HSNC UNIVERSITY, MUMBAI

(2025-2026)

Ordinances and Regulations

With Respect to

Choice Based Credit System (CBCS)

For the Programme Under

The Faculty of Science & Technology

Curriculum – Second Year Information Technology

Undergraduate Programme

2025-2026

Revised Syllabus for S.Y B.Sc. (IT)

(With effect from the academic year 2025-2026)

Board of Studies in the Subject of

Information Technology

1.) Name of Chairperson/Co-Chairperson/Coordinator: -
a) **Dr. Rakhi O. Gupta: Chairperson** (Assistant Professor and Head, Department of IT, K.C College, Churchgate)
rakhi.gupta@kccollege.edu.in 9619914191.
2.) Two to five teachers each having minimum five years teaching experience amongst the full-time teachers of the Departments, in the relevant subject.
a) **Dr.   Pragati V Thawani : Co- Chairperson (**Assistant Professor, Department of IT, K.CCollege, Churchgate**)** pragati.thawani@kccollege.edu.in **9960782000**
   b) **Ms. Sandhya S Bhavsar: (Assistant** Professor, Department of IT, K. C. College, Churchgate) sandhya.bhasvar@kccollege.edu.in **8446677463**
c) **Ms. Neha Patel (** Assistant Professor, Department of IT, K. C. College, Churchgate) neha.patel@kccollege.edu.in **9820609142**
d) **Ms. Nashrah Gowalker: (Assistant** Professor, Department of IT, K. C. College, Churchgate) nashrah.gowalker @kccollege.edu.in **9664774108**

3.) One Professor / Associate Professor from other Universities or professor / Associate Professor

from colleges managed by Parent Body; nominated by Parent Body; -

a) **Dr**.**Rasika S. Mallya** (Associate Professor, Navinchandra Mehta Institute of Technology & Development, Mumbai.) rasikamallya@gmail.com **9819682436.**

4.) Four external experts from Industry / Research / eminent scholar in the field relevant to the subject nominated by the Parent Body;
a) **Dr. Hiren Dand** (Head of Department (IT), Mulund College of Commerce) Hiren.dand@mccmulund.ac.in   **9821140717.**

b) **Mr. Asif K. Rampurawala** (Vice Principal, Vidyalankar School of Information Technology)asif.rampurawala@vsit.edu.in 9820765273.

c.) **Mr. Kaushal Shah** (Senior Manager Reliance Power Ltd.) Kaushalshah78@gmail.com 9869069203.

d.) **Mr. Prabhav** (Founder, MD & Managing Partner at Pagadi group of companies & associated entities under Wealth Vigyan, Skillsher & Peacommerce) prabhav@skillsher.com 9321031131   .
e.) **Ms. Kirti Bhatt** (Lecturer/ Industry Expert) kirti.bhatt@kccollege.edu.in 9869856998

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    Dr. Rakhi O. Gupta
BOS Chairperson – Information Technology

Part –I

Outline of Choice Based Credit System as outlined by University Grants Commission:

R. ****:The Definitions of the Key Terms Used in the Choice Based Credit System and Grading System introduced from the academic Year 2023-2024 are as under:

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

   2.1 **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/ Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

   2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

   2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.
   P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Choice Base Credit System:** CBCS allows students to choose inter-disciplinary, intra-disciplinary courses, skill oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students.

4. **Honours Program:** To enhance employability and entrepreneurship abilities among the learners, through aligning Inter Disciplinary / Intra Disciplinary courses with Degree Program. Honors Program will have
40 additional credits to be undertaken by the learner across three years essentially in Inter / Intra Disciplinary course.

A learner who joins Regular Undergraduate Program will have to opt for Honours Program in the first year of the Program. However, the credits for honours, though divided across three years can be completed within three years to become eligible for award of honours Degree.

5. **Program:** A Program is a set of course that are linked together in an academically meaningful way and generally ends with the award of a Degree Certificate depending on the level of knowledge attained and the total duration of study, B.Sc. Programs.

6. **Course:** A 'course' is essentially a constituent of a 'program' and may be conceived of as a composite of several learning topics taken from a certain knowledge domain, at a certain level. All the learning topics included in a course must necessarily have academic coherence, i.e. there must be a common thread linking the various components of a course. A number of linked courses considered together are in practice, a 'program'.

7. **Bridge Course:** Bridge course is visualized as Pre semester preparation by the learner before commencement of regular lectures. For each semester the topics, whose knowledge is considered as essential for effective and seamless learning of topics of the Semester, will be specified. The Bridge Course can be conducted in online mode. The Online content can be created for the Bridge Course Topics.

8. **Module and Unit:** A course which is generally an independent entity having its own separate identity, is also often referred to as a 'Module' in today's parlance, especially when we refer to a 'modular curricular structure'. A module may be studied in conjunction with other learning modules or studied independently. A topic within a course is treated as a Unit. Each course should have exactly 3 Units.

9. **Self-Learning: 20% of the topics will be marked for Self-Learning.** Topics for Self-Learning are to be learned independently by the student, in a time-bound manner, using online and offline resources including online lectures, videos, library, discussion forums, fieldwork, internships etc.

Evaluative sessions (physical/online), equivalent to the credit allocation of the Self Learning topics, shall be conducted, preferably, every week for each course. Learners are to be evaluated real time during evaluative sessions. The purpose of evaluative sessions is to assess the level of the students' learning achieved in the topics earmarked for Self-Learning.

The teacher's role in these evaluative sessions will be that of a Moderator and Mentor, who will guide and navigate the discussions in the sessions, and offer concluding remarks, with proper reasoning on the aspects which may have been missed by the students, in the course of the Self-Learning process.

The modes to evaluate self-learning can be a combination of the various

methods such as written reports, handouts with gaps and MCQs, objective tests, case studies and Peer learning. Groups can be formed to present self- learning topics to peer groups, followed by Question and Answer sessions and open discussion. The marking scheme for Self-Learning will be defined under Examination and Teaching.

The topics stipulated for self-learning can be increased or reduced as per the recommendations of the Board of Studies and Academic Council from time to time. All decisions regarding evaluation need to be taken and communicated to the stakeholders preferably before the commencement of a semester. Some exceptions may be made in exigencies, like the current situation arising from the lockdown, but such ad hoc decisions are to be kept to the minimum possible.

10. **Credit Point:** Credit Point refers to the 'Workload' of a learner and is an index of the number of learning hours deemed for a certain segment of learning. These learning hours may include a variety of learning activities like reading, reflecting, discussing, attending lectures / counseling sessions, watching especially prepared videos, writing assignments, preparing for examinations, etc. Credits assigned for a single course always pay attention to how many hours it would take for a learner to complete a single course successfully. A single course should have, by and large a course may be assigned anywhere between 2 to 8 credit points wherein 1 credit is construed as corresponding to approximately 15 learning hours.

11. **Credit Completion and Credit Accumulation:** Credit completion or Credit acquisition shall be considered to take place after the learner has successfully cleared all the evaluation criteria with respect to a single course. Thus, a learner who successfully completes a 4 CP (Credit Point) course may be considered to have collected or acquired 4 credits. Learner level of performance above the minimum prescribed level (viz. grades / marks obtained) has no bearing on the number of credits collected or acquired. A learner keeps on adding more and more credits as he completes successfully more and more courses. Thus, the learner 'accumulates' course wise credits.

12. **Credit Bank:** A Credit Bank in simple terms refers to stored and dynamically updated information regarding the number of Credits obtained by any given learner along with details regarding the course/s for which Credit has been given, the course-level, nature, etc. In addition, all the information regarding the number of Credits transferred to different programs or credit exemptions given may also be stored with the individual's history.

13. **Credit Transfer:** (performance transfer) When a learner successfully completes a program, he/she is allowed to transfer his/her past performance to another academic program having some common courses and Performance transfer is said to have taken place.

14. **Course Exemption:** Occasionally, when two academic programs offered by a single university or by more than one university, may have some common or equivalent course-content, the learner who has already completed one of these

academic programs is allowed to skip these 'equivalent' courses while registering for the new program. The Learner is 'exempted' from 'relearning' the common or equivalent content area and from re-appearing for the concerned examinations. It is thus taken for granted that the learner has already collected in the past the credits corresponding to the exempted courses.

Part-II

O***** The fees for transfer of credits or performance will be based on number of credits that a learner has to complete for award of the degree.

The Scheme of Teaching and Examination:

The performance of the learners shall be evaluated in two components: Internal Assessment with 40% marks by way of continuous evaluation and by Semester End Examination with 60% marks by conducting the theory examination.

INTERNAL ASSESSMENT: - It is defined as the assessment of the learners on the basis of continuous evaluation as envisaged in the credit based system by way of participation of learners in various academic and correlated activities in the given semester of the program.

A). Internal Assessment– 40%   **40 marks**

    1. For Theory Courses

Sr. No.	Particulars	Marks
1	Self-Learning Evaluation – Active participation in routine class instructional deliveries Overall Performance – Attendance Record	15

 2. For Courses with Practicals -

Practical Assessment– 25 Marks (50 Marks converted into 25 Marks) Duration – **2 Hours**

Sr. No	Evaluation type	Marks
1	Two Best Practical a. Evaluation of One Program	20
	b. Evaluation of Second Program	20
2	Journal	05
3	Viva	05

B) Theory Assessment– 60%   **60 marks**

Theory Question Paper Pattern

The semester end examination (external component) of 60 % for each course will be as follows:
      i) **Theory Component Duration** – **2 Hours**
      ii) **Theory Question Paper Pattern**: -

Q-No.	Particulars	Marks
Q-1	All Units	15 Marks
Q-2	Unit-I	15 Marks
Q-3	Unit-II	15 Marks
Q-4	Unit-III	15 Marks

      The marks will be given for all examination and they will be converted into grade (quality) points. The semester-end, final grade sheets and transcripts will have only credits, grades, grade points, SGPA and CGPA.

3. Project and Assignment:

- Project or Assignment, which can in the following forms
   - Case Studies
   - Videos
   - Blogs
   - Research paper (Presented in Seminar/Conference) Field Visit Report

   - Presentations related to the subject
   - Internships (Exposition of theory into practice)
   - Open Book Test
   - Any other innovative methods adopted with the prior approval of Director Board of Examination and Evaluation.

4.   **Self-Learning Evaluation**

- 20% of the topics of curriculum are learned by the student through self-learning using online / offline academic resource specified in the curriculum.
- Hence 20% of the lectures shall be allocated for evaluation of students on self-learning topics
- The identified topics in the syllabus shall be learnt independently by the students in a time bound manner preferably from online resources.

Methods for Evaluation of Self-learning topics:

–   Seminars/presentation (PPT or poster), followed by Q&A – Objective questions /Quiz / Framing of MCQ Questions.

- Debates
- Group discussion
- You-Tube videos (Marks shall be based on the quality and viewership)
- Improvisation of videos
- Viva Voce
  Any other innovative method

Teachers can frame other methods of evaluation also provided that the method, duly approved by the college examination committee, is notified to the students at least 7 days before the commencement of the evaluation session and is forwarded for information and necessary action at least 3 days before the commencement of the evaluation session. The marks of the internal assessment should not be disclosed to the students till the results of the corresponding semester is declared.

