided to other Layer, framing, Error control, Flow control; Error detection and Correction; Simplex, Sliding window protocol, Using Go-Back n, Stop & Wait Protocol ARQ. The Medium Access Sub Layer: Static and Dynamic Channel Allocation in LANs and MANs; IEEE standard 802.3, 802.4, 802.5; CSMA.	**08**	1,2,3	1
Module-3	**The Network Layer:** Network layer design issues, Shortest path routing, Flooding, flow- based routing, Broadcast routing, Congestion control and prevention policies Internetworking: connectionless Interworking, IP addressing, IPv4, Fragmentation.	**08**	1,2,3	1
Module-4	**The Transport Layer**: QOS, the transport service; Transport protocols: Addressing, Establishing and releasing a connection; TCP/UDP header. Session Layer-RPC, Synchronization, dialog management.	**08**	1,2,3,4	1
Module-5	**The Application Layer:** Network Security, FTP, SNMP, Telnet, E- mail, Multimedia, WWW, DNS, SMTP. Presentation Layer: ASN, data compression, encryption. Multimedia Networking: Introduction, Streaming Stored Audio and Video, Real Time Streaming Protocol (RTSP), Protocols for Real Time Interactive Applications: RTP, RTCP, SIP, H.323; Providing multiple classes of service.	**08**	1,2,3,4	1,2
Total No. of Hours		**40**		

Learning Outcomes:	● Understand OSI and TCP/IP models ● Analyze MAC layer protocols and LAN technologies ● Design applications using internet protocols ● Understand routing and congestion control algorithms ● Understand how the internet works

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Andrew S. Tanenbaum (3/e), Computer Networks, PHI
2.	Frouzan , Data Communications & Networking(3/e, 4/e)
3.	W.Stallings (5/e), Data and Computer Communications, PHI
4.	Douglas E.Comer (3/e), Interworking with TCP/IP,Principles, Protocols & Architecture
5.	Anuranjan Misra, “Computer Networks”, Acme Learning
6.	G. Shanmugarathinam, ”Essential of TCP/ IP”, Firewall Media

CO-PO/PSO MAPPING														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√	√	√	√									√	√
CO2	√	√	√	√									√	√
CO3	√	√	√										√	√
CO4	√	√	√	√	√								√	√
CO5	√	√	√		√								√	√

Course Code: BCW-C512
Course Name: CLOUD COMPUTING

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	Discrete Mathematics, Computer Networks
Objectives:	• To understand the concepts of Cloud Computing. • To learn Taxonomy of Virtualization Techniques. • To learn Cloud Computing Architecture. • To acquire knowledge on Aneka Cloud Application Platform. • To learn Industry Cloud Platforms.
Course Coordinator	Dr.Nishant Kumar

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Overview of cloud computing:** What is a cloud, Definition of cloud, Characteristics of cloud, why use clouds, How clouds are changing, Driving factors towards cloud, Comparing grid with cloud, Public clouds (commercial)	**08**	1,2	1
Module-2	**Cloud computing concepts:** Concepts of cloud computing, Cloud computing leverages the Internet, Positioning cloud to a grid infrastructure, Elasticity and scalability, Virtualization, Characteristics of virtualization, Benefits of virtualization, Virtualization in cloud computing, Hypervisors, Multitenancy, Types of tenancy, Application programming interfaces (API), Billing and metering of services, Management, tooling, and automation in cloud computing.	**08**	1,2,3	1,2
Module-3	**Cloud service delivery:** Cloud service , Cloud service model architectures, Infrastructure as a service (IaaS) architecture , Infrastructure as a service (IaaS) details, Platform as a service (PaaS) architecture, Platform as a service (PaaS) details, Platform as a service (PaaS) , Examples of PaaS software, Software as a service (SaaS) architecture, Software as a service (SaaS) details , Examples of SaaS applications , Trade-off in cost to install versus , Common cloud management platform reference architecture: Architecture overview diagram, Common cloud management platform, Database as a Service - Monitoring as a Service –Communication as services.	**08**	1,2,3,4	1,2
Module-4	**Cloud deployment scenarios:** Cloud deployment models, Public clouds, Hybrid clouds, Community, Virtual private clouds, Vertical and special purpose, Migration paths for cloud, Selection criteria for cloud deployment, Case study example: AWS Platform. Virtualization For Cloud Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization – System Vm, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation and binary translation, HLL VM - Hypervisors – Xen, KVM , VMWare, Virtual Box, Hyper-V.	**08**	1,2,3,4, 5	1,2

Module-5	**Security in cloud computing:** Cloud security reference model, How security gets integrated, Cloud security, Understanding security risks, Principal security dangers to cloud computing, Data corruption or loss, User account and service hijacking, Steps to reduce cloud security breaches. Classification of Cloud Implementations: Amazon Web Services, The Elastic Compute Cloud (EC2). The Simple Storage Service (S3), The Simple Queuing Services (SQS), Google AppEngine - PaaS, Windows Azure; Aneka, Hadoop, A Comparison of Cloud Computing Platforms.	**08**	1,2,3,4, 5	1,2
Total No. of Hours		**40**		

Learning Outcomes:	• Understand the concept of virtualization and how this has enabled the development of Cloud Computing • Know the fundamentals of cloud, cloud Architectures and types of services in cloud • Understand scaling, cloud security and disaster management • Design different Applications in cloud • Ability to use AWS/IBM Cloud/Google cloud

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Practices and Paradigms in Cloud Computing, RajKumar Buyya
2.	IBM , Handouts
3.	Michael Miller, Cloud Computing (1 ed.), Que Publishing, 2008. ISBN 978-0789738035.
4.	Cloud Computing, Publisher: Jones and Barret India, Author : Kris Jasm
5.	Anthony Velte, Toby Velte and Robert Elsenpeter, Cloud Computing: A practical Approach (1 ed.), Tata McGrawHill, 2009. ISBN 978-0070683518.

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√										√	√
CO4	√	√										√	√	√
CO5	√	√	√		√							√	√	√

Course Code: BCW-M001
Course Name: UNIVERSAL HUMAN VALUES

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 0**

Prerequisites:	None
Objectives:	• Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence. • Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence. • Strengthening of self-reflection. • Development of commitment and courage to act.
Course Coordinator	AICTE

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Course Introduction** - Need, Basic Guidelines, Content and Process for Value Education. Purpose and motivation for the course, recapitulation from Universal Human Values-I Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration Continuous Happiness and Prosperity- A look at basic Human Aspirations Priority Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.	**08**	1,2	1,2
Module-2	**Understanding Harmony in the Human Being** - Harmony in Myself**,** Understanding human being as a co-existence of the sentient 'I'& the Material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) Understanding the characteristics and activities of 'I' and harmony in 'I' Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.	**08**	1,2	1,2

Module-3	**Understanding Harmony in the Family and Society-** Harmony in Human- Human Relationship Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention & competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.	**08**	1,2,3	1,2
Module-4	**Understanding Harmony in Nature and Existence -** Whole existence as Coexistence. Understanding the harmony in Nature, Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature. Understanding Existence as Coexistence of mutually interacting units in all- pervasive space. Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.	**08**	1,2,3	1,2
Module-5	**Implications of the above Holistic Understanding of Harmony on Professional Ethics** Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: At the level of individuals: as socially and ecologically responsible engineers, technologists and managers. At the level of society: as mutually enriching institutions and organizations. Sum up Include practice Exercises and CaseStudies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.	**08**	1,2	1,2
Total No. of Hours		**40**		

Learning Outcomes:	● By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature). ● They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

	• It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. • This is only an introductory foundational input. It would be desirable to follow it up by o faculty-student or mentor-mentee programs throughout their time with the institution. o Higher level courses on human values in every aspect of living. E.g. as a professional.

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books,New Delhi, 2010
2.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4.	The Story of Stuff (Book).
5.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
6.	Small is Beautiful - E. F Schumacher.
7.	Slow is Beautiful - Cecile Andrews
8.	Economy of Permanence - J C Kumarappa
9.	Bharat Mein Angreji Raj – Pandit Sunderlal
10.	Rediscovering India - by Dharampal
11.	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
12.	India Wins Freedom - Maulana Abdul Kalam Azad
13.	Vivekananda - Romain Rolland (English)
14.	Gandhi - Romain Rolland (English)

CO-PO/PSO MAPPING														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√	√										√	√	√
CO2	√	√	√									√	√	√
CO3	√	√	√										√	√
CO4	√	√											√	√

Course Code: BCW-P513
Course Name: OBJECT ORIENTED PROGRAMMING USING CPP

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	Basic knowledge of programming.
Objectives:	● Introduction to Object oriented Paradigm ● Features of object-oriented programming, class and object: state, identity, and behavior ● Data Abstraction and Data Hiding ● Encapsulation, Inheritance and polymorphism. ● Inheritance in OO design. ● Implementing OO language features. ● Memory management. ● Generic types and collections
Course Coordinator	Dr.Aman Tyagi

