10 YEARS OF UNIVERSITY RECOGNITION
20 YEARS OF ACADEMIC EXCELLENCE

REVA UNIVERSITY
Bengaluru, India

HANDBOOK OF

B.Tech Artificial Intelligence and Data Science

ACADEMIC YEAR 2023-24

RUKMINI EDUCATIONAL
Charitable Trust

www.reva.edu.in

Chancellor’s Message

“Education is the most powerful weapon which you can use to change the world.”

- Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when ‘intellectual gratification’ has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of ‘Knowledge is power’, we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I’m always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, bothеducational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said ‘A University should be a place of light, of liberty and of learning’. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVA Universityto join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju

The Founder and Hon'ble Chancellor, REVA University

Pro-Chancellor's Message

REVA University is most sought-after destination for higher education in the major streams of engineering, science, commerce, management, architecture, law, arts and humanities. University practices modern tools and ICT basedtechnologies that focus on digital learning, project-basedlearning, personalized learning, etc. Educational reforms are adopted in terms of STEM education, teacher professional development with good mix of diversity and inclusivity.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. CBCS courses also provide knowledge on local, regional, national and global level issues along with enabling them to be employable and also aid to inculcate entrepreneurial skills across all the programs. Ample of opportunities are given for students to enhance their skill-sets through value added courses.

The current trends in engineering education Engineering profession in the next two decades will undergo dramatic changes, driven by not only technological developments but also societal transformation. Besides increased globalization, more acute concern for environment for sustainable development will characterize changes and challenges for future engineers in their roles.

REVA University is fully prepared to all such challenges and ready for creating talented engineers andleaders. Such growth has been witnessed in terms of design and delivery of curriculum, student centric methods in teaching-learning, hands-on based practices through state-of-the-art laboratories and research centres and effective outreach activities with premiere industries and academic institutions.

I thank all our students, parents, faculty, staff and well-wishers for their effort and contribution to take this university as one of next generation globally recognized education hub.

P. Umesh Raju
Pro-Chancellor, REVA University

Vice-Chancellor's Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. A strong believer and practitioner of the dictum "Knowledge is Power", REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built over 50 acres of green campus, this 'temple of learning' has excellent and state-of-the-art infrastructure facilities conducive to higher teaching- learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Benchmarked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is aculmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of Reva University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Mostof the faculty members of the University are involved in research by attracting funded projects from various research level organizations like STI HUB, ISRO, DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT),in the year 2002. **Rukmini Educational Charitable Trust** (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trustis Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU toPost Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 16,000 students study various courses across REVA’s three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette No. 80 dated 27thFebruary, 2013. The University isempowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 50 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library and central computer centre, the well planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

REVA consistently ranked as one of the top universities in various categories because of the diverse community of international students and its teaching excellence in both theoretical and technical education in the fields of Engineering, Management, Law, Science, Commerce, Arts, Performing Arts,and Research Studies. REVA offers 41 Undergraduate Programmes, 31 Full-time and 2 Part-time Postgraduate Programmes, 18 PhD Programmes, and other Certificate/ Diploma/Postgraduate Diploma Programmes in various disciplines.

The curriculum of each programme is designed with a keen eye for detail by giving emphasis on hands- on training, industry relevance, social significance, and practical applications. The University offers world-class facilities and education that meets global standards.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. TheChoice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of educationhas been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. CBCS courses also provide knowledge on local, regional, national and global level issues along with enabling them to be employable and also aid to inculcate entrepreneurial skills across all the programs. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. Ample of opportunities are given for students to enhance their skill-sets through value added courses. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Sensor Networks, Computer Networks, IOT, MEMS, Nano- Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic team and supported by well experienced Trainers, Counselors and Placement Officers.

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Dean facilitating skill related training to REVA students and other unemployed students. The University has been recognized as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd,Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitates students to study some of the programs partlyin REVA University and partly in foreign university.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms. To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N RNarayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director IISc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of DefenseDr. Sathish Reddy, Scientific Advisor, Ministry of Defense, New Delhi and many others have acceptedour invitation and blessed our students and faculty members by their inspiring addresses and interaction.

REVA organizes various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of suchcultural events is REVOTSAVA conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges. During three days of this megaevent students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga class's everyday to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Vision

REVA University aspires to become an innovative university by developing excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standard.

Mission

- To create excellent infrastructure facilities and state-of-the-art laboratories and incubation centers
- To provide student-centric learning environment through innovative pedagogy and education reforms
- To encourage research and entrepreneurship through collaborations and extension activities
- To promote industry-institute partnerships and share knowledge for innovation and development
- To organize society development programs for knowledge enhancement in thrust areas
- To enhance leadership qualities among the youth and enrich personality traits, promote patriotism and moral values.