HSNC University Mumbai

(2025-2026)

Ordinances and Regulations

With Respect to

Choice Based Credit System (CBCS)

For the Program Under

The Faculty of Science and Technology

For the Course

Information Technology

Revised Curriculum – Second Year Undergraduate Program

Semester-III and Semester -IV

2025-2026

Part 1- Preamble

The revised and restructured curriculum for the B.Sc. (IT) under NEP is integrated course as systematically designed considering the current industry needs in terms of skills sets demanded under new technological environment. It also endeavors to align the programme structure and course curriculum with student aspirations and corporate expectations. The proposed curriculum is more contextual, industry affable and suitable to cater the needs of society and nation in present day context. The B.Sc. Information Technology programme was started in 2001 with an aim to make the students employable and impart industry oriented training. The main objectives of the course are:

• To think analytically, creatively and critically in developing robust, extensible and highly maintainable technological solutions to simple and complex problems.

• To apply their knowledge and skills to be employed and excel in IT professional careers and/or to continue their education in IT and/or related post graduate programmes.

• To be capable of managing complex IT projects with consideration of the human, financial and environmental factors.

• To work effectively as a part of a team to achieve a common stated goal.

• To adhere to the highest standards of ethics, including relevant industry and organizational codes of conduct.

• To communicate effectively with a range of audiences both technical and non-technical.

• To develop an aptitude to engage in continuing professional development.

The new syllabus is aimed to achieve the objectives. The syllabus spanning four years covers the industry relevant courses. The students will be ready for the jobs available in different fields like:

- **Software Development (Programming)**
- **Website Development**
- **Mobile app development**
- **Embedded System with Internet of Things**
- **Network Security**
- **Software Testing**
- **Networking**
- **Database Administration**
- **System Administration**
- **Cyber Law Consultant**
- **Virtualization**
- **Devops (Development & Operation)**
- **Entrepreneurship Development &Management**
- **Green IT and many other.**

We sincerely believe that any student taking this programme will get very strong foundation and exposure to basics, advanced and emerging trends of the subject. We wholeheartedly thank all experts who shared their valuable feedbacks and suggestions in order to improvise the contents, we have sincerely attempted to incorporate each of them.

1. **Process adopted for curriculum designing:**

   The Department conducted multiple meetings with academic partners, industry partners and BOS Members. After discussion with them personally, via mail, via messages, the changes in the syllabus were introduced. The course design focusses on immediate employability of the student after graduation.

2. **Salient features, how it has been made more relevant:**

   After discussion and interaction with industry and academic experts, many innovative changes are introduced in the syllabus. Innovative and advanced teaching on Software Project Management, Embedded System with Internet of Things,Enterprise Networking, Introduction to Artificial Intelligence, Linux System Administration, NOSQL DB, Data mining & Business Intelligence, Cyber Laws, Compliance & Frameworks. New subjects like Virtual Reality, Cryptography & Information Security, Mobile & Cloud Computing, Virtualization Concepts &Applications, DevOps and Entrepreneurship Development &Management are introduced. Community-based program (Social Responsibility), Career Skill Development, Soft Skills and Hands - on Training approach has been adopted.

3. **Learning Outcomes:**

   The revised syllabus is expected to provide students with a strong foundation in Technology, Mathematical and Scientific fundamentals required to develop problem solving ability. It is expected to train students in comprehending, analyzing, designing, and creating novel products that provide solution frameworks to the real-world problems.

   It will inculcate in students, the ability to gain multidisciplinary knowledge, modern tools usage and skills necessary for designing, developing and deploying software and hardware based applications. Our graduates should be able to set up various entrepreneurship ventures which in turn will facilitate employability.

   At the end of six semesters in UG program , learners will acquire hands - on expertise in subjects like - Programming languages, Hardware concepts, Operating System , Networking ,Database Management System, Software Engineering and SQA, Project Management, Security, Data Analytics , IoT , Virtual Reality, Cyber Law, Virtualization Concepts , Mobile & Cloud Computing, Artificial Intelligence and Machine Learning, Entrepreneurship and Business Management.

   Understanding and knowledge of basic concepts of IT with systems and applications such as algorithms, data structures, data handling, data communication and computation. Development of ability to identify, formulate and design solutions to computational challenges. Students will be empowered with superior expertise set of cutting-edge innovation so that they are placed with prestigious IT companies like TCS , Infosys , Capgemini , Wipro, Datamatics, Pagadi, Wealth Vigyan, Skillsher, Peacommerce, LTI, Pi Techniques, Atos Syntel, Tatvic Analytics and many more.

4. Input from stakeholders:

There are modifications suggested in syllabus by industry personnel, alumni, and students. Subjects which have greater market applicability like Core Java, Database Management System, Web Programming and Applied Mathematics have been upgraded with latest technologies. New subjects like Android Programming, Data Analytics using R programming and Digital Marketing are incorporated, Virtual Reality, Cryptography & Information Security, Mobile & Cloud Computing, Virtualization Concepts &Applications, DevOps and Entrepreneurship Development & Management are introduced. Students are introduced to Statistics and Marketing concepts for technical analysis with the help of upgraded programming skills.

PROGRAM EDUCATIONAL OBJECTIVES

PEO 01	**Apply Foundational Knowledge in Mathematics and Programming** Graduates will have a strong grounding in mathematical principles and programming concepts, enabling logical reasoning, analytical thinking, and effective problem-solving in the IT domain.
PEO 02	**Analyze, Design, and Develop Sustainable IT Systems** Graduates will be capable of analyzing complex problems, designing efficient system architectures, and developing sustainable and optimized computer-based systems using appropriate testing and implementation strategies.
PEO 03	**Adapt to Emerging Technologies and Interdisciplinary Challenges** Graduates will stay proficient in cutting-edge technologies, integrating knowledge from diverse disciplines to create innovative IT solutions for real-world applications.
PEO 04	**Demonstrate Professionalism, Ethics, and Social Responsibility** Graduates will understand and apply ethical, legal, and societal principles in the development and deployment of IT systems, promoting responsible use of technology for the benefit of society.
PEO 05	**Exhibit Leadership, Teamwork, Research, and Entrepreneurial Skills** Graduates will demonstrate leadership and teamwork through collaborative projects and will be prepared for research, innovation, and entrepreneurship through hands-on learning and professional skill development.

PROGRAM OUTCOMES

PO 01	**Technical Proficiency, Critical Thinking and Problem Solving through System Analysis** Demonstrate a comprehensive understanding of fundamental concepts, principles, and technologies in information technology, including programming, software development, and system design. Apply system analysis and design methodologies to identify, analyze, and solve effective IT solutions for real-world problems.
PO 02	**Design and Development using Cutting Edge Technologies** By embracing cutting edge technologies, teams can enhance their creative potential, deliver higher-quality products, and stay competitive in an ever-evolving market. Whether focusing on AI, VR, cloud computing, or other emerging tools, these technologies enable teams to push the boundaries of what's possible in design and development.
PO 03	**Networking and Computer Security** Understand, configure, and manage computer networks and protocols, ensuring smooth communication and connectivity. Evaluate and implement cyber security measures to protect information systems.
PO 04	**Facilitating Soft Skills (Communication, Team work, Empathy, Creativity)** Facilitating the development of soft skills like communication, teamwork, empathy, and creativity is essential for fostering a positive, productive work environment.
PO 05	**Collaborative Project Management & Teamwork** Apply project management principles (such as Agile or Waterfall methodologies) to plan, execute, monitor, and deliver IT projects. Ability to work in multidisciplinary projects and make it IT enabled. Collaborate effectively within project teams, ensuring communication, coordination, and successful project outcomes.
PO 06	**Convergence of Emerging Technologies (AI &ML, Cloud)** Stay informed about and adapt to emerging trends and technologies in the IT field, such as Artificial Intelligence (AI), Machine Learning (ML), Cloud Computing (CC) and the Internet of Things (IoT). Apply emerging technologies to solve real-world problems and improve business processes in various industries.
PO 07	**Interdisciplinary & Multidisciplinary Connections** Students will cultivate leadership and teamwork skills, enabling them to collaborate effectively in diverse, interdisciplinary teams. Leadership qualities such as decision-making and delegation will help them achieve successful outcomes in various projects.

PO 08	**Promote Environmental & Green Sustainability** Students will understand the environmental impact of scientific activities and advocate for sustainable practices. By considering environmental factors in their work, they will contribute to the long-term health of the planet.
PO 09	**Research Competencies, Legal & Ethical Considerations** Research competencies are a blend of technical expertise, analytical skills, creativity, and ethical awareness. Demonstrate ethical behavior and professionalism in all aspects of the IT profession, adhering to industry standards and organizational values. Understand and adhere to ethical, legal, and societal considerations related to the use, deployment, and management of information technology systems.
PO 10	**Self-reliance through Entrepreneurship and Employability** Students will be equipped with essential skills for entrepreneurship and employability, focusing on job readiness, soft skills, and practical business knowledge. Hands-on experience through internships and mentorship will further enhance their readiness for the job market and entrepreneurial ventures.

PROGRAM SPECIFIC OUTCOMES

PSO 01	**Technical Proficiency in IT Infrastructure** Students will demonstrate the ability to install, configure, and manage software and hardware systems, networks, databases, and cloud-based infrastructures to support business operations.
PSO 02	**Software Development and Programming** Students will apply programming languages and software engineering principles to design, develop, test, and deploy software solutions across various platforms, meeting industry standards.
PSO 03	**Problem-Solving and Analytical Thinking** Students will demonstrate the ability to analyze complex IT problems, design appropriate solutions, and implement algorithms to solve real-world issues.
PSO 04	**Cyber security and Ethical Practices** Students will demonstrate an understanding of cyber security principles and ethical practices in IT, ensuring that their work adheres to privacy, security, and legal guidelines.
PSO 05	**Data Management and Business Intelligence** Students will be able to manage large volumes of data, analyze trends, and create

	visualizations to inform decision-making in a business or organizational context.
PSO 06	**Web and Mobile Application Development** Students will demonstrate the ability to design, develop, and deploy responsive web and mobile applications using modern development frameworks and tools.
PSO 07	**Project Management and Teamwork** Students will develop project management skills and the ability to work collaboratively in teams to plan, implement, and deliver IT projects successfully.
PSO 08	**Professional Learning and Sustainable Development** Students will develop the ability to engage in continuous learning, adapt to evolving technologies, and contribute to the IT field by participating in professional organizations and pursuing advanced studies or certifications.