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Introduction:** Review of C, Difference between C and C++, Cin, Cout, new, delete operators, abstraction, encapsulation, inheritance, polymorphism, Structured versus object-oriented development, elements of object-oriented programming. **Class Overview:** Class specification, class objects, accessing class members, defining member functions, outside member functions as inline, accessing member functions within a class, data hiding, access boundary of objects revisited, empty classes, pointers within a class, passing objects as arguments, returning objects from functions, friend functions and friend classes, constant parameters and member functions, structures and classes, static data and member functions, class, objects and memory resource, class design steps.	**08**	1,2,3	1
Module-2	**Object Initialization and Cleanup:** Class revisited, constructors, parameterized constructors, destructor, constructor overloading, order of construction and destruction, constructors with default arguments, copy constructor, static data members with constructors and destructors. **Operator Overloading:** Introduction, over loadable operators, unary operator overloading, operator keyword, operator return values, limitations of increment/decrement operators, binary operator overloading, arithmetic operators, data conversion, conversion between basic data types, conversion between objects and basic types, conversion between objects of different classes, overloading with friend functions.	**08**	1,2,3,4	1,2
Module-3	**Inheritance :** Introduction, class revised, derived class declaration, forms of inheritance, inheritance and member accessibility, constructors in derived classes, destructors in derived classes, constructors invocation and data members initialization, overloaded member functions,	**08**	1,2,3,4	1,2

	multilevel inheritance, multiple inheritance, hierarchical inheritance, multipath inheritance and virtual base classes, hybrid inheritance.			
Module-4	**Virtual Functions and Classes:** Introduction, need for virtual functions, static and dynamic binding, pointer to derived class objects, definition of virtual functions, pure virtual functions, abstract classes, virtual destructors. **Generic Programming with Templates:** Introduction, function templates, overloaded function templates, multiple argument's function templates, user defined template arguments, class templates	**08**	1,2,3,4	1,2
Module-5	**Stream Computation with Files:** Introduction, hierarchy of file stream classes, opening and closing of files, file modes, file pointers, sequential access to a file, saving and retrieving of objects, file input/output with stream class. **Exception Handling:** Introduction, error handling, exception handling model, exception handling constructs.	**08**	1,2,3,4, 5	1,2
Total No. of Hours		**40**		

Learning Outcomes:	CO1. Remembering (Knowledge) Define key OOP concepts, including classes, objects, inheritance, and polymorphism. Recall the syntax and basic rules of C++ for OOP.List the fundamental data types in C++. Memorize the basic C++ operators used in object-oriented programming. CO2. Understanding (Comprehension) Explain the concept of encapsulation and its benefits in OOP. Describe the difference between a class and an object. Compare and contrast inheritance and composition in C++. Interpret and explain code examples that involve OOP principles. Illustrate the concept of dynamic memory allocation in C++. CO3. Applying (Application) Develop C++ programs that utilize classes and objects to model real-world entities. Implement inheritance hierarchies to model relationships between classes. Create polymorphic functions and use them in practical programming scenarios. Solve problems using object-oriented design principles. Apply access specifiers (public, private, protected) to control class member visibility and access. CO4. Analyzing (Analysis) Evaluate and critique code for adherence to OOP principles. Analyze and debug C++ programs involving inheritance-related issues. Identify and resolve design flaws in class hierarchies. CO5 Creating (Evaluation) Develop a C++ application that demonstrates a deep understanding of inheritance, polymorphism, and encapsulation.

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	E.Balagurusamy, Object Oriented Programming with C++, TMH
2.	R.Lafore, Object Oriented Programming using C++, Galgotia
3.	S.B.Lippman & J.Lajoie, C++ Primer, Addison Wesley
4.	G.Booch, Object Oriented Design & Applications, PHI

CO-PO/PSO MAPPING														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√		√								√	√
CO4	√	√		√	√							√	√	√
CO5	√	√	√									√	√	√

Course Code: BCE-P514
Course Name: COMPUTER GRAPHICS

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	C, C++, Linear algebra, Matrices
Objectives:	• To understand about the different graphics display units. • To study about the scan line and circle drawing algorithms. • To learn about the various 2D and 3D transformations. • To introduce the various hidden surface elimination algorithms. • To study about the various color models used in computer graphics.
Course Coordinator	Mr.Aman

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Introduction:** Graphic displays: Random scan displays, raster scan displays, Frame buffer and video controller, points and lines, Raster and Random Scan-Line and circle drawing algorithms-Polygon filling.	**08**	1,2	1,2
Module-2	**2D Geometric Transformations:** 2D Viewing – Window-Viewport Transformation - Two dimensional Geometric transformations – Line, Polygon, Curve and Text clipping algorithms.	**08**	1,2	1
Module-3	**3D Geometric Transformations:** Need for 3-Dimensional Imaging, Techniques for 3-Dimesional displaying, Parallel Projections, Perspective projection, Splines, viewing.	**08**	1,2,3	1
Module-4	**Hidden Surface Elimination:** Hidden line elimination-Hidden surface elimination-Painter's algorithm- Scan the algorithm-Octree method-Z- buffer-Ray tracing.	**08**	1,2,3	1
Module-5	**Color Models:** Chromaticity diagram-RGB, CMY, HSV, HLS, CIE models-Realism in rendering, halving-Illumination and shading-Gouraud and Phong shading	**08**	1,2,3,4	1,2
Total No. of Hours		**40**		

Learning Outcomes:	• Understand the basics of computer graphics, different graphics systems and applications of computer graphics. • Discuss various algorithms for scan conversion and filling of basic objects and their comparative analysis. • Use of geometric transformations on graphics objects and their application in composite form. • Explore projections and visible surface detection techniques for display of 3D scene on 2D screen. • Explore about Shading: illumination and surface modeling, Phong shading model, polygon shading.

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Hearn D and Baker M.P., Computer Graphics, Second Edition, PHI.
2.	Foley J.D., Van Dam A, Fiener S.K. and Hughes J.F., Computer Graphics, Addison Wesley.
3.	Newman W.M. and Sproull R.F., Principles of Interactive Computer Graphics, Tata McGraw Hill Publishing Company Limited.
4.	Hughes, Van Dam, et al. Computer Graphics Principles and Practice 3e, Pearson, 2014.
5.	P Shirley, Fundamentals of Computer Graphics, 2e, AK Peters, 2005.

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√	√	√								√	√
CO4	√	√		√								√	√	√
CO5	√	√	√									√	√	√

Course Code: BCW-C515
Course Name Machine Learning I: Foundations and Supervised Learning

MM: 100 **Sessional: 30**
Time: 3 Hr. **ESE: 70**
L T P **Credit : 4**
3 1 0

Prerequisites:	Basic Programming Knowledge and python
Objectives:	1. Understand fundamentals of Machine Learning and data-driven problem solving 2. Apply Python libraries for data handling, preprocessing, and visualization 3. Analyze datasets using statistical and visualization techniques 4. Develop regression and classification models using Machine Learning algorithms 5. Evaluate and interpret Machine Learning model performance using appropriate metrics 6. Build practical ML solutions for real-world applications.
Course Coordinator	Mr. Namit Khanduja

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain Ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	Introduction to Python for Machine Learning: Introduction to Artificial Intelligence, Data Science, and Machine Learning, Python environment setup, Jupyter Notebook / Google Colab, Introduction to NumPy, Arrays and matrix operations, Introduction to Pandas, DataFrames and Series, Data loading and manipulation, Handling missing values, basic statistical operations	**06**	1,2,5,12	1
Module-2	**Data Visualization and Data Preparation:** Importance of Data Visualization, Matplotlib and Seaborn, Line plots, histograms, scatter plots, box plots, Exploratory Data Analysis (EDA), Data preprocessing techniques, Feature scaling, Encoding categorical data Train-test split	**08**	1,2,3,4,5, 12	1
Module-3	**Introduction to Machine Learning:** What is Machine Learning?, Types of Machine Learning, Supervised Learning, Unsupervised Learning, Reinforcement Learning, Machine Learning workflow, Features and labels, Training and testing datasets, Bias and Variance, Overfitting and Under fitting, Introduction to ML Pipeline	**08**	1,2,3,4,5, 12	1
Module-4	**Supervised Learning – Linear Regression:** Understanding prediction-using patterns, Intuition of best-fit line, real-world regression examples. Linear Regression, Univariate Linear Regression, Multivariate Linear Regression, Hypothesis Function. **Cost Function:** Error and prediction, Squared error intuition, Cost minimization. **Gradient Descent**: Optimization intuition, Learning rate, Parameter updates **Model Evaluation**: MAE, MSE, RMSE, R^2 Score	**10**	1,2,3,4,5, 8,9, 12	1
Module-5	**Logistic Regression and Classification :** Introduction to Classification, Binary Classification, Logistic Regression, Sigmoid Function ,Decision Boundary, Confusion Matrix, Accuracy, Precision, Recall, F1-Score, ROC-AUC	**08**	1,2,3,4,5, 8,9,10, 12	1,2
Total No. of Hours		**40**		