Objectives

- Creation, preservation and dissemination of knowledge and attainment of excellence in different disciplines
- Smooth transition from teacher - centric focus to learner - centric processes and activities
- Performing all the functions of interest to its major constituents like faculty, staff, students and the society to reach leadership position
- Developing a sense of ethics in the University and Community, making it conscious of its obligations to the society and the nation
- Accepting the challenges of globalization to offer high quality education and other services in a competitive manner

REVA UNIVERSITY
Bengaluru, India

ACADEMIC REGULATIONS

B. Tech., (4 years) Degree Programs
(Applicable for the programs offered from 2023-24)

(Framed as per the provisions under Section 35 (ii), Section 7 (x) and Section 8 (xvi) & (xxi) of the REVA University Act, 2012)

THESE ACADEMIC REGULATIONS ARE UNDER CHOICE BASED CREDIT SYSTEM AND CONTINUOUS ASSESSMENT GRADING PATTERN (CBCS-CAGP)

1. Title and Commencement:

1.1 These Regulations shall be called **"REVA University Academic Regulations – B. Tech., Degree Program for academic year 2023-24 subject to amendments from time to time by the Academic Council on recommendation of respective Board of Studies and approval of Board of Management"**

1.2 These Regulations shall come into force from the date of assent of the Chancellor.

2. The Programs:

These regulations cover the following B. Tech., Degree programs of REVA University offered during 2023-24 under respective schools.

SL No.	Name of the School	Name of the Program
1	School of Civil Engineering	B Tech in Civil Engineering
		B Tech in Agriculture Engineering
2	School of Computing and Information Technology	B Tech Computer Science and Engineering (AI and ML)
		B Tech Computer Science and Information Technology
		B Tech in Information Science and Engineering
		B Tech in Computer Science and Systems Engineering
3	School of Computer Science and Engineering	B Tech in Computer Science and Engineering
		B Tech in Computer Science and Engineering (AI and DS)
		B Tech in Computer Science and Engineering (IoT, Cybersecurity and Blockchain)
4	School of Electrical and Electronics Engineering	B Tech in Electrical and Electronics Engineering
5	School of Electronics and Communication Engineering	B Tech in Electronics and Communication Engineer
		B Tech in Electronics and Computer Engineering
		B Tech in Robotics and Automation
6		B Tech in Mechanical Engineering

	School of Mechanical Engineering	B Tech in Mechatronics Engineering
		B.Tech in Aerospace Engineering

3. Duration and Medium of Instructions:

3.1 Duration: The duration of the B Tech degree program shall be **FOUR** years comprising of **EIGHT** Semesters. A candidate can avail a maximum of 16 semesters - 8 years as per double duration norm, in one stretch to complete B. Tech degree, including blank semesters, if any. Whenever a candidate opts for blank semester, he/she has to study the prevailing courses offered by the School when he/she resumes his/her studies.

3.2 The medium of instruction shall be English.

4. Definitions:

4.1 Course: "Course" means a subject, either theory or practical or both and project, listed under a program; Example: "Fluid Mechanics" in B. Tech Civil Engineering program, "Engineering Thermodynamics" in B. Tech., Mechanical program are examples of courses to be studied under respective programs.

Every course offered will have three components associated with the teaching-learning process of the course, namely: L, T and P, where,

L stands for **Lecture** session consisting of classroom instruction.

T stands for **Tutorial** session consisting participatory discussion/self-study/desk work/brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the lecture classes.

P stands for **Practice** session and it consists of hands-on experience such as laboratory experiments, field studies, case studies, project based learning or course end projects and self- study courses that equip students to acquire the required skill component.

4.2Classification of Courses

Courses offered are classified as: Foundation courses, hard core courses, Softcore courses, Open Electives, Mandatory courses, Project work/Dissertation, Skill Development Courses, etc.

4.2.1 Foundation Course: The foundation Course is basic course which should be completed successfully as a part of graduate degree program irrespective of the program of study.

4.2.2 Hard Core Course (HC)(also Professional Core Course): The **Hard Core Course** is a Core Course in the main branch of study and related branch(es) of study, if any, that the candidates have to complete compulsorily.

4.2.3 Soft Core Course (SC) (also known as Professional Elective Course): A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study.

4.2.4 Open Elective Course (OE): An elective course chosen generally from other discipline / subject, with an intention to seek exposure to the basics of subjects other than the main discipline the student is studying is called an **Open Elective Course.**

4.2.5 Mandatory Non Credit Course (MC): These courses are mandatory for students joining B.Tech. Program and students have to successfully complete these courses before the completion of degree.