Part 2- The Scheme of Teaching and Examination is as under NEP: Summary

Year	Sem.	Theory / Practical	Paper Code	Course Title	No of Credits	No of Lectures Hours	Total Credits
1	I	M1	BIT101	Object Oriented Programming with C++	4	60	Major = 8 Minor =4
		M2	BIT102	Digital Electronics	4	60	
		Mi3	BIT103	Computational Mathematics I	4	60	
	II	M4	BIT104	Python Programming	4	60	Major = 8 Minor =4
		M5	BIT105	Microprocessor Architecture and Interfacing	4	60	
		Mi6	BIT106	Computational Mathematics II	4	60	
2	III	M7	BIT201	Database Management System	4	60	Major = 8 Minor =4
		M8	BIT202	Software Engineering	4	60	
		Mi9	BIT203	Operational Mathematics	4	60	
	IV	M10	BIT204	Data Structures and Analysis	4	60	Major = 8 Minor =4
		M11	BIT205	Software Testing and Quality Assurance	4	60	
		Mi12	BIT206	Quantitative Analysis of Computer Networks	4	60	
	V	M13		Enterprise Java	4	60	Major = 8 + DSE+IKS = 4+2 Total = 14
		M14		Cryptography and Information Security	4	60	
		DSE1		Cloud Computing Architecture	4	60	
		DSE2		Virtualization Technologies	4	60	
		IKS(2T)		Integrating IKS into Sustainable Software Project Management	2	30	
	VI	M16		Full-Stack Web Development	4	60	Major = 8 + DSE+2P = 4+2 Total = 14
		M17		Data Mining and Business Intelligence	4	60	
		DSE3		AI and Computer Vision	4	60	
		DSE4		Cyber security and Law	4	60	
		2P		Internet of Things Fundamentals	2	30	

Multi-Disciplinary / General Elective

Year	Sem.	Papers	Paper Code	Course Title	No of Credits	No of Lectures Hours	Total Credits
1	I	ME1	BIT101C	Green Computing	2	30	2
	II	ME2	BIT102C	Digital Marketing	2	30	2
2	III	ME3	BIT204B	Data Analytics using R	3	45	3
	IV	ME4	BIT208B	Cyber Laws	3	45	3

Vocational Courses Linked to Major/Minor

Year	Sem.	Papers	Paper Code	Course Title	No of Credits	No of Lectures Hours	Total Credits
1	I	V1	BIT107D	Operating System	1	15	1
	II	V2	BIT108D	Linux System Administration	1	15	1
3	V	V2		Mobile Programming	2	15T+30P	4
				Virtual Reality	2	15T+30P	
	VI	V3		DevOps (Development & Operations)	2	15T+30P	4
				No SQLDB Integration with Cloud Services	2	15T+30P	

Skill Enhancement Courses

Year	Sem.	Papers	Paper Code	Course Title	No of Credits	No of Lectures Hours	Total Credits
2	III	S1	BIT201C	Web Development & Programming	3	45	3
	IV	S2	BIT202C	Java Programming	3	45	3

Second Year Semester III – Units – Topics- Teaching Hours

Sr No.	Subject Code & Title		Subject Unit Title	Total Lectures	Credit	Total Marks
1	BIT201B Database Management System	1	Introduction to DBMS, Database Design, Data Models	45 L	3	60
		2	Relational database model, Constraints, Views and SQL			
		3	Data Storage and Querying, Transaction Management and Concurrency.			
2	BIT202B Software Engineering	1	Introduction, Software Requirements, Software Processes, Software development Process Models, Agile software development: Critical system Models	45 L	3	60
		2	Requirements Engineering Processes, Architectural Design, User Interface Design, Project Management Verification and Validation, Software Measurement, Software Cost Estimation.			
		3	Process Improvement Service Oriented Software Engineering, Software Reuse, Distributed Software Engineering			
3	BIT203B Operational Mathematics	1	Complex Numbers, The Laplace Transform, Inverse Laplace Transform, Transfer functions, impulse response function of linear systems.	45 L	3	60
		2	Equation of the first order and of the first degree, Linear Differential Equations with Constant Coefficients, Higher Order Differential Equations with Constant Coefficients.			
		3	Z Transform, Inverse Z transform, Analysis of system using Z Transform, Fourier Transform, Inverse of Fourier Transform			
4	BIT201D Database Management System	1	Practicals based on BIT201D Database Management System	30 L	1	40
5	BIT202D Software Engineering	2	Practicals based on BIT202D Software Engineering	30 L	1	40
6	BIT203D Operational Mathematics	3	Practicals based on BIT203D Applied Mathematics	30 L	1	40

Part 3: Detailed Scheme Theory
Semester -III

BIT201B-Database Management System

Course Objectives

- To understand the basic concepts and the applications of database systems.
- To master the basics of SQL and construct queries using SQL.
- Topics include data models, database design, relational model, relational algebra, transaction control, concurrency control, storage structures and access techniques.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Gain knowledge of fundamentals of DBMS, database design and normal forms	L1: Remember
CO2	Master the basics of SQL for retrieval and management of data	L2: Understand
CO3	Be acquainted with the basics of transaction processing and concurrency control	L2: Understand
CO4	Familiarity with database storage structures and access techniques	L3: Apply, L4: Analyze

Course Code: BIT201B-Database Management System

Unit	Content	No. of Lectures
1	**1.1 Introductory concepts of DBMS**: What is database system, purpose of database system, Data Abstraction, View of data- The Three Levels of Architecture-The External Level- the Conceptual Level- the Internal Level, Mapping, Instances and Schemas, Data Independence - Relation Systems and Others, Database Languages- DDL, DML. Database System architecture-levels, Database Users and DBA, Database Management Systems. **1.2 Data Models**: The importance of data models, Basic building blocks, Business rules, The evolution of data models. **1.3 Database Design, ER Diagram:** Database design and ER Model: Entity and Entity Set, Attribute and Domain, Symbols in ER-Diagram, ER-Diagram with Role-Indicators, ER-Diagram with Ternary Relationship Keys -Super, Candidate Keys, Primary Key, Foreign, Key Unique, Surrogate, Composite, Mapping Cardinalities, Relationship and Relationship Sets, Weak Entity Set with Total Participation. Entity Relationship Diagram. **1.4 Extended ER**: Specialization and Generalization. ER-Diagram with Aggregation, ER-Diagram with Existence Dependency. Forming Schemas	15

	From ER-Diagram, Database System Applications.		
2	**2.1 Relational database model**: Relational Model and Codd rules, Logical view of data, keys, integrity rules, Relational Database design: features of good relational database design, Mapping from ER model to Relational Model, Anomalies in Relational Model. **2.2 Constraints, Views and SQL**: Constraints, types of constrains, Integrity constraints, Views: Introduction to views, data independence, security, updates on views, comparison between tables and views. SQL: data definition, aggregate function, Null Values, nested sub queries, Joined relations. Triggers. **2.3Schema Refinement**: Problems caused by redundancy, decompositions, problems related to decomposition, reasoning about functional dependencies, First, Second, Third normal forms, BCNF, lossless join decomposition, multi-valued dependencies.	**15**	
3	**3.1 Data Storage and Querying**: Storage and File Structure-Overview, File Organization, Organization of Records in Files, Data-Dictionary Storage. Indexing and Hashing: Indexing and its types, Sorted Files, Ordered Indices, B+ - Tree Index Files, B-Tree Index Files. **3.2 Transaction Management and Concurrency**: Testing of Serializability, Multiple Granularity, Definition of Transaction, State Transition of a Transaction, Architecture of a Database Transaction, ACID properties, serializability and Recoverability, concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management.	**15**	

Self-Learning topics

Topic

• **Self-Learning topics (Unit wise):**
  1.3 Database System Applications
  2.2 Canonical Cover of FDs, 3 NF Algorithm
  4.2 Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Index Definition in SQL, Multiple-Key Access

NPTEL Web Course:

https://onlinecourses.nptel.ac.in/noc18_cs15/preview http://nptel.ac.in/courses/106106093/

http://nptel.ac.in/courses/106106095/ NPTEL Video Course:

https://www.youtube.com/watch?v=EUzsy3W4I0g

https://www.youtube.com/playlist?list=PL52484DF04A264E59

Books and References:

Text Books

1. Data base Management Systems, Raghu Ramakrishnan, Johannes Gehrke, McGraw Hill Education (India) Private Limited, 3rd Edition.

2. Data base System Concepts, A. Silberschatz, Henry. F. Korth, S. Sudarshan, McGraw Hill Education(India) Private Limited l, 5th edition.

Reference Books
1. Database Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th

Edition

2. Fundamentals of Database Systems, Elmasri Navrate, Pearson Education

3. Introduction to Database Systems, C. J. Date, Pearson Education 4. Oracle for Professionals, the X

Team, S.Shah and V. Shah, SPD .

4. Oracle for Professionals, The X Team, S.Shah and V. Shah, SPD.

5. Database Systems Using Oracle: A Simplified guide to SQL and PL/SQL,Shah, PHI.

6. Fundamentals of Database Management Systems, M. L. Gillenson, Wiley Student Edition

BIT202B-Software Engineering

Course Objectives

- The objective of this course is to provide students with an understanding of Software engineering principles, processes, and methodologies.
- To orient them with the idea of decomposing the given problem into Analysis, Design, Implementation, Testing and Maintenance phases.
- To provide an idea of using various process models in the software industry according to given problem statement and circumstances.
- To gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Understand the principles and practices of software engineering.	L1:Understand
CO2	Students will be able to decompose the given project in various phases of a lifecycle.	L2:Understand , Knowledge
CO3	Apply software engineering processes and methodologies to develop software systems.	L3: Apply
CO4	Demonstrating competence in communication, planning, analysis, design, construction and Deployment.	L4: Create, Analyze
CO5	Implement software using appropriate programming languages and development tools.	L4:Implement
CO6	Students will be able to choose appropriate process model depending on the user requirements.	L3:Apply
CO7	Analyze and able to work as individual and as a part of multidisciplinary team to develop and deliver quality software.	L4:Analyze
CO8	Students can apply the knowledge, techniques, and skills in the development of a software product.	L3:Apply

Course Code: BIT202B-Software Engineering

Unit	Content	No. of Lectures
1	**1.1 Introduction**: What is software engineering? Software Development Life Cycle, Requirements Analysis, Software Design, Coding, Testing, Maintenance etc. **1.2 Software Requirements:** Functional and Non-functional requirements, User Requirements, System Requirements, Interface Specification, Documentation of the software requirements. **1.3 Software Processes:** Process and Project **1.4 Software Development Process Models-** ☐ Waterfall Model. ☐ Prototyping. ☐ Iterative Development./Spiral Model ☐ Rational Unified Process. ☐ The RAD Model ☐ Time boxing Model. **1.5 Agile software development:** Agile methods, Plan-driven and agile development, Extreme programming, Agile project management. **1.6 Socio-technical system:** Essential characteristics of socio technical systems, Emergent System Properties, Systems Engineering, Components of system such as organization, people and computer, Legacy Systems. **1.7 Critical system**: Types of critical system, A simple safety critical system, Dependability of a system, Availability and Reliability, Safety and Security of Software systems. **1.8 System Models:** Models and its types, Context Models, Behavioral Models, Data Models, Object Models, Structured Methods.	15
2	**2.1 Requirements Engineering Processes**: Feasibility study, Requirements, elicitation and analysis, Requirements Validations, Requirements Management. **2.2 Architectural Design**: Architectural Design Decisions, System Organization, Modular Decomposition Styles, Control Styles, Reference Architectures. **2.3 User Interface Design**: Need of UI design, Design issues, The UI design Process, User analysis, User Interface Prototyping, Interface Evaluation. **2.4 Project Management** : Software Project Management, Management activities, Project Planning, Project Scheduling, Risk Management **2.5 Verification and Validation**: Planning Verification and Validation, Software Inspections, Automated Static Analysis, Verification and Formal Methods. V-model for software, Testing during stages of V-model, VV Model, Critical Roles and Responsibilities. Acceptance Testing. **2.6 Software Measurement**: Size-Oriented Metrics, Function-Oriented Metrics, Extended Function Point Metrics **2.7 Software Cost Estimation**: Software Productivity, Estimation Techniques, Algorithmic Cost Modelling, Project Duration and Staffing	15