Learning Outcomes

CO Code	Course Outcome	Bloom's Level
CO1	Explain fundamental concepts of Machine Learning and supervised learning	Understand (K2)
CO2	Utilize Python libraries for data preprocessing and visualization	Apply (K3)
CO3	Analyze datasets using statistical and visualization techniques	Analyze (K4)
CO4	Implement Linear and Logistic Regression models using Scikit-learn	Apply (K3)
CO5	Evaluate ML model performance using appropriate evaluation metrics	Evaluate (K5)
CO6	Design basic Machine Learning solutions for real-world problems	Create (K6)

Suggested books:

S. No.	Name of Authors /Books /Publisher
1.	Hands-On Machine Learning with Scikit-Learn and TensorFlow — Aurélien Géron
2.	Python for Data Analysis — Wes McKinney
3.	Introduction to Machine Learning with Python — Andreas Müller
4.	Machine Learning — Tom Mitchell

Blooms Taxonomy:

K1 (Remember), K2 (Understand), K (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create)

CO-PO/PSO MAPPING														
Course Outcomes	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**	
(COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	1	-	-	-	-	-		2	**1**	
CO2	2	2	1	1	3	-	-	-	-	-		2	**1**	
CO3	2	3	1	2	2	-	-	-	-	-		2	**1**	
CO4	3	3	3	2	3	-	-	1	-	-		2	**1**	
CO5	2	3	2	3	2	-	-	-	1	-		2	**1**	**1**
CO6	3	3	3	2	3	1	-	2	1	1		3	**1**	**1**

Course Code: BCE-P516
Course Name: DATA ANALYTICS-1

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	Basic knowledge of data structure
Objectives:	● To provide an overview of an exciting growing field of big data analytics. ● To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce. ● To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability. ● To enable students to have skills that will help them to solve complex real-world problems in for decision support.
Course Coordinator	Mr.Namit Khanduja

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Introduction to Data Analytics:** Sources and nature of data, classification of data (structured, semi-structured, unstructured), characteristics of data, introduction to Big Data platform, need of data analytics, evolution of analytic scalability, analytic process and tools, analysis vs reporting, modern data analytic tools, applications of data analytics. Data Analytics Lifecycle**.**	**08**	1,2	1
Module-2	**Data Analysis:** Regression modelling, multivariate analysis, Bayesian modelling, inference and Bayesian networks, support vector and kernel methods, analysis of time series: linear systems analysis & nonlinear dynamics, rule induction	**08**	1,2,3	1
Module-3	**Neural Networks:** Learning and Generalisation, competitive learning, principal component analysis and neural networks, fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, stochastic variables and search methods.	**08**	1,2,3	1,2
Module-4	**Mining Data Streams:** Introduction to streams concepts, stream data model and architecture, stream computing, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, decaying window, Real-time Analytics Platform (RTAP) applications.	**08**	1,2,3,4, 5	1,2
Module-5	**Frequent Itemsets and Clustering:** Mining frequent itemsets, market-based modelling, Apriori algorithm, handling large data sets in main memory, limited pass algorithm, clustering techniques: hierarchical, K-means, clustering high dimensional data, CLIQUE and ProCLUS, frequent pattern-based clustering methods, clustering in non-euclidean space, clustering for streams and parallelism.	**08**	1,2,3,4, 5	1,2
Total No. of Hours		**40**		

Learning Outcomes:	• Describe the life cycle phases of Data Analytics through discovery, planning and building. • Learn various Data Analysis Techniques. • Implement various Data streams. • Understand item sets, Clustering, frame works & Visualizations. • Apply R tool for developing real time applications.

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press.
2.	Bill Franks, Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & Sons.
3.	Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley
4.	David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big Data Analytics", EMC Education Series, John Wiley
5.	Frank J Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley and SAS Business Series
6.	Michael Berthold, David J. Hand," Intelligent Data Analysis", Springer
7.	Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw Hill.
8.	Mark Gardner, "Beginning R: The Statistical Programming Language", Wrox Publication.
9.	Pete Warden, Big Data Glossary, O'Reilly.
10.	Glenn J. Myatt, Making Sense of Data, John Wiley & Sons.
11.	Peter Bühlmann, Petros Drineas, Michael Kane, Mark van der Laan, "Handbook of Big Data", CRC Press.
12.	Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer.
13.	Colleen Mccue, "Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis", Elsevier.
14.	Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer.
15.	Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier.

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√	√	√									√	√
CO2	√	√											√	√
CO3	√	√	√										√	√
CO4	√	√	√	√									√	√
CO5	√	√	√		√	√							√	√

Course Code: BCW-C562
Course Name: CLOUD COMPUTING LAB

MM: 50 **Time: 3 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit: 01**

Objectives:	• To develop web applications in cloud • To learn the design and development process involved in creating a cloud-based application
Course Coordinator	Dr.Nishant Kumar

NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 20 students for daily practical work in the laboratory. 3. No batch for practical class shall consist of more than 20 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

LIST OF EXPERIMENTS	**No. of Hours**	**POs mapped**	**PSOs mapped**
1.How to create a Virtual Machine on AWS cloud using EC2 service. 2.How to download and install applications on VM. 3.How to train a model using amazon sage maker in Machine Learning on AWS. 4.How to Deploy code on AWS. 5.How to deploy a static website by using the S3 service of AWS. 6.Create a chatbot using AWS services. 7.How to create users and roles in IAM services. 8.How to change policies in S3 Bucket services. 9.How to deploy serverless applications on Lambda by using serverless architecture. 10. How to download VMWare Workstation and install a VM on it.	**03**	1,2,3,4,5	1,2

Learning Outcomes:	• Apply the steps and procedures to create a Virtual Machine on AWS EC2 • Identify and select appropriate AWS services for building a chatbot • Utilize IAM services to create and manage user accounts and groups • Utilize AWS Lambda to develop and deploy serverless applications • Configure and create a Virtual Machine using VMWare Workstation

CO-PO/PSO MAPPING

Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√		√								√	√
CO4	√	√		√	√							√	√	√
CO5	√	√	√	√	√							√	√	√

Course Code: BCW-P563

Course Name: OBJECT ORIENTED PROGRAMMING USING C++ LAB

MM: 50 **Sessional: 15**
Time: 3 Hr. **ESE: 35**
L T P **Credit: 01**
0 0 2

Objectives:	1. To implement object-oriented programming concepts using C++. 2. To develop programs using classes, inheritance, and polymorphism. 3. To understand templates, file handling, and exception handling.
Course Coordinator	Mr. Namit Khanduja

NOTE:	4. In practical examination, the student must perform one experiment. 5. A teacher shall be assigned 20 students for daily practical work in the laboratory. 6. No batch for a practical class shall consist of more than 20 students. 7. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. **8.** Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

LIST OF EXPERIMENTS	No. of Hours / Week	POs mapped	PSOs mapped
Programs demonstrating classes, objects, inline functions, static members, and friend functions	**02**	1,2,3	1,2
Programs using constructors, destructors, copy constructors, and operator overloading	**02**	1,2,3	1,2
Applications based on inheritance including single, multilevel, multiple, and hierarchical inheritance	**02**	1,2,3,4	1,2
Programs demonstrating runtime polymorphism, virtual functions, and templates	**02**	1,2,3,4,5	1,2
Programs for file handling and exception handling in C++	**02**	1,2,3,4,5	1,2

Learning Outcomes	CO1: Explain the fundamental concepts of object-oriented programming using C++. CO2: Develop applications using classes, objects, constructors, and operator overloading. CO3: Implement inheritance and polymorphism in real-world programming problems. CO4: Analyze and debug C++ programs using templates and exception handling. CO5: Design complete object-oriented applications using file handling and advanced C++ features..

CO-PO/PSO MAPPING

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
(COs)	**PO**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**2**											**1**	**1**
CO2	**3**	**3**	**2**		**1**								**1**	**1**
CO3	**3**	**3**	**3**	**2**	**2**								**1**	**1**
CO4	**2**	**3**	**2**	**3**	**2**								**1**	**1**
CO5	**3**	**3**	**3**	**2**	**3**								**1**	**1**

Course Code: BCW-P564
Course Name: COMPUTER GRAPHICS LAB

MM: 50 **Sessional: 15**
Time: 3 Hr. **ESE: 35**
L T P **Credit: 01**
0 0 2

Objectives:	1. To implement graphics algorithms using C/C++. 2. To understand 2D and 3D transformations. 3. To demonstrate clipping, shading, and hidden surface elimination techniques.
Course Coordinator	Dr. Suyash Bhardwaj

NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 20 students for daily practical work in laboratory. 3. No batch for practical class shall consist of more than 20 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean

LIST OF EXPERIMENTS	No. of Hours/ Week	POs mapped	PSOs mapped
Implement line, circle drawing, and polygon filling algorithms	**02**	1,2,3	1,2
Implement 2D transformations and clipping algorithms	**02**	1,2,3,4	1,2
Develop applications using 3D transformations and projections	**02**	1,2,3,4	1,2
Implement hidden surface elimination and ray tracing techniques	**02**	1,2,3,4,5	1,2
Demonstrate color models, illumination, Gouraud shading, and Phong shading	**02**	1,2,3,4,5	1,2

Learning Outcomes:	CO1: Understand graphics primitives and raster graphics algorithms. CO2: Apply 2D and 3D transformations on graphical objects. CO3: Implement clipping and projection techniques for graphics applications. CO4: Analyze hidden surface elimination and rendering techniques. CO5: Design graphical applications using shading and illumination models.