4.2.6 Project Work / Dissertation: Project work / Dissertation work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problems to solve a multivariable or complex engineering problems. The project will be conducted in two phases, phase-I, consists of literature survey, problem identification, formulation and methodology. In Phase-II , student should complete the project work by designing or creating an innovative process or development of product as an outcome. A project work is carried out as minor project in 3rd year and major project in 4th year with appropriate credits allocated.

4.2.7 Skill Development Course: It is a practice based course introduced in first year, second year and third year that lead to a certificate, diploma and advanced diploma, respectively.

4.3“Program” means the academic program leading to a Degree, Post Graduate Degree, Post Graduate Diploma Degree or such other degrees instituted and introduced in REVA University.

5. Eligibility for Admission:

5.1. The eligibility criteria for admission to B Tech Program of 4 years (8 Semesters) is given below:

Sl. No.	Program	Duration	Eligibility
1	Bachelor of Technology (B. Tech)	4 Years (8 Semesters)	Passed 10+2 examination with Physics and Mathematics as compulsory subjects, along with any one of the following subjects, namely, Chemistry, Bio-Technology, Computer Science, Biology, Electronics and Technical Vocational subject Obtained at least 45% marks (40% in case of candidate belonging to SC/ST category) in the above subjects taken together.

Sl. No.	Program	Duration	Eligibility
2	Bachelor of Technology (B Tech)	3 Years (6 Semesters)	A. Passed Minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) in ANY branch of Engineering and Technology. B. Passed B.Sc Degree from a recognized University as defined by UGC, with at least 45% marks (40% in case of candidates belonging to SC/ST category) and passed XII standard with mathematics as a subject. C. Provided that in case of students belonging to B.Sc. Stream, shall clear the subjects of Engineering Graphics / Engineering Drawing and Engineering Mechanics of the first year Engineering program along with the second year subjects. D. Provided further that, the students belonging to B. Sc. Stream shall be considered only after filling the seats in this category with students belonging to the Diploma stream. E. Provided further that student, who have passed Diploma in Engineering & Technology from an AICTE approved Institution or B. Sc., Degree from a recognized University as defined by UGC, shall also be eligible for admission to the first year Engineering Degree courses subject to vacancies in the first year class in case the vacancies at lateral entry are exhausted. However the admissions shall be based strictly on the eligibility criteria as mentioned in A, B, D, and E above. F. Passed D.Voc. Stream in the same or allied sector. (The Universities will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the program)
3	Bachelor of Technology (B Tech)		Any candidate with genuine reason from any University / Institution in the country upon credit transfer could be considered for lateral admission to the respective semester in the concerned branch of study, provided he/she fulfils the University requirements.

5.2 Provided further that the eligibility criteria are subject to revision by the Government Statutory Bodies, such as AICTE, UGC from time to time.

6. Courses of Study and Credits

6.1 Each course of study is assigned with certain credit value

6.2 Each semester is for a total duration of 20 weeks out of which 16 weeks dedicated for teaching and learning and the remaining 4 weeks for IA and Semester End Examination, evaluation and announcement of results.

6.3 The credit hours defined as below:

In terms of credits, every one hour session of L amounts to 1 credit per Semester and a minimum of two hour session of T or P amounts to 1 credit per Semester or a three hour session of T / P amounts to 2 credits over a period of one Semester of 16 weeks for teaching- learning process.

The total duration of a semester is 20 weeks inclusive of semester-end examination.

The following table describes credit pattern

Table -2: Credit Pattern

Lectures (L)	Tutorials (T)	Practice (P)	Credits (L:T:P)	Total Credits	Total Contact Hours
4	2	0	4:1:0	5	6
3	2	0	3:1:0	4	5
3	0	2	3:0:1	4	5
2	2	2	2:1:1	4	6
0	0	6	0:0:3	3	6
4	0	0	4:0:0	4	4
2	0	0	2:0:0	2	2

a. The concerned BoS will choose the convenient Credit Pattern for every course based on size and nature of the course.

7. Different Courses of Study:

Different **Courses of Study** are labeled as follows:

a. Core Course (CC)

b. Foundation Course (FC)

c. Hard Core Course (HC)

d. Soft Core Course (SC)

e. Open Elective Course (OE)

f. Skill Development Course (SDC)

g. Mandatory Non Credit Course (MC)

h. Project Work / Dissertation: A project work is carried out as minor project in 3rd year and major project in 4th year with appropriate credits allocated. These are defined under Section 4.2.6 of this regulation.