3	**3.1 Process Improvement:** Process and product quality, Process Classification, Process Measurement, Process Analysis and Modeling, Process Change, The CMMI Process Improvement Framework. **3.2 Service Oriented Software Engineering**: Services as reusable components, Service Engineering, Software Development with Services. **3.3 Software Reuse**: The reuse landscape, Application frameworks, Software product lines, COTS product reuse. **3.4 Distributed Software Engineering**: Distributed systems issues, Client–server computing, Architectural patterns for distributed systems, Software as a service Case Study: Project tracking (including defect tracking, status reports, milestone analysis)	**15**

Self-Learning topics

Topic

• **Self-Learning topics (Unit wise):**
    1.6 Socio-technical system: Essential characteristics of socio technical systems
    2.2 System Organization, Reference Architectures.
    2.3 Need of UI design, Design issues, The UI design Process,
    2.5 Planning Verification and Validation,
    2.7 Software Productivity, Project Duration and Staffing
    3.4 Case Study: Project tracking (including defect tracking, status reports, milestone analysis)

Online Resources
https://nptel.ac.in/courses/106/105/106105182/
https://nptel.ac.in/courses/106/105/106105150/
https://nptel.ac.in/courses/106/101/106101061/

Reference Books:
1. Software Engineering by Ian Somerville, Pearson Education. Ninth Edition.
2. Software Engineering by Pankaj Jalote, Narosa Publication
3. Software engineering, a practitioner's Approach by Roger Pressman, Tata Mcgraw-Hill, Seventh Edition.
4. Software Engineering principles and practice by WS Jawadekar, Tata Mcgraw-hill
5. Software Testing and Continuous Quality Improvement by William E. Lewis, CRC Press, Third Edition, 2016
6. Software Testing: Principles, Techniques and Tools by M. G. Limaye, TMH, 2017.
7. Foundations of Software Testing by Dorothy Graham, Erik van Veenendaal, Isabel Evans, Rex Black, Cengage Learning, Third Edition.
8. Software Testing Technique by Boris Beizer, Dreamtech Press, Premier press 2014
9. Software Testing: A Craftsman"s Approach by Paul C. Jorgenson, CRC Press, Fourth Edition, 2017
10. Software Testing A Craftsman's approach by Paul C. Jorgensen, CRC Press, Second Edition, 1997

BIT203B- Operational Mathematics

Course Objectives

- Ability to interpret the mathematical results in physical or practical terms for complex numbers.
- Apply the knowledge of Laplace Transforms to solve the problems.
- Know and to understand various types of methods to solve differential equation.
- Solve and analyze the Fourier and Z Transform and their application in related field.
- Inculcate the habit of Mathematical Thinking through Indeterminate forms.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course, the student must demonstrate the knowledge and ability to:		
CO 01	Perform arithmetic operations with complex numbers and apply the concept of complex conjugates. Visualize complex numbers as points or vectors in the complex plane and the geometric significance of arithmetic operations.	L1: Understand
CO 02	Apply De Moivre's theorem for finding powers and roots.	L1: Understand L2: Knowledge
CO 03	Learn the properties and theorems associated with the Laplace transform. Utilize available Laplace transform tables for quick reference and transformation of functions.	L3: Apply
CO 04	Apply the knowledge of Laplace Transforms and Inverse Laplace Transform to solve the problems. Apply the Laplace transform to solve ordinary differential equations.	L4: Demonstrate
CO 05	Recognize different types of differential equations (ordinary, partial, linear, nonlinear). Determine the order and degree of differential equations.	L4: Demonstrate
CO 06	Apply methods such as separation of variables, integrating factors, and exact equations. Solve second-order and higher-order linear differential equations.	L3: Apply
CO 07	Learn to transform discrete-time signals using the Z transform. Apply the inverse Z transform to retrieve original signals.	L1: Understand, L3: Apply
CO 08	Apply the Fourier transform to continuous and discrete signals. Use the Fourier transform to analyze and process signals. Apply the transform to solve linear difference equations. Understand the implications of the ROC. Use the transform in various field application.	L1: Understand, L3: Apply

Course Code: BIT203B- Operational Mathematics

Unit	Content	No. of Lectures
1	**1.1 Complex Numbers**: Complex number, Equality of complex numbers, Graphical representation of complex number (Argand's Diagram), Polar form of complex numbers, Polar form of x+iy for different signs of x, y, Exponential form of complex numbers, Mathematical operation with complex numbers and their representation on Argand's Diagram, Circular functions of complex angles, Definition of hyperbolic function, Relations between circular and hyperbolic functions, Inverse hyperbolic functions. **1.2 The Laplace Transform**: Introduction, Definition of the Laplace Transform, Table of Elementary Laplace Transforms, Theorems on Important Properties of Laplace Transformation, First Shifting Theorem, Second Shifting Theorem, Laplace Transform of Derivatives. **1.3 Inverse Laplace Transform**: Shifting Theorem, Partial fraction Methods, Solution of Ordinary Linear Differential Equations with Constant Coefficients, Heaviside Unit Step Function, Dirac-delta Function (Unit Impulse Function), **1.4 Transfer functions, impulse response function of linear systems:** Applications of Laplace transform techniques for solving integrals, differential equations, difference equations, integral equations.	15
2	**2.1 Equation of the first order and of the first degree:** Separation of variables, Equations homogeneous in x and y, non-homogeneous linear equations, Exact differential Equation, Integrating Factor, Linear Equation and equation reducible to this form, Method of substitution. **2.2 Linear Differential Equations with Constant Coefficients:** Introduction, The Differential Operator, Linear Differential Equation f(D) y = 0, Different cases depending on the nature of the root of the equation f(D) = 0, Linear differential equation f(D) y = X, The complimentary Function, The inverse operator 1/f(D) and the symbolic expiration for the particular integral 1/f(D) X; the general methods, Particular integral : Short methods, Particular integral: Other methods, Differential equations reducible to the linear differential equations with constant coefficients. Application of Differential equation **2.3 Higher Order Differential Equations with Constant Coefficients**: - Solving second order ODE, Existence, and uniqueness of solutions of ODE	15
3	**3.1 Z Transform:** Sequence, Representation of Sequence, Operations on Sequence, Definition of Z transform, Linearity Property (without proof), Z transform of standard sequences- sin k, cos k, cosh k, sinh k, Properties of Z Transform: Change of scale property, Shifting Property, Convolution Theorem **3.2 Inverse Z transform:** Direct Division. Binomial Expansion, Partial Fraction method, **3.3 Analysis of system using Z Transform:** Transfer function, Poles and Zeros of transfer function, Stability of system, impulse and step response, relationship between Laplace transform and Z transform. Plotting poles and zeros of transfer function. **3.4 Fourier Transform:** Sub-Topics: Fourier Integral Theorem (statement only), Fourier Transform of a function, Fourier Transforms of elementary functions.	15

| Properties of Fourier Transform: Linearity, Shifting, Change of scale, Examples. Fourier Transform of Derivatives. Relation between discrete time Fourier transform and Z transform, Relation between Fourier Transform and Laplace Transform
 3.5 Inverse of Fourier Transform: partial fraction method, Examples, Application of Fourier Transform to solutions of ODEs. | |

Self-Learning topics

Topic
• **Self-Learning topics (Unit wise):** 1.4 Applications of Laplace transform techniques for solving integrals, differential   2.2 The complimentary Function, The inverse operator 1/f(D) and the symbolic expiration for the particular integral 1/f(D) X , Application of Differential equation.   2.3 Higher Order Differential Equations with Constant Coefficients: Solving second order ODE, Existence and uniqueness of solutions of ODE.   3.1 Convolution Theorem   3.2 Partial Fraction method,   3.3 Plotting poles and zeros of transfer function.   3.4 Shifting, Change of scale property of Fourier Transform   3.5 Partial fraction method, Applications of Fourier Transforms to solutions of ODEs.

Online Resources
1. Integral Transforms and their Applications - Course (nptel.ac.in)
2. Integral Transforms and their Applications - Course (nptel.ac.in)
3. Laplace Transform - Course (nptel.ac.in)
4. Transform Calculus and its applications in Differential Equations - Course (nptel.ac.in)
5. Integral Transforms And Their Applications - Course (nptel.ac.in)
6. Engineering Mathematics - I - Course (nptel.ac.in)
7. Engineering Mathematics - I - Course (nptel.ac.in)
8. Ordinary and Partial Differential Equations and Applications - Course (nptel.ac.in)
9. Complex Analysis - Course (nptel.ac.in)
10. Laplace Transform - Course (nptel.ac.in)
11. Introduction to Methods of Applied Mathematics - Course (nptel.ac.in)

Reference Books:
1. A text book of Applied Mathematics Vol I, P. N. Wartikar and J. N. Wartikar, Pune Vidyathi Graha, 7th Edition, 1995.
2. Applied Mathematics II, , P. N. Wartikar and J. N. Wartikar, Pune Vidyathi Graha,7 th ,1995
3. Higher Engineering Mathematics, Dr. B. S.Grewal, Khanna Publications.

Part - 4 Detailed Scheme Practicals
Semester- III

Course Code: BIT201D-Database Management System

Practical	Database Management System	Total Credits: 1
Unit (1 to 3)	Content	No. of Lectures (30)
1	Design a Database and create required tables. For e.g. Bank, College Database	
2	Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables.	
3	Write a sql statement for implementing ALTER, UPDATE and DELETE.	
4	Write the queries to implement the joins.	
5	Write the query for implementing the following functions: MAX(),MIN(),AVG(),COUNT()	
6	Write the query to implement the concept of Integrity constraints.	
7	Perform the following operation for demonstrating the insertion, updation and deletion using the referential integrity constraints.	
8	Write the query for creating the users and their role.	
9	Write the query to create the views.	
10	Perform the queries for triggers.	