CO-PO/PSO MAPPING

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
(COs)	**PO**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO1**	**PO1**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**2**											**1**	**1**
CO2	**3**	**3**	**2**	**1**	**1**								**1**	**1**
CO3	**3**	**3**	**3**	**2**	**2**								**1**	**1**
CO4	**2**	**3**	**2**	**3**	**2**								**1**	**1**
CO5	**3**	**3**	**3**	**2**	**3**								**2**	**2**

Course Code: BCW-P565

Course Name: MACHINE LEARNING I: FOUNDATIONS AND SUPERVISED LEARNING LAB

MM: 50 **Sessional: 15**
Time: 3 Hr. **ESE: 35**
L T P **Credit: 01**
0 0 2

Objectives:	1. To develop practical skills in Python for Machine Learning. 2. To perform data preprocessing and exploratory data analysis. 3. To implement supervised learning algorithms and evaluate models.
Course Coordinator	Dr. Namit Khanduja

NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 20 students for daily practical work in laboratory. 3. No batch for practical class shall consist of more than 20 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean

LIST OF EXPERIMENTS	No. of Hours/ Week	POs mapped	PSOs mapped
Perform NumPy, Pandas operations, and data preprocessing tasks	**02**	1,2,3	1
Implement data visualization, feature scaling, and train-test split	**02**	1,2,3,4	1
Demonstrate supervised and unsupervised Machine Learning workflows	**02**	1,2,3,4	1
Implement and evaluate Linear Regression models	**02**	1,2,3,4,5	1,2
Implement Logistic Regression and evaluate classification performance metrics	**02**	1,2,3,4,5, 9	1,2
Implementation using AI Assisted Platforms (Claude, Chatgpt, Gemini, IBM Bob, Kiro etc.)			

Learning Outcomes:	CO1: Explain the fundamentals of Machine Learning and supervised learning. CO2: Apply Python libraries for preprocessing and visualization. CO3: Analyze datasets using Machine Learning techniques. CO4: Implement Linear and Logistic Regression models using Scikit-learn. CO5: Evaluate Machine Learning models using standard performance metrics.

CO-PO/PSO MAPPING

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
(COs)	**PO**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO1**	**PO1**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**1**											**1**	**1**
CO2	**3**	**3**	**2**	**1**	**1**								**1**	**1**
CO3	**3**	**3**	**3**	**2**	**2**								**1**	**1**
CO4	**2**	**3**	**2**	**3**	**2**			**1**					**1**	**1**
CO5	**3**	**3**	**3**	**2**	**3**				**1**				**2**	**2**

Course Code: BCW-P566
Course Name: DATA ANALYTICS-I LAB

MM: 50 **Sessional: 15**
Time: 3 Hr. **ESE: 35**
L T P **Credit: 01**
0 0 2

Objectives:	1. To provide practical exposure to data analytics techniques. 2. To implement data mining and stream processing algorithms. 3. To develop analytical applications using clustering and predictive models.
Course Coordinator	Namit Khanduja

NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 20 students for daily practical work in laboratory. 3. No batch for practical class shall consist of more than 20 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean

LIST OF EXPERIMENTS	**No. of Hours/ Week**	**POs mapped**	**PSOs mapped**
Explore datasets and perform preprocessing using analytical tools	**02**	1,2,3	1,2
Implement regression, Bayesian, and time-series analysis techniques	**02**	1,2,3,4	1,2
Develop applications using neural networks and fuzzy logic	**02**	1,2,3,4	1,2
Implement stream mining, filtering, and real-time analytics concepts	**02**	1,2,3,4,5	1,2
Implement Apriori algorithm and clustering techniques such as K-means and hierarchical clustering	**02**	1,2,3,4,5	1,2

Learning Outcomes:	CO1: Understand the lifecycle and techniques of data analytics. CO2: Apply regression, Bayesian, and time-series analysis methods. CO3: Implement neural network and fuzzy logic models. CO4: Analyze stream data and real-time analytics applications. CO5: Design clustering and frequent item set mining applications..

CO-PO/PSO MAPPING

Course Outcomes	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**	
(COs)	**PO**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO1**	**PO1**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**2**											**1**	**1**
CO2	**3**	**3**	**2**	**1**	**1**								**1**	**1**
CO3	**3**	**3**	**3**	**2**	**2**								**1**	**1**
CO4	**2**	**3**	**2**	**3**	**2**								**1**	**1**
CO5	**3**	**3**	**3**	**2**	**3**								**2**	**2**

Course Code: BCW- S560
Course Name: Project-II

MM: 50 **Sessional: 15**
Time: 3 Hr. **ESE: 35**
L T P **Credit : 4**
0 0 2

The project is to be done by students in batches with maximum number of students four. Project must focus on solving some problem and demonstrate the skills learned till fifth semester. Examples of projects can be taken from various hackathon conducted from time to time by different organizations/companies.

Course Objectives

The objective of this course is to:

1. Enhance the ability of students to identify and analyze real-world problems.
2. Develop skills for designing and implementing software/hardware-based solutions.
3. Encourage the use of modern tools, frameworks, databases, APIs, and emerging technologies.
4. Strengthen teamwork, project management, documentation, and presentation skills.
5. Promote innovation, research orientation, and industry-relevant problem solving.

Project Guidelines

- The project shall be carried out in groups consisting of a maximum of four students.
- Project-II should be an extension and enhancement of Project-I with improved functionality, optimization, scalability, security, or deployment.
- Students are expected to perform detailed requirement analysis, system design, implementation, testing, and validation.
- The project should demonstrate the application of concepts learned up to the fifth semester.
- Students are encouraged to work on interdisciplinary, socially relevant, research-oriented, or industry-focused projects.
- Proper documentation including synopsis, requirement specification, design diagrams, implementation details, testing reports, and user manuals must be maintained.
- The final evaluation shall include project demonstration, report submission, presentation, viva-voce, and assessment of teamwork and innovation.

Suggested Areas for Projects

Web Application Development, Mobile Application Development, Artificial Intelligence and Machine Learning, Data Analytics and Visualization, Internet of Things (IoT), Cloud Computing and DevOps, Cyber Security and Digital Forensics, Blockchain Applications, Automation and Smart Systems, Healthcare, Education, Agriculture, or Smart City Solutions

Suggested Reference Platforms

1. GitHub - https://github.com/topics
2. IEEE Xplore - https://ieeexplore.ieee.org
3. Hackster.io - https://www.hackster.io/projects
4. Instructables - https://www.instructables.com/technology/projects/
5. Devpost - https://devpost.com/hackathons
6. HackerEarth - https://www.hackerearth.com/challenges/hackathon/
7. TechGig - https://www.techgig.com/hackathon

8. Kaggle - https://www.kaggle.com
9. Google Developers - https://developers.google.com
10. Microsoft Learn - https://learn.microsoft.com

Learning Outcomes (COs)

CO Code	Course Outcomes
CO1	Identify and analyze real-world problems and formulate appropriate project objectives.
CO2	Design and develop a software/hardware solution using suitable technologies and tools.
CO3	Apply testing, validation, and optimization techniques to improve project performance and reliability.
CO4	Work effectively in teams and demonstrate project management and communication skills.
CO5	Prepare technical documentation and present project outcomes professionally.

CO-PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	-	-	-	1	1	-	2	1	1
CO2	3	3	3	2	3	-	-	-	2	1	1	2	1	2
CO3	2	3	3	3	2	-	-	-	1	1	-	2	2	2
CO4	1	1	2	1	1	-	-	1	3	3	2	2	2	2
CO5	1	1	1	1	1	-	-	1	2	3	1	2	2	2

Course Code: BCW-P611
Course Name: SOFTWARE ENGINEERING

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	None
Objectives:	● To meet the Computer Science Program Objectives. ● To understand principles, concepts, methods, and techniques of the software engineering approach to producing quality software (particularly for large, complex systems). ● To organize and manage a medium-sized software development project, including project plans and documentation, schedule and cost estimates, and quality assurance activities. ● To think critically about ethical and social issues in software engineering.
Course Coordinator	Mr.Namit Khanduja

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Introduction:** Introduction to software Engineering, Software characteristics, Software components, Software applications, Software Engineering Principles, Software metrics and measurement, monitoring and control. Software development life-cycle, Water fall model, prototyping model, Incremental model, Iterative enhancement Model, Spiral model.	**08**	1,2	1
Module-2	**Software Requirement Specification:** Requirements Elicitation Techniques, Requirement's analysis, Models for Requirements analysis, requirements specification, requirements validation. **System Design:** Design Principles: Problem partitioning, abstraction. Top down and bottom up – design, structured approach. Functional versus object-oriented approach of design, design specification, Cohesiveness and Coupling. Overview of SA/SD Methodology, structured analysis, data flow diagrams, extending DFD to structure chart.	**08**	1,2,3	1
Module-3	**Software project Management:** Project planning and Project scheduling. Software Metrics: Size Metrics like LOC, Token Count, Function Count. Cost estimation using models like COCOMO. Risk management activities. Software Reliability and Quality Assurance: Reliability issues, Reliability metrics, reliability models, Software quality, ISO 9000 certification for software industry, SEI capability maturity model.	**08**	1,2,3	1,2
Module-4	**Testing:** Verification and validation, code inspection, test plan, test case specification. Level of testing: Unit, Integration Testing, Top down and bottom-up integration testing, Alpha and Beta testing, System testing and debugging. functional testing, structural testing, Software testing strategies.	**08**	1,2,3	1,2

Module-5	**Software Maintenance**: Structured Vs unstructured maintenance, Maintenance Models, Configuration Management, Reverse Engineering, Software Re-engineering.	**08**	1,2,3	1,2
Total No. of Hours		**40**		

Learning Outcomes:	• Understand design process. • Implement large programs of greater than 2.5k lines of code • Design and execute tests to identify software bugs • Repair software bugs, redesigning and refactoring code when necessary • Utilize, analyze, and critique code written by others

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	R. S. Pressman, "Software Engineering – A practitioner's approach", 3rd ed., McGraw Hill Int. Ed..
2.	K. K. Aggarwal & Yogesh Singh, "Software Engineering", 2ndEd.,
3.	New Age International Sommerville, "Software Engineering", Addison Wesley.