8. Credits and Credit Distribution

8.1 A candidate has to earn 168 credits for successful completion of B Tech degree with the distribution of credits for different courses with the credit distribution given in the scheme of study.

8.2 The concerned BOS based on the credits distribution shall prescribe the credits to various types of courses and shall assign title to every course including project work, practical work, field work, self-study elective, as **Foundation Course (FC), Hard Core (HC)or Soft Core (SC), Open Elective (OE) Skill Development Course (SDC).**

8.3 Every course including project work, practical work, field work, self-study elective should be entitled as **Foundation Course (FC), Hard Core (HC) or Soft Core (SC) or Open Elective (OE)** or Mandatory Course (MC) by the BoS concerned. However, as per AICTE, the credit distribution for various category of courses given below.

Sl. No.	Course Category	Abbreviation (AICTE)	Abbreviation (REVA)	Suggested breakup of credits (AICTE)	Credit breakup (REVA)
1	Humanities and Social Sciences including Management courses (HSMC)	HSMC	FC	12	9
2	Basic Science Courses	BSC	FC	25	20
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	ESC	FC	24	29
4	Professional core courses	PCC	HC	48	58
5	Professional Elective courses relevant to chosen specialization/branch	PEC	SC	18	15
6	Open subjects – Electives from other technical and /or emerging subjects	OE	OE	18	12
7	Project work, seminar and internship in industry or elsewhere	PROJ	HC	15	19
8	Mandatory Courses [Environmental Sciences, Induction training, Indian	MC	MC	-	-

	Constitution, Essence of Indian Knowledge Tradition]				
9	Skill Development Courses (SDC)	-	SDC		06
TOTAL CREDITS				**160**	**168**

8.4 The concerned BOS shall specify the desired Program Educational Objectives, Program Outcomes, Program Specific Outcomes and Course Outcomes while preparing the curriculum of a particular program. A candidate can enroll for a maximum of 26 credits and a minimum of 16 credits per Semester. However, he / she may not successfully earn a maximum of 26 credits per semester. This maximum of 26 credits does not include the credits of courses carried forward by a candidate.

8.5 Only such full-time candidates who register for a minimum prescribed number of credits in each semester from I semester to VIII semester and complete successfully168 credits in 8 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students.

8.6Add- on Proficiency Certification:

To acquire Add on Proficiency Certification a candidate can opt to complete a minimumof 4 extra credits either in the same discipline /subject or in different discipline / subject in excess to 168credits for the B Tech Degree program.

8.6.1 Add on Proficiency Diploma / Minor degree/ Honor Degree:

To acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree: a candidate can opt to complete a minimum of 18 extra credits either in the same discipline /subject or in different discipline / subject in excess to 168 credits forthe B Tech Degree program. The Add on Proficiency Certification / Diploma/ Minor degree/ Honor Degree: so issued to the candidate contains the courses studied and grades earned.

9 Assessment and Evaluation

9.1 The Scheme of Assessment will have two parts, namely;

i. Continuous Internal Assessment (CIA); and
ii. Semester End Examination (SEE)

9.2 Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of UG Engineering programs shall carry 50:50 marks respectively (i.e., 50 marks internal assessment; 50 marks semester end examination).

9.3 The 50 marks of CIA shall comprise of:

Internal Assessment Test	40 marks
Assignments / Seminars / Model Making / Integrated Lab / Project Based Learning / Quizzes, etc.	10 marks

9.4 There shall be **two Internal Assessment Tests** are conducted as per the schedule announced below. **The Students' shall attend both the Tests compulsorily.**

- 1st test is conducted for 20 marks during **8th week** of the Semester;
- 2nd test is conducted for 20 marks during **15th week** of the of the Semester;

9.5 The coverage of syllabus for the said tests shall be as under:

- Question paper of the **1st test should be based on first 50% of the total syllabus(Unit 1 & 2)**;
- Question paper of the **2nd test should be based on remaining 50 % of the total syllabus (Unit 3 & 4)**;
- An assignment must be designed to cover the entire syllabus

9.6 There shall be two Assignment / Project Based Learning / Field Visit / Quiz test carrying 10 marks covering the entire syllabus.

9.7 SEE for 50 marks practical exam shall be held in the 16th and 17th week of the semester.

9.8 SEE for 50 marks theory exam shall be held in the 18th 19th and 20th week of the semester and it should cover entire syllabus.

9.9 Internal test paper is set for a maximum of 40 marks to be answered in 1.5 hours duration (for 1 credit course, exam is conducted for 25 marks with a duration of 1 hour). A test paper can have 5 main questions. Each main question is set for 10 marks. The main question can have 2-3 sub questions all totaling 10 marks. Students are required to answer any 4 main questions. Each question is set using Bloom's verbs. The questions must be set to assess the course outcomes described in the course document even with the choice is given in questions.