Course Code: BIT202D-Software Engineering

Practical	Software Engineering	Total Credits: 1
Unit (1 to 3)	**Content**	No. of Lectures (30)
1	Creation of SRS based on chosen case study & Application software development process model in chosen case study	
2	Study and implementation of Entity Relationship Diagrams	
3	Study and implementation of Data Flow Diagrams.	
4	Study and implementation of Class diagrams	
5	Study and implementation of Use Case Diagrams	
6	Study and implementation of Sequence Diagrams	
7	Study and implementation of State Transition Diagrams.	
8	Study and implementation of. Activity Diagrams	
9	Study and implementation of Collaboration Diagrams.& Component Diagrams.& Deployment Diagrams.	
10	Effort & Cost estimation (case study)	

Course Code: BIT203D - Operational Mathematics

The practical will be based on the core subject Operational Mathematics using the Python/ Scilab Programming solutions.

Practical	Operational Mathematics	Total Credits: 1
Unit (1 to 3)	Content	No. of Lectures (30)
1	Complex Number a. To add, subtract, multiply and divide two complex numbers. b. To solve given problem using demoivre's theorem c. To find multiple roots of complex number.	
2	Laplace Transform & Inverse Laplace Transform a. To find Laplace transform of given function and plot the same. b. To find inverse Laplace transform. c. Perform different Laplace operation on signal and plot them.	
3	To find solution of given differential equation. (First and second order)	
4	Fourier Transform &Inverse Fourier Transform a. To find Fourier transform of given function and plot the same. b. To find inverse Fourier transform of given function and plot	
5	Z Transform &Inverse Z Transform a. To find Z transform for given transfer function of system. b. To find transfer function from given Z Transform using inverse Z Transform and plot the same to check stability of the system.	
6	Obtaining Impulse response of the system and pole zero plot, using Laplace Transform.	
7	Obtaining system response and plot, using Fourier Transform.	
8	Check stability and system response using Z Transform	

Second Year Semester IV – Units – Topics- Teaching Hours

S.N	Subject Code & Title		Subject Unit Title	Total Lectures	Credit	Total Marks
1	BIT204B Data Structures and Analysis	1	Introduction, Algorithm, Array, General Multi- Dimensional Arrays	45 L	3	60
		2	Link List, Stack, Queue			
		3	Graph, Sorting Technique, Tree, Heap			
2	BIT205B Software Testing and Quality Assurance	1	Introduction to Software Quality, Fundamentals of Testing, Principles of Software Testing, Testing Methodologies	45 L	3	60
		2	Unit Testing, Path Testing, Software Verification and Validation, V-test Model			
		3	Levels of Testing, Special Tests: Introduction, Intersystem Testing, Object Oriented Application Testing			
3	BIT206B Quantitative Analysis of Computer Networks	1	Introduction, Network Models, Introduction to Physical layer Bandwidth Utilization, Transmission and Transmission media, Introduction to the Data Link Layer, Media Access Control, Wireless LANs, Connecting devices and Virtual LANs	45 L	3	60
		2	Introduction to the Network Layer, Unicast Routing, Next generation IP, Introduction to the Transport Layer, Introduction to Application Layer			
		3	Quantitative Analysis, Mathematical Modeling of Networks, Traffic Analysis, Queueing Theory in Networking, Statistical Analysis Tools			
4	BIT204D	1	Practicals based on BIT204D Data Structures and Analysis	30 L	1	40
5	BIT205D	1	Practicals based on BIT205D Software Testing and Quality Assurance	30 L	1	40
6	BIT206D	1	Practicals based on BIT206D Quantitative Analysis of Computer Networks	30 L	1	40

Part 5: Detailed Scheme Theory
Semester -IV

BIT204B -Data Structures and Analysis

Course Objectives

- The objective of this course is to familiarize students with fundamental data structures and their applications in solving computational problems.
- The course aims to develop students' skills in designing, implementing, and analyzing various data structures.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Understand the concepts of data structures and their importance in computing.	L1:Understand
CO2	Implement and use common data structures such as arrays, linked lists, stacks, queues, trees, and graphs.	L2:Apply
CO3	Analyze the time and space complexity of algorithms related to data structures.	L3: Analyze
CO4	Apply data structures to efficiently solve real-world problems..	L2: Apply L4: Demonstrate

Course Code- BIT204B -Data Structures and Analysis

Unit	Content	No. of Lectures
1	**1.1 Introduction:** Data and Information, Data Structure, Classification of Data Structures, Primitive Data Types, Operations on Data Structure. **1.2 Algorithm:** Importance of Algorithm Analysis, Complexity of an Algorithm, Asymptotic Analysis and Notations, Big O Notation, Big Omega Notation, Big Theta Notation, Rate of Growth and Big O Notation. Non primitive data types, Types of data structures: Linear and Non-Linear. **1.3 Array:** Introduction, One Dimensional Array, Memory Representation of One-Dimensional Array, Traversing, Insertion, Deletion, Searching-Linear Search, Binary Search, Sorting: Bubble Sort Merging of Arrays. **1.4 General Multi- Dimensional Arrays:** Memory Representation of Two-Dimensional Arrays, Sparse Arrays, Sparse Matrix, Memory Representation. Special kind of Matrices, Advantages and Limitations of Arrays.	15
2	**2.1 Linked List:** Introduction to Linked List, One-way Linked List, Traversal of Linked List, Searching, Memory Allocation and De-allocation, Insertion in Linked List, Deletion from Linked List. Circular Linked List, Two way Linked List, Header Linked List, Applications of the Linked list, Representation of Polynomials, Storage of Sparse Arrays. **2.2 Stack:** Introduction, Operations on the Stack Memory Representation of Stack, Array Representation of Stack, Applications of Stack, Evaluation of Arithmetic Expression, Matching Parenthesis, infix and postfix operations, Recursion, Polish Expression. Reverse Polish Expression And Their Compilation, Tower of Hanoi. **2.3 Queue:** Introduction, Queue, Operations on the Queue, Memory Representation of Queue, Array representation of queue, Linked List Representation of Queue, Circular Queue, Some special kinds of queues, Deque, Priority Queue, Application of Priority Queue, Applications of Queues.	15

| 3 | **3.1 Graph :** Introduction, Graph, Graph Terminology, Memory Representation of Graph, Adjacency Matrix Representation of Graph, Adjacency List or Linked Representation of Graph, Graph Traversal.
 3.2 Sorting Techniques: Selection, Insertion, and Merge Sort.
 3.3 Tree: Tree, Binary Tree, Properties of Binary Tree, Memory Representation of Binary Tree, Operations Performed on Binary Tree, Binary tree traversal (In order, post order, preorder, Reconstruction of Binary Tree from its Traversals, Huffman Algorithm, Binary Search Tree, Operations on Binary Search Tree.
 3.4 Heap: Memory Representation of Heap, Operation on Heap, Heap Sort. | |

Self-Learning topics

Topic

• **Self-Learning topics (Unit wise):**
    1.1 Primitive Data Types, Abstract Data Types, Data structure vs. File Organization
    2.1 Header Linked List, Applications of the Linked list
    2.2 Applications of Stack
    2.3 Application of Priority Queue, Applications of Queues.
    3.1 Applications of the Graph, Reachability

Online Resources

- https://nptel.ac.in/courses/106/103/106103069/

- https://nptel.ac.in/courses/106/105/106105164/

Reference Books

1. A Simplified Approach to Data Structures by Lalit Goyal, Vishal Goyal, Pawan Kumar, 1st Edition

   SPD, 2014.

2. Data Structure and Algorithm by Maria Rukadikar 1st Edition, SPD 2017

3. Schaum's Outlines Data structure by Seymour Lipschutz, 2nd Edition, Tata McGraw Hill 2005

4. Data Structures and Algorithm Analysis in C++ by M. A. Weiss, Addison-Wesley, 3rd Edition

BIT205B -Software Testing and Quality Assurance

Course Objectives

- The students will be familiar with the process of verification and validation.
- To explore the effective testing techniques (both black-box and white box) for ensuring high Quality software.
- To learn metrics for managing quality assurance and understand capabilities of test tools
- The students will understand the process of applying tests to software and the fundamental Components of a test case.
- The students will be able to derive test cases from software requirement specifications - Including being able to partition input and output domains, form test specifications, and Identify valid combinations of input.
- To learn how to planning a test project, design test cases and data, conduct testing operations, manage software problems and defects, generate a testing report.
- The students will understand how to build models of system behavior and prove that their obey required properties.
- To understand software test automation problems and solutions and be familiar with methods of measuring software reliability.
- To expose the advanced software testing topics, such as object-oriented software testing methods, and component-based software testing issues, challenges, and solutions.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Understand the importance of software testing in the software development life cycle.	L1: Understand
CO2	Apply different testing techniques and methodologies to solve problems by designing and selecting software test models, criteria, strategies, and methods.	L2: Understand, Apply
CO3	Design and execute test cases to verify software functionality.	L3: Design
CO4	Identify and report software defects effectively and manage those defects for improvement in quality for given Software.	L4: Create, Analyze
CO5	Understand the role of automated testing tools in software testing.	L1: Understand
CO6	Students learn to design SQA activities, SQA strategy, formal technical review report for software quality control and assurance.	L3: Design

Course Code: BIT205B -Software Testing and Quality Assurance

Unit	Content	No. of Lectures
1	**1.1 Introduction to Software Quality:** Definitions of Quality, Core Components of Quality, Customers, Suppliers and Processes, Total Quality Management (TQM), Quality Management Through Statistical Process Control, Continual (Continuous) Improvement Cycle, Benchmarking and Metrics, Problem Solving Techniques, Problem Solving Software Tools., Constraints of Software Product Quality Assessment, Quality and Productivity Relationship, Requirements of a Product, Characteristics of Software, Software Development Process, Types of Products, Software Quality Management, Process and Product Quality, Quality assurance and Standards, Quality Planning, Quality Control, Software Measurement and Metrics. , Processes Related to Software Quality, Quality Management System Structure, Pillars of Quality Management System, **1.2 Fundamentals of Testing**: Introduction, Necessity of testing, What is testing? Misconceptions About Testing., Fundamental test process, Definitions of Testing, Approaches to Testing, Testing During Development Life Cycle, Requirement Traceability Matrix, Essentials of Software Testing, Workbench, Important Features of Testing Process, **1.3 Principles of Software Testing**: Salient Features of Good Testing, Test Policy, Test Strategy or Test Approach, Test Planning, Testing Process and Number of Defects Found in Testing, Test Team Efficiency, Process Problems Faced by Testing, Cost Aspect of Testing, Establishing Testing Policy, Structured Approach to Testing, Categories of Defect, Defect, Error, or Mistake in Software. **1.4 Testing Methodologies**: Developing Test Strategy: Developing Testing Methodologies (Test Plan), Testing Process, Test Methodologies/Approaches: Skills Required by Tester, Testing throughout the software life cycle, Software development models, Test levels, Test types, the targets of testing, Maintenance testing.	15