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√	√	√									√	√
CO2	√	√											√	√
CO3	√	√	√										√	√
CO4	√	√	√	√									√	√
CO5	√	√	√										√	√

Course Code: BCW-C612
Course Name: Fundamentals of Algorithms and Computational Thinking

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	Basic knowledge of data structure
Objectives:	This course is designed for students who have very little background in programming and mathematics. The course introduces algorithms gradually by teaching the required mathematics side-by-side with programming concepts and practical problem solving. The emphasis is on understanding, visualization, logical thinking, and implementation rather than heavy theoretical proofs.
Course Coordinator	Mr.Namit Khanduja

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Computational Thinking, Programming Basics, and Mathematical Foundations:** Introduction to problem solving, computational thinking, definition and characteristics of algorithms, steps for designing algorithms, pseudocode, flowcharts, variables, constants, data types, input and output operations, conditional statements, loops, basic arithmetic operations, powers and exponents, logarithms, functions and growth of functions, counting operations in algorithms, introduction to time and space complexity, best case and worst case analysis, introduction to Big-O notation, linear search, finding maximum and minimum elements.	**08**	1,2,3,4 ,5,9,10	1,2
Module-2	**Recursion, Divide and Conquer, and Sorting Algorithms**: Sequences and patterns, summation notation, concept of recursion, recursive and iterative approaches, factorial and Fibonacci using recursion, recursion tree, divide and conquer strategy, binary search, bubble sort, selection sort, insertion sort, merge sort, comparison of sorting algorithms, introduction to recurrence relations, logarithmic complexity.	**08**	1,2,3,4 5,9,10	1,2
Module-3	**Greedy Algorithms, Dynamic Programming, and Optimization**: Introduction to optimization problems, greedy method, greedy choice strategy, activity selection problem, fractional knapsack problem, coin selection problems, introduction to graphs, nodes and edges, paths and weighted graphs, real-world graph applications, dynamic programming concepts, overlapping subproblems, memoization, tabulation, Fibonacci using dynamic programming, coin change problem, 0/1 knapsack problem, introduction to matrices and tables in algorithms.	**08**	1,2,3,4, 5, 9 ,10	1,2
Module-4	**Graph Algorithms and Backtracking:** Graph representation, adjacency matrix, adjacency list, Breadth First Search (BFS), Depth First Search (DFS), applications of graph traversal, introduction to trees and connectivity,	**08**	1,2,3,4, 5,9,10	1,2

	backtracking technique, state-space tree, n-Queen problem, Sudoku solver, sum of subsets problem, graph coloring problem, combinatorial problem solving.			
Module-5	**Complexity Concepts and Introduction to Modern Computing:** Polynomial and exponential growth, comparison of algorithm efficiency, feasible and infeasible problems, introduction to complexity classes, basic concepts of P and NP, introduction to NP-hard problems, sequential and parallel computing, data parallelism, task parallelism, introduction to multi-core systems, simple parallel matrix operations, applications of algorithms in search engines, recommendation systems, artificial intelligence applications, scheduling and optimization applications.	**08**	1,2,3,4, 5,9,10,1 1,12	1,2
Total No. of Hours		**40**		

Learning Outcomes:	• Understand the fundamentals of computational thinking, algorithms, and systematic problem-solving techniques. • Apply basic mathematical concepts such as logarithms, summations, recursion, and growth of functions in algorithm analysis. • Analyze the time and space complexity of algorithms using basic asymptotic notation. • Design and implement searching, sorting, recursive, greedy, dynamic programming, and graph algorithms. • Apply algorithmic techniques such as divide and conquer, backtracking, and optimization methods to solve computational problems. • Develop logical reasoning, analytical thinking, and introductory programming skills for real-world computational applications.

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Grokking Algorithms, Aditya Bhargava, 2nd Edition, Manning Publications.
2.	Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 4th Edition, MIT Press.
3.	Algorithm Design, Jon Kleinberg, Éva Tardos, 1st Edition, Pearson Education.
4.	Discrete Mathematics and Its Applications, Kenneth H. Rosen, 8th Edition, McGraw-Hill Education.
5.	Problem Solving with Algorithms and Data Structures Using Python, Bradley N. Miller, David L. Ranum, Revised Edition, Franklin, Beedle & Associates.

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1	-	-	-	1	1	-	2	1	1

CO2	3	3	2	2	1	-	-	-	-	-	-	2	**1**	**1**
CO3	3	3	2	2	1	-	-	-	-	-	-	2	1	**1**
CO4	3	3	3	3	3	-	-	-	1	1	-	2	**1**	**1**
CO5	3	3	3	2	2	-	-	-	1	-	-	2	**1**	**1**
CO5	3	3	2	2	3	1	-	1	2	2	1	3	**1**	**1**

Course Code: BCW-P613
Course Name: Machine Learning II: Unsupervised Learning and Applications

MM: 100 **Sessional: 30**
Time: 3 Hr. **ESE: 70**
L T P **Credit : 4**
3 1 0

Prerequisites:	Basic Programming Knowledge and python
Objectives:	1. Understand advanced Machine Learning algorithms and learning paradigms 2. Apply supervised and unsupervised learning techniques to real-world datasets 3. Analyze model performance and optimization techniques 4. Develop practical Machine Learning solutions using classical ML techniques and Python libraries 5. Evaluate Machine Learning models using advanced evaluation metrics 6. Design intelligent prediction and classification systems using Machine Learning techniques
Course Coordinator	Mr. Namit Khanduja

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain Ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**K-Nearest Neighbors (KNN) :** Similarity-based learning, Real-life intuition of nearest neighbors,Distance metrics, Euclidean distance, Manhattan distance, Choosing value of K, Lazy learning concept, KNN for classification, KNN for regression	**06**	1,2,3	1
Module-2	**Decision Trees and Ensemble Learning** Tree-based learning intuition, Entropy, Information Gain, Gini Index, Tree construction, Overfitting in trees, Pruning.Ensemble Learning:Random Forest, Bagging , Boosting (Introduction)	**08**	1,2,3,4,5	1
Module-3	**Support Vector Machine (SVM)** Margin intuition, Best separating boundary, SVM Concepts, Hyperplane, Support vectors, Maximum margin classifier, Linear SVM, Kernel trick (Introduction), Polynomial and RBF kernels, Hyperplane equation.	**08**	1,2,3,4,5	1
Module-4	**Unsupervised Learning and Clustering:** Introduction to Unsupervised Learning: Difference between supervised and unsupervised learning, Clustering intuition, K-Means Clustering, Cluster formation Centroid concept, Elbow method, Inertia. Dimensionality Reduction: Curse of dimensionality, PCA intuition, Feature reduction basic.	**10**	1,2,3,4,5, 8,9	1
Module-5	**Applied Machine Learning and Model Deployment:** Introduction to Natural Language Processing, Text preprocessing, Sentiment Analysis using classical ML, Recommendation Systems, Time Series Forecasting basics, Model serialization using Pickle/Joblib, Introduction to ML deployment using Flask/Streamlit, Ethical issues and bias in ML systems, AI Guardrails.	**08**	1,2,3,4,5, 8,9	1,2
Total No. of Hours		**40**		

Learning Outcomes

CO Code	Course Outcome	Bloom's Level
CO1	Explain advanced supervised and unsupervised learning algorithms	Understand (K2)
CO2	Implement ML algorithms such as KNN, Decision Trees, and SVM	Apply (K3)
CO3	Analyse clustering and dimensionality reduction techniques	Analyze (K4)
CO4	Develop practical Machine Learning applications using Python libraries	Apply (K3)
CO5	Evaluate and optimize ML models using advanced techniques	Evaluate (K5)
CO6	Design and implement intelligent prediction systems.	Create (K6)

Suggested books:

S. No.	Name of Authors /Books /Publisher
1.	Hands-On Machine Learning with Scikit-Learn and TensorFlow — Aurélien Géron
2.	Python for Data Analysis — Wes McKinney
3.	Introduction to Machine Learning with Python — Andreas Müller
4.	Machine Learning — Tom Mitchell