2	**2.1 Unit Testing**: Black Box Testing 2.1.1 Boundary Value Analysis and Testing: Normal Boundary Value Testing, Special Value Testing, Examples, Random Testing, Guidelines for Boundary Value Testing, Non-functional Boundaries, Functional Boundaries 2.1.2 Equivalence Class Testing: Equivalence Classes, Traditional Equivalence Class Testing, Avoiding Equivalence Partitioning Errors, Composing Test Cases with Equivalence Partitioning, Equivalence Partitioning Exercise, Examples of Equivalence Partitioning and Boundary Values, Edge Testing, Guidelines and Observations. 2.1.3 Decision Table–Based Testing: Decision Tables, Decision Table Techniques, Cause-and-Effect Graphing, Guidelines and Observations, **2.2 Path Testing**: White Box Testing, Program Graphs, DD-Paths, Test Coverage Metrics, Basis Path, Testing, Guidelines and Observations, Data Flow Testing: Define/Use Testing, Slice-Based Testing, Program Slicing Tools. **2.3 Software Verification and Validation**: Introduction, Verification, Verification Workbench, Methods of Verification, Entities involved in verification, Reviews in testing lifecycle, Coverage in Verification, Concerns of Verification, Validation, Validation Workbench, Levels of Validation, Coverage in Validation, Acceptance Testing, Management of Verification and Validation, **2.4 V-test Model**: Introduction, V-model for software, testing during Proposal stage, testing during requirement stage, Testing during test planning phase, testing during design phase, Testing during coding, VV Model, Critical Roles and Responsibilities.	15
3	**3.1 Levels of Testing**: Introduction, Requirement Testing, Design Testing, Code Review, Unit Testing, Module Testing, Integration Testing, Big-Bang Testing, Sandwich Testing, Critical Path First, Sub System Testing, System Testing, Testing Stages. **3.2 Special Tests**: Introduction: GUI testing, Compatibility Testing, Security Testing, Performance Testing, Volume Testing, Stress Testing, Recovery Testing, Installation Testing, Requirement Testing, Regression Testing, Error Handling Testing, Manual Support Testing, **3.3 Intersystem Testing**: Control Testing, Smoke Testing, Adhoc Testing, Parallel Testing, Execution Testing, Operations Testing, Compliance Testing, Usability Testing, Decision Table Testing, Documentation Testing, Rapid Testing, Control flow graph, State Graph, Risk Associated with New Technologies, Process maturity level of Technology, Testing Adequacy of Control in New technology usage, **3.4 Object Oriented Application Testing**: Testing of Internal Controls, COTS Testing, Client Server Testing, Web Application Testing, Mobile Application Testing, eBusinesse Commerce Testing, Agile Development Testing,	15

Self-Learning topics

Topic
• **Self-Learning topics (Unit wise):** 1.1 Customers, Suppliers and Processes, Continual (Continuous) Improvement Cycle, Constraints of Software Product Quality Assessment, Characteristics of Software 1.2 Necessity of testing, what is testing? Misconceptions about Testing., 1.3 Test Team Efficiency, Process Problems Faced by Testing, 1.4 Skills Required by Tester, Testing throughout the software life cycle, 2.1.1 Non-functional Boundaries, Functional Boundaries, 2.1.2 Edge Testing, Guidelines and Observations. 2.2 Slice-Based Testing, Program Slicing Tools. 2.3 Management of Verification and Validation, 2.4 Critical Roles and Responsibilities 3.1 Sub System Testing, System Testing, Testing Stages. 3.2 Error Handling Testing, Manual Support Testing, 3.3 Risk Associated with New Technologies, Process maturity level of Technology, Testing Adequacy of Control in New technology usage, 3.4 eBusinesse Commerce Testing,

Online Resources

https://onlinecourses.nptel.ac.in/noc22_cs61/preview
https://archive.nptel.ac.in/courses/106/101/106101163/
https://www.classcentral.com/course/youtube-software-testing-47402

Reference Books

1. Software Testing and Continuous Quality Improvement by William E. Lewis, CRCPress, Third Edition, 2016
2. Software Testing: Principles, Techniques and Tools by M. G. Limaye, TMH, 2017.
3. Foundations of Software Testing by Dorothy Graham, Erik van Veenendaal, Isabel Evans, Rex Black, Cengage Learning, Third Edition.
4. Software Testing Technique by Boris Beizer, Dreamtech Press, Premier press 2014
5. Software Testing: ACraftsman‟s Approach by Paul C. Jorgenson, CRCPress, Fourth Edition 2017
6. Software Testing A Craftsman's approach by Paul C. Jorgensen, CRC Press, Second Edition 1997.

BIT206B - Quantitative Analysis of Computer Networks

Course Objectives

- Be familiar with computer network functions and usage.
- The capacity to recognize various network topologies and types.
- Knowledge of digital and analog data transmission.
- To study the functions of TCP/IP and OSI layers.
- To understand the functionalities of Data link layer.
- Getting acquainted with the routing methods.
- Be familiar with different Protocols used in network Model.

Course Outcomes

Sr No.	Course Outcomes (CO)	Blooms Level
After completing this course, the student must demonstrate the knowledge and ability to:		
CO1	Categorize various modulation and multiplexing techniques.	L1: Understand
CO2	Understand OSI layers, TCP/IP protocol stack and describe various network topologies.	L2: Knowledge
CO3	Exercise error correction techniques.	L1: Understand
CO4	Examine and explain various access methods.	L4: Demonstrate
CO5	Use Algorithms to implement a routing strategy.	L4: Analyze
CO6	Knowledge of various protocols at network layer and application layer.	L3: Apply
CO7	Knowledge of mathematical modelling of computer network	L1: Understand, L2: Knowledge
CO8	Understand queuing theory and network of queues	L1: Understand, L2: Knowledge

Course Code: BIT206B - Quantitative Analysis of Computer Networks

Unit	Content	No. of Lectures
1	**1.1 Introduction:** Data communications, networks, network types, Internet history, Protocol and standards. **Network Models:** Protocol layering, TCP/IP protocol suite, The OSI model. **1.2 Introduction to Physical layer:** Data and signals, analog signals, digital signals, transmission impairment, data rate limits, performance. **Digital and Analog transmission:** Digital-to-digital conversion, analog-to-digital conversion, transmission modes, digital-to-analog conversion. **1.3 Bandwidth Utilization:** Multiplexing and Spectrum Spreading: Multiplexing TDM, FDM, Spread Spectrum. **Transmission and Transmission media:** Guided Media, Unguided Media, Synchronous and asynchronous Transmission. **Switching**: circuit switched networks, packet switching, **1.4 Introduction to the Data Link Layer:** Link layer addressing, Data Link Layer, Error detection and correction, checksum, Cyclic Redundancy check code, forward error correction versus retransmission, Framing, Flow control. DLC services. **1.5 Media Access Control:** Random access, controlled access, channelization, Wired LANs – Ethernet Protocol, standard ethernet, fast ethernet, gigabit ethernet, IEEE Standard 802.3 Ethernet, 802.4 Token Bus, 802.5 Token Ring. **Connecting devices and Virtual LANs.** **1.6 Wireless LANs:** Introduction, IEEE 802.11 project, Bluetooth, WiMAX, Cellular telephony, Mobile IP.	15
2	**2.1 Introduction to the Network Layer**: Internet Protocol (IP): Datagram Format, Fragmentation and reassembly, Network layer services, network layer performance, IPv4 addressing, forwarding of IP packets, Internet Protocol, ICMPv4, Address mapping, ARP, RARP, DHCP. **2.2 Unicast Routing:** Introduction, routing algorithms, unicast routing protocols-Distant Vector routing, Link State Routing, Path vector routing. Spanning tree, spanning tree algorithm, Multicast, Broadcast. **2.3 Introduction to the Transport Layer:** Introduction, Transport layer protocols (Simple protocol, Stop-and-wait protocol, Sliding Window protocol, Go-Back-n protocol, Selective repeat protocol, Transport layer services, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Congestion control. **2.4 Introduction to Application Layer:** Worldwide-web and HTTP, FTP, Electronic mail, MIME (Multipurpose Internet Mail Extension), Telnet, Secured Shell, Domain name system. SNMP.	15

3	**3.1 Quantitative Analysis**: Introduction , Role of quantitative analysis in optimizing network performance, Types of metrics used in networking. **3.2 Mathematical Modeling of Networks**: Basics of graph theory in networks (paths, cycles, connectivity), Network flow optimization techniques. **3.3 Traffic Analysis**: Methods of analyzing real-time traffic flow. Performance parameters: Throughput, packet loss, jitter. **3.4 Queueing Theory in Networking**: Basics of queueing systems, Application of M/M/1 and M/M/c models in network scenarios. **3.5 Statistical Analysis Tools**: Basics of probability in network design, Using regression and correlation for data analysis.	**15**

Self-Learning topics

Unit Wise Topics
1.3 Transmission and Transmission media: Guided Media, Unguided Media, Synchronous and asynchronous Transmission, Spread Spectrum 1.5 HDLC, Point-to-point protocol. 1.6 gigabit ethernet, IEEE Standard 802.3 Ethernet, 802.4 Token Bus, 802.5 Token Ring WiMAX, Cellular telephony, Mobile IP. 2.1 IPv6 addressing, IPv6 protocol, ICMPv6 protocol, transition from IPv4 to IPv6. 2.3 Selective repeat protocol, Transport layer services 2.4 MIME (Multipurpose Internet Mail Extension), Domain name system. SNMP, Secured Shell 3.3 Methods of analyzing real-time traffic flow.

Online Resources

1.   Computer Networks and Internet Protocol - Course (nptel.ac.in)

2. Computer Networks - Course (swayam2.ac.in)

3. Sr.Secondary: Computer Science (330) - Course (swayam2.ac.in)

4. Introduction to Wireless and Cellular Communications - Course (nptel.ac.in)

5. Demystifying Networking - Course (nptel.ac.in)

6. Introduction to Computer Networks; Internet Protocols - Course (swayam2.ac.in)

Reference Books:

1. Data Communication and Networking by Behrouz A. Forouzan, Tata McGraw Hill, Fifth Edition, 2013.

2. TCP/IP Protocol Suite by Behrouz A. Forouzan , Tata McGraw Hill,Fourth Edition 2010

3.   Computer Networks by Andrew Tanenbaum, Pearson, Fifth Edition 2013

4.   Data Communication by William Stalling, Tata McGraw Hill, Fifth Edition

Part - 6 Detailed Scheme Practicals
Semester- IV

Course Code: BIT204D -Data Structures and Analysis

Practical I	Data Structures and Analysis	Total Credits: 1
Unit (1 to 3)	Content	No. of Lectures(30)
1	Implementing Arrays	
2	Implementing 2D arrays	
3	Write a program to implement the concept of Stack with Push, Pop, Display and Exit operations. (Menu Driven)	
4	Write a program to implement the concept of Queue with Insert, Delete, Display and Exit operations. (Menu Driven)	
5	Implementing Linked List	
6	Implement Sorting- Insertion and Selection	
7	Implement Searching- Linear and Binary	
8	Write a program to insert the element into maximum heap.	
9	Case Study on Graph Traversals	

Course Code: BIT205D -Software Testing and Quality Assurance

Practical II	Software Testing and Quality Assurance	Total Credits: 1
Unit (1 to 3)	Content	No. of Lectures (30)
1	**Evaluating Test Exit Criteria and Reporting.**	
2	**Static and Dynamic Analysis**	
3	**Rate Quality Attributes for Domain and Technical Testing**	
4	**Perform Review**	
5	**Incident Management**	
6	**Path Testing and Equivalence Partitioning**	
7	**Performance Testing**	
8	**Using Testing Tool Selenium**	
9	**Using Testing ToolQTP(QuickTest Professional) / UFT(Unified Functional Testing.)**	
10	**Using Testing Tool WAPT**	

Course Code: BIT206D- Quantitative Analysis of Computer Networks

Practical	Quantitative Analysis of Computer Networks	Total Credits: 1
Unit (1 to 3)	Content	No. of Lectures (30)
1	IPv4 Addressing and Subnetting a. Given an IP address and network mask, determine other information about the IP address such as: ☐ Network address ☐ Network broadcast address ☐ Total number of host bits ☐ Number of hosts b. Given an IP address and network mask, determine other information about the IP address such as: ☐ The subnet address of this subnet ☐ The broadcast address of this subnet ☐ The range of host addresses for this subnet ☐ The maximum number of subnets for this subnet mask ☐ The number of hosts for each subnet ☐ The number of subnet bits The number of this subnet	
2	Use of ping and tracert / traceroute, ipconfig / ifconfig, route and arp utilities. Study of network analysis	
3	a. Configure IP static routing and Configure IP routing using RIP. b. Implement Spanning tree algorithm	
4	a. Configuring Simple OSPF. Simulate given routing algorithm. b. Configuring OSPF with multiple areas.	
5	a. Create virtual PC based network using virtualization software and virtual NIC. b. Implement broadcasting in the designed network	
6	a. Configuring DHCP server and client. b. Configuring DNS Server and client.	
7	Use of Wireshark to scan and check the packet information of following Protocols HTTP, ICMP, TCP, SMTP, POP3	
8	Analyzing Traffic Flow. Use simulation mode to capture and analyze data packet headers and traffic patterns.	

SYLLABUS FOR GENERAL ELECTIVE (NEP)

TITLE – Interactive and Sustainable Technology

SEMESTER	UNIT	TOPIC	LECTURES
1		**Green Computing - BIT101C**	**30**
		Course Objectives • This course educates and empowers students to reduce wastage, energy usage, carbon footprint and other environmental impacts of IT systems. • They are taught to reduce life cycle costs of processes, improve business efficiency by lowering costs while improving the product design and creating new jobs thereby achieving sustainability. • To learn the fundamentals of Green Computing. • To analyze the Green computing Grid Framework. • To understand the issues related with Green compliance. • To study and develop various case studies. **Course Outcomes** • To understand what Green Computing is and how it can help improve environmental Sustainability. • To understand the principles and practices of Green Computing. • To understand how Green Computing is adopted or deployed in enterprises. • Apply the Green computing practices to save energy. • Discuss how the choice of hardware and software can facilitate a more sustainable operation. • Use methods and tools to measure energy consumption.	
	I	**1.1 Overview, Issues and Problems:** Toxins, Power Consumption, Equipment Disposal, Company's Carbon Footprint: Measuring, Details, reasons to bother, Plan for the Future, Cost Savings: Hardware, Power. **1.2 Initiatives and Standards:** Global Initiatives: United Nations, Basel Action Network, Basel Convention, WEEE Directive, RoHS, National Adoption in India **1.3 Minimizing Power Usage:** Power Problems, Monitoring Power Usage, Servers, Low-Cost Options, Reducing Power Use, Data De-Duplication, Virtualization, Management, Bigger Drives, Involving the Utility Company, Low-Power Computers, Computer Settings, Storage,	15

		Monitors, Power Supplies, Wireless Devices, Software.	
	II	**2.1 Changing the Way of Work:** Old Behaviors, starting at the Top, Process Reengineering with Green in Mind, Analyzing the Global Impact of Local Actions, Steps: Water, Recycling, Energy, Pollutants, Tele-workers and Outsourcing, Telecommuting, Outsourcing, how to Outsource. **2.2 Going Paperless:** Paper Problems, The Environment, Costs: Paper and Office, Practicality, Storage, Destruction, Going Paperless, Organizational Realities, Changing Over, Paperless Billing, Handheld Computers vs. the Clipboard, Electronic Data Interchange (EDI), Value Added Networks, Advantages, Obstacles. **2.3 Recycling:** Problems, Materials, Means of Disposal, Recycling, Refurbishing, Make the Decision, Life Cycle, from beginning to end, Life, Cost, Green Design, Recycling Companies, Role of quality, minimization of natural resource utilization.	15

Self-Learning topics Topic
- Minimizing Power Usage: Power Problems, Monitoring Power Usage
- Changing the Way of Work: Old Behaviors, starting at the Top, Process Reengineering with Green in Mind, Analyzing the Global Impact of Local Actions
- Role of quality, minimization of natural resource utilization

Online Resources NPTEL :
https://nptel.ac.in/courses/112/104/112104225/

Reference Books – Green Computing
1. Green IT Toby Velte, Anthony Velte, Robert Elsenpeter, McGraw Hill, 1st Edition

2. Green Data Center: Steps for the Journey by Alvin Galea, Michael Schaefer, Mike Ebbers Shroff Publishers and Distributers, 2011

3. Green Computing and Green IT Best Practice by Jason Harris Emereo, 2008

4.Green Computing Tools and Techniques for Saving Energy, Money and Resources by Bud E. Smith, CRC Press, 2014

2	**Digital Marketing - BIT102C**	**30**

Course Objectives

- This course is an initiative designed to educate students in the area of Digital Marketing. Digital Marketing and Social Media have transformed marketing and business practice across the globe.
- This course provides an understanding of the ever evolving digital landscape and examines the strategic role of digital marketing processes and tools in designing the overall Marketing strategy and the Digital Marketing Plan.
- It explores the challenges of Interactive media, the online market place, and the creative challenges of communicating and retention strategies of customers through these media, the main search engines and the future trends in digital marketing.

Course Outcomes

- Translate some of the key marketing and business models that will help to shape digital marketing strategy
- Review the history of digital marketing to give some perspective to digital strategic plan
- Describe online market presence, segmentation and the 4 Ps of marketing and their implications for digital marketing
- Discuss the opportunities and risks of integrated digital marketing
- Outline an approach to developing a digital marketing plan.

| I | **1.1 Introduction to Digital Media Marketing**: Terms & Terminologies, Display Advertising, Introduction To Digital Selling, Driving Strategy, WordPress Setup, Understanding WordPress, Working with pages, posts, categories, tags, menus Building Website structure.
1.2 Web Analytics: Introduction to Google Analytics, why companies use Analytics, How Analytics works, How to set up Analytics & Define Goals, Filters & Segments. Setting up Search Console, Link website to GA & Search Console, Linking Search Console, and Understanding Analytics Reports.
1.3 Ecommerce Marketing: Understanding Electronic Commerce & Importance, How to do SEO of E-Commerce Website, Using affiliate Marketing to promote E-Commerce, Technology Infrastructure for ECommerce, E-commerce Security Issues & Controls, Implementing Ecommerce, E-Commerce Marketing, E- | 15 |

		Commerce business models and Strategy.	
	II	**2.1 Social Media Marketing & Content:** Understanding the various Social Media Platforms, Knowing how to market/communicate through Social Media Platforms Choosing a platform to fit the brand objective, Objectives and Metrics, Research and Mapping Tools, tactics, targets and teams, Developing an effective Social Media Strategy, Content Marketing **2.2 Digital Media Planning & Buying**: Overview-Role of a media planner, Understanding Client Brief: decoding the expectations of the client, Setting Campaign, Objectives, Audience analysis: User behavior, online opportunities and challenges, Market research, Media formats channels and placement, Media planning tools, software & platform selection, Media research and analysis, Media buying options, art of negotiating rates, Sample media plan, Presentation to the client.	15

Self-Learning topics Topic
- Working with pages, posts, categories, tags, menus Building Website structure.
- Understanding the various Social Media Platforms,
- What is E-mail? Brand Case Studies & Trends in the Industry.
- Video Marketing, Influencer Marketing, Paid/Performance Marketing

Online Resources NPTEL : Links: https://neilpatel.com/what-is-digital-marketing/
https://www.hubspot.com/resources

NOC:Marketing Management-II (Management) (digimat.in) NPTEL :: Management - NOC:Marketing Management – II

Reference Books -Digital Marketing
- All-in-One for Dummies, Stephanie Diamond, Wiley and Sons, 1st 2019.
- Social Media Marketing All-in-one Dummies, Jan Zimmerman, Deborah Ng, 4th Edition; John Wiley & Sons Inc, 2017.
- Digital Marketing for Dummies, Ryan Deiss and Russ Henneberry. John Wiley & Sons 1st edition 2017.

3	**Data Analytics using R - BIT204B**	**45**
	Course Objectives - The basics of statistical computing and data analysis - How to use R for analytical programming - How to implement data structure in R - R loop functions and debugging tools	

- Object-oriented programming concepts in R
- Data visualization in R
- How to perform error handling
- Writing custom R functions

Course Outcomes

- Explain critical R programming concepts

- Demonstrate how to install and configure RStudio

- Apply OOP concepts in R programming
- Explain the use of data structure and loop functions
- Analyze data and generate reports based on the data
- Apply various concepts to write programs in R

I	**1.1 Introduction to R**: Overview and History of R, Install R, RStudio, R libraries Basics of R, RStudio. **1.2 R Basics**: Markdown Data types, operations Vectors, sequences, functions Import/export, summarize data Coding style. Use of R as a calculator, functions and matrix operations, missing data and logical operators. **1.3 Data preparation** with R Transform data frames with mutate and map values Write user-defined functions Use if/else, for, while, apply, with Learn factors in R, lapply, tapply, split, mapply, apply, Coding Standards	15
II	**2.1 Vector**: indexing, factors, Data management with strings, display and formatting. Data management with display paste, split, nd and replacement, manipulations with alphabets, evaluation of strings, data frames. Data frames, import of external data in various le formats, statistical functions, compilation of data. **2.2 Descriptive statistics & visualization with R:** Use plyr, ggplot2 libraries to make summary tables, graphs, and maps, 2/5 Hypothesis testing with R Test group mean differences (t-test, Chi squared test, non-parametric and other tests), Scoping Rules, Debugging Tools	15
III	**3.1ANOVA**: linear regression (OLS), binary/categorical independent. Variables Diagnostics, output, and other post-estimation tables, graphs and iteration functions for simulations. Graphics and plots, statistical functions for central tendency, variation, skewness and kurtosis, handling of bivarite data through graphics, correlations, programming and illustration with example.	15

		3.2 Linear regression with R: Assess goodness of SIT, consider alternative functional forms, interaction effects, interpret results and evaluate model assumptions with statistic tests, tables and plots, Apply these techniques to a case study	

Self-Learning topics Topic
- Data management with strings, display and formatting, statistical functions, compilation of data.
- Evaluate model assumptions with statistic tests, tables and plots, apply these techniques to a case study.
- Install R, RStudio, R libraries Basics of R,