Blooms Taxonomy:

K1 (Remember), K2 (Understand), K (Apply), K4 (Analyze), K5 (Evaluate), K6 (Create)

CO-PO/PSO MAPPING														
Course Outcomes	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**	
(COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	1	-	-	-	-	-		2	**1**	
CO2	2	2	1	1	3	-	-	-	-	-		2	**1**	
CO3	2	3	1	2	2	-	-	-	-	-		2	**1**	
CO4	3	3	3	2	3	-	-	1	-	-		2	**1**	
CO5	2	3	2	3	2	-	-	-	1	-		2	**1**	**1**
CO6	3	3	3	2	3	1	-	2	1	1		3	**1**	**1**

Course Code: BCW-P614
Course Name: SOFTWARE PROJECT MANAGEMENT

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	None
Objectives:	• To understand the Software Project Planning and Evaluation techniques. • To plan and manage projects at each stage of the software development life cycle (SDLC). • To learn about the activity planning and risk management principles. • To manage software projects and control software deliverables. • To develop skills to manage the various phases involved in project management and people management. • To deliver successful software projects that support organization's strategic goals.
Course Coordinator	Mr.Vivudh Fore

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Review of software engineering concepts:** Managed Using Phased Lifecycle, Perform Continuous Validation, Maintained Disciplined Product Control, Use Modern Programming Practices (MPP), Maintain Clear Accountability for Results, Features of Good Software, Quality Requirement in Different Application Areas	**08**	1,2	1
Module-2	**Software Process**: Software Process Definition: Software Process Models, Life Cycle Models, Waterfall Life Cycle Model, Incremental Life Cycle Model, Spiral Life Cycle Model Evolutionary Development Life Cycle Model, Prototyping Life Cycle Model Or Throwaway Prototyping, Object Oriented Life Cycle Model, Winwin Spiral Life Cycle Model, Rational Unified Process, System Engineering, Software Specification, Software design and implementation, Software validation, Software evolution, Tools and Techniques for Process Modeling, Static modeling, Dynamic modeling.	**08**	1,2,3	1
Module-3	**Introduction to Project Management**: Introduction of project, Activities by software project. Feasibility study, Planning, Project execution, Methodologies, Ways of categorizing software projects, Stakeholders, Setting objectives, project success and failures, Management, Principles of Project management, Principles of Project management, Initiation, Planning, execution, closure	**08**	1,2,3	1
Module-4	**Software Project Planning:** Introduction ,Projects and Activities, Sequencing and Scheduling Activities, Formulating a Network Model, Forward Pass and Backward Pass, Identifying the critical path , Shortening the Project Duration, Activity-on-Arrow Networks, Work Breakdown Structure, Generating the WBS, Criteria for completeness in the WBS, Estimating Activity Resources Requirements , Cost Estimation techniques, Joint Project Planning Session , Project Management Plan , Scope Management and Schedule	**08**	1,2,3	1

	Management, Cost Management and Quality Management, Human Resource and communication Management			
Module-5	**Project Economics**: Project Costing, Example for Project Costing, Software Project Estimation, Work Breakdown Structure (WBS), Measuring Effort for a Project, SLOC- Technique, Function Point (FP) Technique, Project Scheduling and Tracking Techniques, COSMIC Full Function Points, Task Network and Scheduling Methods, Monitoring and Control Progress, Risk Concept and Risk Management, Software Metrics and Project Management	**08**	1,2,3	1
Total No. of Hours		**40**		

Learning Outcomes:	• Understand Project Management principles while developing software. • Gain extensive knowledge about the basic project management concepts, framework and the process models. • Obtain adequate knowledge about software process models and software effort estimation techniques. • Estimate the risks involved in various project activities. • Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles. • Learn staff selection process and the issues related to people management

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi	2012
2.	Robert K. Wysocki ―Effective Software Project Management – Wiley Publication	2011
3.	Walker Royce: ―Software Project Management- Addison-Wesley	1998
4.	Gopalaswamy Ramesh, ―Managing Global Software Projects – McGraw Hill Education (India), Fourteenth Reprint	2013

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√											√	√
CO2	√	√	√								√		√	√
CO3	√	√	√	√	√				√	√	√	√	√	√
CO4	√	√		√	√				√	√	√	√	√	√
CO5	√	√	√	√	√		√	√	√	√	√	√	√	√

Course Code: BCW-P615
Course Name: FULL STACK WEB DEVELOPMENT

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	Academic level web application knowledge
Objectives:	• Enable participants to develop a complete web application from the scratch that includes Front-end, Back-end and Data-exchange technologies • Build strong foundations (ex: OOPS) in entry level engineers thereby making them job ready as per industry requirements. Enable them to learn new technologies by applying foundation paradigms • By the end of the program participants will be become an industry-ready engineer who can be readily deployed in a project.
Course Coordinator	Dr.Nishant Kumar

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Fundamental of web development** **Understanding browser internals:** Rendering engine, Parsing - HTML parsing, CSS parsing, Render tree, Layouting, Painting, Engine's thread - Event loops, CPU, GPU, Memory, and multi-process architecture. **Building basic web apps using HTML, CSS & Javascript** **HTML -** HTML Basics, HTML Forms, HTML APIs. **CSS -** Selectors, Box model, positioning, Pseudo-class, specificity, Animations. **Javascript -** Fundamental, Object, Arrays, Functions, Events, Scope, Hoisting, Errors, this keyword, ES6, Conditions, Iterations, Debugging, Promises, Synchronous & Asynchronous flow.	**08**	1,2,3,4	1,2
Module-2	**Server side of web development** **Understanding NodeJs -** Fundamental, Modules, File System, NPM, Events, Callbacks, Global namespace, Garbage collection, NPM registry, HTTP server. **Building REST APIs using ExpressJs -** Creating Basic Server, JSON, Middleware, Synchronous, Asynchronous, Dynamic Routes, Static Files, Template Engine, Streams, Error handling, MVC pattern.	**08**	1,2,3,4	1,2
Module-3	**Storage in depth** **Understanding Browser storage -** LocalStorage, Session Storage, Cookies, IndexedDB, Web SQL, Cache. **Storing application data in MongoDB -** Fundamental, Create Database, Create Collections, Insert, Find, Query, Delete, Drop, Update, Join, Using Mongoose.	**08**	1,2,3,4	1,2
Module-4	**Web security** **Understanding authentication & authorization -** Understanding basics of security, Access control, OAuth, Encryption, multi-factor authentication. **Vulnerabilities in Web Apps-** Cross-Site Scripting (XSS), SQL Injection,	**08**	1,2,3,4	1,2

	Cross-Site Request Forgery, Denial of Service (DoS), Transport Layer Security (TLS)/ Secure Socket Layer (SSL), Server-side JavaScript Injection (SSJI)			
Module-5	**Advanced web development** **Building dynamic apps using ReactJs-** ReactJs fundamentals, LifeCycle, Hooks, JSX, Component, State, Props, Synthetic events. **Web application performance -** Measuring performance, Performance metrics - (FCP, LCP, FMP, TTI, FP), Improving Performance - (Assets Compressions, CDN, Caching, Lazy load, BundleSize, SSR, Prefetching).	**08**	1,2,3,4	1,2
Total No. of Hours		**40**		

Learning Outcomes:	• Understand Structure and implement HTML/CSS. • Understand visualizations in accordance with UI/UX theories. • Develop a fully functioning website and deploy on a web server. • Derive information from data and implement data into applications. • Implement a RESTful backend API for storing and retrieving data via AJAX calls.

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Jennifer Robbins, "Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics".
2.	Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites".
3.	Kyle Simpson, "You Don't Know JS: Up & Going"
4.	Matt Zandstra, "PHP Objects, Patterns, and Practice, Second Edition"
5.	Leonard Richardson, "RESTful Web APIs: Services for a Changing World"

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√											√	√
CO2	√	√	√								√		√	√
CO3	√	√	√	√	√							√	√	√
CO4	√	√		√	√							√	√	√
CO5	√	√	√	√	√							√	√	√

Course Code: BCW-P616
Course Name: DATA ANALYTICS-2

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	Basic knowledge of data structure and data analytics.
Objectives:	• To provide an overview of an exciting growing field of big data analytics. • To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce. • To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability. • To enable students to have skills that will help them to solve complex real-world problems in for decision support.
Course Coordinator	Mr.Namit Khanduja

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Supervised Learning with Regression and Classification Techniques:** Bias-Variance Dichotomy, Linear and Quadratic Discriminant Analysis, Classification and Regression Trees, Ensemble Methods: Random Forest, Neural Networks, Deep Learning.	**08**	1,2,3,4	1,2
Module-2	**Machine Learning:** Introduction and Concepts: Ridge Regression; Lasso Regression; and K-Nearest Neighbours, Regression and Classification.	**08**	1,2,3,4	1,2
Module-3	**Introduction to R**: - R graphical user interfaces, data import and export, attribute and data types, descriptive statistics, exploratory data analysis, visualization before analysis, 08 analytics for unstructured data.	**08**	1,2,3,4	1,2
Module-4	**Classification:** Decision Trees – Attribute Selection Measures and Tree Pruning; Bayesian and Rule-based Classification; Model Evaluation and Selection; Cross-Validation; Classification Accuracy; Bayesian Belief Networks; Classification by Backpropagation; and Support Vector Machine.	**08**	1,2,3,4	1,2
Module-5	**Business Analytics:** Predictive Analysis (Regression and Correlation, Logistic Regression, InSample and Out-of-Sample Predictions), Prescriptive Analytics (Optimization and Simulation with Multiple Objectives).	**08**	1,2,3,4	1,2
Total No. of Hours		**40**		

Learning Outcomes:	• Apply R tool for developing real time applications. • Gain the principle concepts and foundational understanding of data analytics. • Understanding of the statistical procedures most often used by practicing engineers. • Demonstrate the business analytical techniques used in decision making. • Understand item sets, classification, clustering and machine learning techniques.

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press.
2.	Bill Franks, Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & Sons.
3.	Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley
4.	David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big Data Analytics", EMC Education Series, John Wiley
5.	Frank J Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley and SAS Business Series
6.	Michael Berthold, David J. Hand," Intelligent Data Analysis", Springer
7.	Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw Hill.
8.	Mark Gardner, "Beginning R: The Statistical Programming Language", Wrox Publication.
9.	Pete Warden, Big Data Glossary, O'Reilly.
10.	Glenn J. Myatt, Making Sense of Data, John Wiley & Sons.
11.	Pete Warden, Big Data Glossary, O'Reilly.
12.	Peter Bühlmann, Petros Drineas, Michael Kane, Mark van der Laan, "Handbook of Big Data", CRC Press.
13.	Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer.
14.	Colleen Mccue, "Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis", Elsevier.
15.	Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer.
16.	Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier.

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√											√	√
CO2	√	√	√								√		√	√
CO3	√	√	√	√								√	√	√
CO4	√	√		√								√	√	√
CO5	√	√	√	√								√	√	√

Course Code: BCW-P663

Course Name: MACHINE LEARNING II: UNSUPERVISED LEARNING AND APPLICATIONS LAB

MM: 50 **Sessional: 15**
Time: 3 Hr. **ESE: 35**
L T P **Credit: 01**
0 0 2

Objectives:	1. To develop practical skills in advanced Machine Learning techniques using Python. 2. To implement clustering, dimensionality reduction, and ensemble learning methods. 3. To analyze and evaluate Machine Learning models using performance metrics. 4. To develop practical Machine Learning applications and simple deployment systems.
Course Coordinator	Dr. Namit Khanduja

NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 20 students for daily practical work in laboratory. 3. No batch for practical class shall consist of more than 20 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean

LIST OF EXPERIMENTS	No. of Hours/Week	POs mapped	PSOs mapped
Implement K-Nearest Neighbors (KNN) classification and regression algorithms using Scikit-learn	02	1,2,3	1
Implement Decision Tree classifier and visualize tree structure	02	1,2,3,4	1
Implement Random Forest and compare performance with Decision Tree models	02	1,2,3,4,5	1
Implement Support Vector Machine (SVM) using linear and RBF kernels	02	1,2,3,4,5	1
Perform model evaluation using confusion matrix, accuracy, precision, recall, and F1-score	02	1,2,3,4,5,9	1,2
Implement K-Means clustering for customer segmentation problems	02	1,2,3,4,5	1
Perform dimensionality reduction using Principal Component Analysis (PCA)	02	1,2,3,4,5	1
Implement text preprocessing and sentiment analysis using classical Machine Learning techniques	02	1,2,3,4,5,8	1,2
Develop a recommendation system using similarity-based approaches along-with AI Guardrails	02	1,2,3,4,5,8	1,2
Serialize and deploy a Machine Learning model using Pickle/Joblib and Streamlit/Flask	02	1,2,3,4,5,8,9	1,2

Learning Outcomes:	CO1: Explain advanced supervised and unsupervised Machine Learning techniques. CO2: Implement Machine Learning algorithms such as KNN, Decision Trees, Random Forest, and SVM using Python libraries. CO3: Analyze clustering and dimensionality reduction techniques for real-world datasets. CO4: Develop practical Machine Learning applications using Scikit-learn and related Python tools. CO5: Evaluate and optimize Machine Learning models using standard performance metrics. CO6: Design and deploy simple intelligent prediction and recommendation systems.

Course Outcomes	**Program Outcomes (POs)**												**PSOs**	
(COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	-	-	1	-	-	-	-	-	-	1	1	-
CO2	3	3	2	1	1	-	-	-	-	-	-	1	1	1
CO3	3	3	3	2	2	-	-	-	-	-	-	1	1	1
CO4	2	3	2	3	2	-	-	1	-	-	-	1	1	1
CO5	3	3	3	2	3	-	-	-	1	-	-	2	2	1
CO6	3	3	3	3	3	1	-	2	1	-	-	2	2	2

Course Code: BCW-P664

Course Name: SOFTWARE PROJECT MANAGEMENT LAB

MM: 50 **Sessional: 15**
Time: 3 Hr. **ESE: 35**
L T P **Credit: 01**
0 0 2

Objectives:	1. To develop practical understanding of software project management principles and practices. 2. To apply project planning, scheduling, estimation, and tracking techniques for software projects. 3. To implement software process modeling and documentation using industry-standard tools. 4. To analyze project risks, resource allocation, and software quality management techniques.
Course Coordinator	Dr. Namit Khanduja

NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 20 students for daily practical work in laboratory. 3. No batch for practical class shall consist of more than 20 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean

LIST OF EXPERIMENTS	No. of Hours/Week	POs mapped	PSOs mapped
Study and comparison of Software Development Life Cycle (SDLC) models including Waterfall, Spiral, Incremental, Prototype, and Agile models	02	1,2,3	1
Preparation of Software Requirement Specification (SRS) document for a software project	02	1,2,3,10	1
Design UML diagrams including Use Case, Class, Sequence, and Activity diagrams for a software system	02	1,2,3,4	1
Perform feasibility analysis including technical, economic, operational, and schedule feasibility for a software project	02	1,2,3,4	1
Identify stakeholders, project scope, assumptions, constraints, and objectives for software projects	02	1,2,3,9	1
Create Work Breakdown Structure (WBS) for software project planning and management	02	1,2,3,4,5	1
Prepare Gantt charts and milestone charts using project management tools	02	1,2,3,4,5	1
Develop PERT and CPM network diagrams and identify critical path for project scheduling	02	1,2,3,4,5	1
Estimate project size, effort, and cost using SLOC, Function Point Analysis, and COCOMO models	02	1,2,3,4,5	1
Perform resource allocation, scheduling, and manpower planning for software projects	02	1,2,3,4,5,11	1
Prepare Software Project Management Plan (SPMP) including scope, schedule, quality, and communication management plans	02	1,2,3,4,5,10	1,2

LIST OF EXPERIMENTS	No. of Hours/Week	POs mapped	PSOs mapped
Identify software project risks and prepare risk mitigation and contingency plans	02	1,2,3,4,5,11	1,2
Monitor and track project progress using software metrics and performance indicators	02	1,2,3,4,5,9	1,2
Study and use of project management tools such as Jira, Trello, OpenProject, Git, and GitHub for task and team management	02	1,2,3,4,5,8	1,2
Mini Project: Develop a complete software project management case study including planning, scheduling, estimation, risk analysis, tracking, documentation, and presentation	02	1,2,3,4,5,8,9,10	1,2

Learning Outcomes:	CO1: Explain software project management concepts, SDLC models, and software engineering practices. CO2: Apply software process modeling and documentation techniques using UML and project management tools. CO3: Perform project planning, scheduling, estimation, and resource allocation activities for software projects. CO4: Analyze software project risks, quality requirements, and monitoring techniques using standard methods. CO5: Develop Software Project Management Plans (SPMP) and manage project execution effectively. CO6: Use project management and collaboration tools to manage software development projects in team environments.