Online Resources NPTEL :
- ugcmoocs.inflibnet.ac.inugcmoocs .
- Descriptive Statistics With R Software - Course (nptel.ac.in)
- Introduction To R Software - Course (nptel.ac.in)
- Advanced Engineering Mathematics - Course (nptel.ac.in

Reference Books –Data Analytics using R
- 1. An Introduction to R by William N. Venables and David M. Smith, Network Theory Limited, 2 nd Edition, 2009
- 2. The Art of R Programming - A Tour of Statistical Software Design by Norman Matloff, No Starch Press.2011
- 3. Getting started with R Studio by John Verzani, O'Reilly Media, 2011

4	**Cyber Law - BIT208B**	**45**
	Course Objectives: • This Course is To Enable Learner to Understand, Explore, and Acquire a Critical Understanding Cyber Law. • Develop Competencies For Dealing With Frauds And Deceptions (Confidence Tricks, Scams) And Other Cyber Crimes For Example, Child Pornography Etc. That Are Taking Place Via The Internet. **Course Outcomes**: • Make Learner Conversant With The Social And Intellectual Property Issues Emerging From 'Cyberspace. • Explore The Legal And Policy Developments In Various Countries To Regulate Cyberspace • Develop The Understanding Of Relationship Between Commerce And Cyberspace. • Give Learners In Depth Knowledge Of Information Technology Act And Legal Frame Work Of Right To Privacy, Data Security And Data Protection. • Make Study On Various Case Studies On Real Time Crimes.	
	I	**1.1 Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global	15

		Perspective on cybercrimes. **1.2 Cyber Crime and Criminal Justice**: Penalties, Adjudication and Appeals Under the IT Act, 2000: Concept of "Cyber Crime " and the IT Act , 2000, Hacking, Teenage Web Vandals, Cyber Fraud and Cyber Cheating, Virus on the Internet, Defamation, Harassment and Email Abuse, Cyber Pornography, Other IT Act Offences, Monetary Penalties, Adjudication and Appeals Under IT Act , 2000, Network Service Providers, Jurisdiction and Cyber Crime, Nature of Cyber Criminality, Strategies to Tackle Cyber Crime and Trends, Criminal Justice in India and Implications on Cyber Crime.	
	II	**The Security Aspect of Cyber Law -**The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law.	15
	III	**Protection of Cyber Consumers in India** Are Cyber Consumers Covered Under the Consumer Protection Act? Goods and Services, Consumer Complaint, Defect in Goods and Deficiency in Services, Restrictive and Unfair Trade Practices, Instances of Unfair Trade Practices, Reliefs Under CPA, Beware Consumers, Consumer Foras, Jurisdiction and Implications on cyber Consumers in India, Applicability of CPA to Manufacturers, Distributors, Retailers and Service Providers Based in Foreign Lands Whose Goods are Sold or Services Provided to a Consumer in India. Amendments in Indian IT Act 2000.	15

Self-Learning topics Topic
- Power of Arrest Without Warrant Under the IT Act, 2000
- Jurisdiction in the Cyber World
- E-Commerce Taxation: Real Problems in the Virtual World
- Protection of Cyber Consumers in India:

Online Resources NPTEL :
- https://onlinecourses.nptel.ac.in/ The Information Technology ACT, 2008- TIFR
- https://www.tifrh.res.in A Compliance Primer for IT professional :
- https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals 33538

Reference Books –Data Analytics using R
- 1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi 2. The Art of R Programming - A Tour of Statistical Software Design by Norman Matloff, No Starch Press.2011,

- 2. Cyber Law Simplified- Vivek Sood TMH Education 2001
- 3. Cybersecurity Law- Jeff Kosseff, Wiley, 2017.
- 4. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi

Skill Enhancement Courses

Sem III- Web Development & Programming BIT204D – 3 Credits

Course Objective-

- To understand the concepts of Hyper Text Markup Language and Cascading Style Sheets.
- To learn JavaScript for creating dynamic websites.
- To learn various operations performed on data among web applications using XML
- To learn Server-Side Programming using PHP

Course Outcomes-

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Understand the core principles of web development, including the client-server model and HTTP protocol.	L1:Understand
CO2	Create and structure web pages using HTML markup language.	L2:Understand , L3: Apply
CO3	Apply CSS styles to control the visual appearance and layout of web pages.	L3: Apply
CO4	Develop a well-structured and maintainable web application.	L4: Design/ Demonstrate
CO5	Implement server-side logic using Node.js for building web applications.	L4: Demonstrate
CO6	Design and interact with relational databases for data storage and retrieval in web applications.	L4: Design/ Demonstrate
CO8	Build basic web applications that demonstrate effective use of front-end, back-end, and database integration.	L4: Demonstrate

Course Code: Web Development & Programming

Unit	Content	No. of Lectures
1	**1.1 Introduction to HTML**: Basic HTML syntax and structure (tags, attributes, elements).Creating and formatting web pages with HTML elements (headings, paragraphs, lists, images, tables). **1.2 Introduction to Cascading Style Sheets (CSS):** Basic CSS syntax and selectors. Styling web pages using CSS properties (color, font, background, layout). Applying CSS for responsive design principles to adapt to different screen sizes. **1.3 Introduction to JavaScript:** Core JavaScript concepts (variables, data types, operators, control flow). DOM manipulation with JavaScript for dynamic content updates. Event handling in JavaScript (user interactions like clicks and form submissions).	15
2	**2.1 Introduction to Node.js** Introduction to node.js as a javaScript runtime environment for server side development. Node.js fundamental: Module, event loop, asynchronous programming, and handling HTTP requests and responses. **2.2 Database Management with Node.js:** Connecting to databases using Node.js drivers (e.g., mysql, pg), performing CRUD (Create, Read, Update, Delete) Operations, and querying data. **2.3 Introduction to PHP**- Introduction to php development. PHP fundamental: Module, event loop and handling HTTP requests and responses. **2.4 Database Management with PHP:** Connecting to databases using PHP drivers (e.g., mysql, pg), performing CRUD (Create, Read, Update, Delete) operations, and querying data.	15

Reference Books:

1. HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, AJAX, PHP and jQuery, 2ed, Dreamtech Press, 2016 2.
2. Web Programming and Interactive Technologies, scriptDemics, StarEdu Solutions India, 2018
3. PHP: A Beginners Guide, Vikram Vaswani, TMH
4. First HTML and CSS" by Elisabeth Robson and Eric Freeman

Practical List-

Practical	Web Development & Programming	Total Credits: 1
Unit (1 to 3)	Content	No. of Lectures (30)
1	Practical on Html tags	
2	Practical on formatting webpages using html.	
3	Practical on CSS	
4	Practical on basic javascript	
5	Practical on javascript event handling	
6	Practical on Node js	
7	Practical on basic php	
8	Practical on php modules	
9	Practical on Connecting to databases using Node.js	
10	Practical on Connecting to databases using PHP	

Sem IV- Java Programming BIT208D – 3 Credits

Course Objective-

- To provide insight into java based applications using OOP concepts.
- To provide understanding of developing GUI based desktop applications in java.
- To provide knowledge of web based applications and Client Server Communication.
- To provide understanding and implementation of Inheritance, Interfaces, Packages, Collections and Multithreading

Course Outcomes-

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Understand the fundamentals of the Java programming language.	L1:Understand
CO2	Develop object-oriented programs using Java.	L2:Understand , L3: Apply
CO3	Apply Java concepts for solving real-world programming problems.	L3: Apply
CO4	Understand and implement exception handling, file I/O, and multithreading in Java.	L1:Understand L4: Demonstrate
CO5	Develop graphical user interfaces (GUIs) using Java Swing or JavaFX.	L1:Understand L4: Demonstrate

Course Code: Java Programming

Unit	Content	No. of Lectures
1	**1.1 Introduction to Java Basics**: Java Operator: Data types: primitive data types, Object Reference Types, Strings, Auto boxing, operators and properties of operators, Arithmetic operators, assignment operators, increment and decrement operator, relational operator, logical operator, bitwise operator, conditional operator. Loops and Control: Control statements for decision making: select statements (if statement, if … else … statement, if …. Else … if … statement, switch statement),looping (while loop, do … while loop and for loop), nested loops, breaking out of loops (break and continue statements), labeled loops. **1.2 Inheritance, Interfaces-** Inheritance: Derived Class Objects, Inheritance and Access Control, Default Base Class Constructors, this and super keywords. Interface and Abstract: Abstract Classes, Abstract Methods, Interfaces, What Is An Interface? How Is An Interface Different From An Abstract Class?, Multiple Inheritance ,Default Implementation, Adding New Functionality, Method Implementation, Classes V/s Interfaces, Defining An Interface, Implementing Interfaces.	15
2	**2.1 Packages, Collection and Multithreading:** Creating Packages, Default Package, Importing Packages, Using A Package. Collection Framework: Array List, Linked List, Hash Set, Tree Map, Enumeration, Queue. The thread control methods, thread life cycle, the main thread, creating a thread, extending the thread class. **2.2 Exceptions, I/O, Networking and AWT** **Exceptions:** Catching Java Exceptions, Catching Run-Time Exceptions, Handling Multiple Exceptions, The finally Clause, The throws Clause. **Byte streams:** Reading console input, writing console output, reading file, writing file, writing binary data, reading binary data, getting started with character stream, writing and reading file. **Networking:** Introduction, Socket, Server socket, Client Server Communication. **Abstract Window Toolkit:** Introduction, Individual Components Label, Button, CheckBox, Radio Button, Choice, List, Menu, Text Field, Text Area and Layout	15

Reference Books:

1. Java: The Complete Reference by Herbert Schildt, MCGrawHill 11th Edition, 2018
2. Java2 Programming - Black Book by Steven Holzner, Dreamtech Press, 5 th Edition, 2006
3. Programming in Java by John Hubbard, Schaum Series, 2 nd Edition 2019
4. Murach's beginning Java with Net Beans by Joel Murach , Michael Urban, Murach, 5 th Edition 2018.

Practical List-

Practical	Java Programming	Total Credits: 1
Unit (1 to 3)	Content	No. of Lectures (30)
1	Write a program to swap two numbers in Java.	
2	Write a program to print all the elements of Fibonacci series.	
3	Check if a given number is palindrome or not.	
4	Write a program to reverse a string.	
5	Write a program to create a class Student2 along with two method getData(),printData() to get the value through argument and display the data in printData. Create the two objects s1, s2 to declare and access the values from class STtest.	
6	Write a program in java to generate an abstract class A also class B inherits the class A. generate the object for class B and display the text "call me from B.	
7	Write a java program in which you will declare an abstract class Vehicle inherits this class from two classes car and truck using the method engine in both display "car has good engine" and "truck has bad engine".	
8	Write a program in java to enter the number through command line argument if first and second number is not entered it will generate the exception. Also divide the first number with second number and generate the arithmetic exception.	
9	Write a java program in which thread sleep for 5 sec and change the name of thread.	
10	Write a java program to read and append a file and display the content on screen.	
11	Write a program to demonstrate the use of AWT component like label , textfield, textarea,button, checkbox, radiobutton and etc.	
12	Write a program to demonstrate different types of layout in AWT Component.	