CO-PO/PSO MAPPING

Course Outcomes	Program Outcomes (POs)												PSOs	
(COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	1	-	-	-	-	-	-	1	1	-
CO2	3	3	2	1	1	-	-	-	-	-	-	1	1	1
CO3	3	3	3	2	2	-	-	-	-	-	-	1	1	1
CO4	2	3	2	3	2	-	-	1	-	-	-	1	1	1
CO5	3	3	3	2	3	-	-	-	1	-	-	2	2	1
CO6	3	3	3	3	3	1	-	2	1	-	-	2	2	2

Course Code: BCW-P665
Course Name: FULL STACK WEB DEVELOPMENT LAB

MM: 50 **Sessional: 15**
Time: 3 Hr. **ESE: 35**
L T P **Credit: 01**
0 0 2

Objectives:	1. To develop practical skills in front-end and back-end web development technologies. 2. To design and implement dynamic, responsive, and database-driven web applications. 3. To develop RESTful APIs and integrate client-side and server-side technologies. 4. To understand web security, authentication mechanisms, and performance optimization techniques.
Course Coordinator	Dr. Namit Khanduja

NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 20 students for daily practical work in laboratory. 3. No batch for practical class shall consist of more than 20 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean

LIST OF EXPERIMENTS	No. of Hours/Week	POs mapped	PSOs mapped
Design static web pages using HTML5 elements, forms, tables, multimedia, and semantic tags	02	1,2,3	1
Implement CSS styling including selectors, box model, positioning, transitions, animations, and responsive layouts	02	1,2,3,5	1
Develop interactive web pages using JavaScript concepts such as arrays, functions, DOM manipulation, events, and form validation	02	1,2,3,4	1
Implement asynchronous programming using callbacks, promises, async/await, and API fetching techniques	02	1,2,3,4,5	1
Create and manage Node.js applications using modules, file systems, NPM packages, and HTTP servers	02	1,2,3,4,5	1
Develop RESTful APIs using Express.js including routing, middleware, error handling, and MVC architecture	02	1,2,3,4,5	1
Implement CRUD operations using MongoDB and Mongoose for database-driven applications	02	1,2,3,4,5	1
Develop session management and browser storage applications using Cookies, LocalStorage, SessionStorage, and IndexedDB	02	1,2,3,5	1
Implement user authentication and authorization using JWT, OAuth, and role-based access control mechanisms	02	1,2,3,4,5,8	1,2
Identify and demonstrate prevention techniques for common web vulnerabilities such as XSS, CSRF, SQL Injection, and DoS	02	1,2,3,4,5,8	1,2
Develop reusable UI components and single-page applications using ReactJS components, props, state, hooks, and JSX	02	1,2,3,4,5	1

LIST OF EXPERIMENTS	No. of Hours/Week	POs mapped	PSOs mapped
Implement API integration in ReactJS applications using Axios or Fetch API	02	1,2,3,4,5	1
Optimize web application performance using lazy loading, caching, asset compression, and bundle optimization techniques	02	1,2,3,4,5,9	1,2
Deploy full stack web applications using GitHub, Render/Netlify/Vercel, and cloud hosting platforms	02	1,2,3,4,5,9	1,2
Mini Project: Develop and deploy a complete full stack web application integrating front-end, back-end, database, authentication, and REST APIs	02	1,2,3,4,5,8,9,10	1,2

Learning Outcomes:	CO1: Explain the architecture and technologies involved in full stack web development. CO2: Design responsive and interactive front-end applications using HTML, CSS, JavaScript, and ReactJS. CO3: Develop server-side applications and RESTful APIs using Node.js and Express.js. CO4: Implement database connectivity, authentication, authorization, and secure web application practices. CO5: Deploy, optimize, and maintain full stack web applications using modern tools and frameworks. CO6: Develop complete industry-oriented web applications integrating client-side, server-side, and database technologies.

CO-PO/PSO MAPPING

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1.	3	2	-	-	1	-	-	-	-	-	-	1	1	-
CO2	3	3	3	2	3	-	-	1	-	-	-	1	2	1
CO3	3	3	3	3	3	-	-	1	-	-	-	1	2	2
CO4	3	3	2	3	3	-	-	2	1	-	-	1	2	2
CO5	3	3	3	3	3	1	-	2	1	1	1	2	2	2
CO6	3	3	3	3	3	2	-	2	2	2	1	2	3	3

Course Code: BCW-P666
Course Name: DATA ANALYTICS 2 LAB

MM: 50 **Sessional: 15**
Time: 3 Hr. **ESE: 35**
L T P **Credit: 01**
0 0 2

Objectives:	1. To develop practical skills in data analytics using R and Machine Learning tools. 2. To perform regression, classification, and predictive analytics tasks. 3. To analyze and visualize structured and unstructured datasets. 4. To implement business analytics and Machine Learning techniques for decision support.
Course Coordinator	Dr. Namit Khanduja

NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 20 students for daily practical work in laboratory. 3. No batch for practical class shall consist of more than 20 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean

LIST OF EXPERIMENTS	No. of Hours/Week	POs mapped	PSOs mapped
Perform data import/export and preprocessing using R	02	1,2,3	1
Implement data visualization and exploratory data analysis	02	1,2,3,4	1
Implement Linear and Logistic Regression models	02	1,2,3,4,5	1,2
Implement Ridge and Lasso Regression techniques	02	1,2,3,4,5	1
Implement KNN classification and regression algorithms	02	1,2,3,4,5	1
Implement Decision Tree classification and pruning	02	1,2,3,4,5	1
Implement Random Forest and ensemble learning methods	02	1,2,3,4,5	1,2
Implement Support Vector Machine for classification	02	1,2,3,4,5	1
Perform model evaluation using confusion matrix and cross-validation	02	1,2,3,4,5,9	1,2
Perform predictive and prescriptive analytics for business applications	02	1,2,3,4,5,8,9	1,2

Learning Outcomes:	CO1: Apply R/Python programming for data analytics and visualization. CO2: Implement regression and classification techniques using Machine Learning tools. CO3: Analyze datasets using statistical and predictive analytics methods. CO4: Evaluate Machine Learning models using performance evaluation techniques. CO5: Develop business analytics solutions for decision support systems.

CO-PO/PSO MAPPING

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1.	3	2	-	-	1	-	-	-	-	-	-	1	1	-
CO2	3	3	3	2	3	-	-	1	-	-	-	1	2	1
CO3	3	3	3	3	3	-	-	1	-	-	-	1	2	2
CO4	3	3	2	3	3	-	-	2	1	-	-	1	2	2
CO5	3	3	3	3	3	1	-	2	1	1	1	2	2	2

Course Code: BCW- S660
Course Name: Project-III

MM: 50 **Sessional: 15**
Time: 3 Hr. **ESE: 35**
L T P **Credit : 4**
0 0 2

The project is to be done by students in batches with maximum number of students four. Project must focus on solving some problem and demonstrate the skills learned till sixth semester. Examples of projects can be taken from various hackathon conducted from time to time by different organizations/companies.

Course Objectives

1. Enable students to undertake a major project involving research, innovation, and practical implementation.
2. Develop industry-oriented and research-oriented problem-solving capabilities.
3. Encourage students to integrate knowledge from multiple domains and emerging technologies.
4. Strengthen professional skills including documentation, presentation, teamwork, ethics, and project management.
5. Prepare students for higher studies, entrepreneurship, product development, and industrial careers.

Project Guidelines

- The project shall be carried out in groups consisting of a maximum of four students.
- Project-III should be a major capstone project demonstrating comprehensive knowledge and technical expertise.
- Students should focus on innovation, scalability, deployment, experimentation, optimization, or research contribution.
- The project may involve prototype development, product development, system implementation, research experimentation, or industrial applications.
- Students are expected to conduct literature review, feasibility analysis, system design, implementation, testing, deployment, and performance evaluation.
- The use of modern technologies, APIs, frameworks, cloud platforms, AI/ML tools, data analytics platforms, and software engineering practices is encouraged.
- Proper project documentation, research paper/report writing, source code management, and demonstration are mandatory.
- The evaluation shall be based on originality, implementation quality, innovation, presentation, report writing, teamwork, and viva-voce.

Suggested Domains

Artificial Intelligence and Generative AI, Machine Learning and Deep Learning, Natural Language Processing, Computer Vision and Intelligent Systems, Internet of Things and Smart Automation, Cloud Computing and Distributed Systems, Cyber Security and Ethical Hacking, Data Science and Big Data Analytics, Blockchain and FinTech Applications, AR/VR, Robotics, and Smart Devices, Sustainable Computing and Green Technologies, Healthcare, Agriculture, Education, and Social Impact Solutions.

Suggested Reference Platforms

1. GitHub - https://github.com/topics
2. IEEE Xplore - https://ieeexplore.ieee.org
3. ACM Digital Library - https://dl.acm.org
4. Kaggle - https://www.kaggle.com
5. Google AI - https://ai.google

6. Hugging Face - https://huggingface.co
7. MLH Hackathons - https://mlh.io/
8. Devpost - https://devpost.com/hackathons
9. HackerEarth - https://www.hackerearth.com/challenges/hackathon/
10. TechCrunch Startup Ideas - https://techcrunch.com

Learning Outcomes (COs)

CO Code	Course Outcomes
CO1	Analyze complex real-world problems and formulate effective technical solutions.
CO2	Design, develop, and deploy a complete project using appropriate technologies and methodologies.
CO3	Evaluate project performance using testing, experimentation, and analytical techniques.
CO4	Demonstrate innovation, research aptitude, teamwork, and project management skills.
CO5	Prepare professional technical reports, research papers, and deliver effective presentations.

CO-PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	1	1	-	3	2	2
CO2	3	3	3	3	3	-	-	-	2	2	1	3	2	2
CO3	2	3	3	3	2	-	-	-	1	1	-	2	2	2
CO4	1	1	2	2	1	-	-	1	3	3	3	3	2	2
CO5	1	1	1	1	1	-	-	1	2	3	2	2	2	2

Evaluation Components

- Problem Identification and Literature Review
- System Design and Methodology
- Implementation and Innovation
- Testing and Performance Evaluation
- Documentation and Technical Report
- Presentation and Demonstration
- Viva-Voce
- Team Contribution and Project Management