9.10 The question papers for internal test shall be set by the internal teachers who have taught the course. If the course is taught by more than one teacher all the teachers together shall devise a common question paper(s). However, these question papers shall be scrutinized by the Question Paper Scrutiny Committee (internal BoE members) to bring the quality and uniformity in the question paper.

9.11 The evaluation of the answer scripts shall be done by the internal teachers who have taught the course and set the test paper.

9.12 Assignment/seminar/Project based learning/simulation based problem solving/field work should be set in such a way, students be able to apply the concepts learnt to a real

life situation and students should be able to do some amount self-study and creative thinking. While setting assignment care should be taken such that the students will not be able to plagiarize the answer from web or any other resources. Course instructor at his/her discretion can design the questions as a small group exercise or individual exercise. This should encourage collaborative learning and team learning and also self- study.

9.13 Internal assessment marks must be decided well before the commencement of SEE.

9.14 SEE theory question paper is set for a maximum of 100 marks to be answered in 3 hours duration. Each main question be set for a maximum of 25 marks, main questions can have a 3 to 4 sub-questions. A total of 8 questions are set so that students will have a choice. Each question is set using Bloom's verbs. The questions must be set to assess the students outcomes described in the course document (question papers have to be set to test the course outcomes).

9.15 There shall be minimum three sets of question papers for the semester end examination of which one set along with scheme of examination shall be set by the external examiners and two sets along with scheme of examination shall be set by the internal examiners. All the question paper sets shall be scrutinized by the Board of Examiners (BoE). It shall be responsibility of the BOE particularly Chairman of the BOE to maintain the quality and standard of the question papers and as well the coverage of the entire syllabus of the course.

9.16 There shall be single evaluation by the examiners for each paper. However, there shall be moderation by one of the senior examiners, either internal or external.

9.17 Board of Examiners, question paper setters and any member of the staff connected with the examination are required to maintain integrity of the examination system and the quality of the question papers.

9.18 There shall also be an **Program Assessment Committee (PAC)** comprising at-least 3 faculty members having subject expertise who shall after completion of examination process and declaration of results review the results sheets, assess the performance level of the students, measure the attainment of course outcomes, program outcomes and assess whether the program educational objectives are achieved and report to the Director of the School. The Examination Review Committee shall also review the question papers of both Internal Tests as well Semester End Examinations and submit reports to the Director of the respective School about the scope of the curriculum covered and quality of the questions.

9.19 The report provided by the Examination Review Committee shall be the input to the Board of Studies to review and revise the scheme of instruction and curriculum of respective program

9.20 During unforeseen situation like the Covid-19, the tests and examination schedules, pattern of question papers and weightage distribution may be designed as per the convenience and suggestions of the board of examiners in consultation with COE and VC

9.21 University may decide to use available modern technologies for writing the tests and SEE by the students instead of traditional pen and paper.

9.22 Any deviations required to the above guidelines can be made with the written consent of the Vice Chancellor.

9.23 Online courses may be offered as per UGC norms.
For online course assessment guidelines would be as follows:

a. If the assessment is done by the course provider, then the School can accept the marks awarded by the course provider and assign the grade as per REVA University norms.

b. If the assessment is not done by the course provider then the assessment is organized by the concerned school and the procedure explained in the regulation will apply

c. In case a student fails in an online course, s/he may be allowed to repeat the course and earn the required credits

IAs for online courses could be avoided and will remain at the discretion of theSchool.

9.24 The online platforms identified could be SWAYAM, NPTEL, Coursera, Edx.org, Udemy, Udacity and any other internationally recognized platforms like MIT online, Harvard online etc.

9.25 Utilization of one or two credit online courses would be:

4 week online course – 1 credit

8 week online course / MOOC – 2 credits 12

week online course / MOOC – 3 credits

9.26 **Summary of Internal Assessment, Semester End Examination and Evaluation** Schedule is provided in the table given below (for theory courses having Credits >=2).

Summary of Internal Assessment and Evaluation Schedule

Sl. No.	Type of Assessment	When	Syllabus Covered	Max Marks	Scaled down to	Date by which the process must be completed
1	Test-1	During 8th week	First 50%	40	20	9th week
2	Test -2	During 15th Week	Remaining 50%	40	20	16th Week
3	Assignment / Quiz - 1	Every week till Test-1	First 50%	10	05	9th Week

4	Assignment / Quiz - 2	Every week during Test-1 and Test-2	Remaining 50%	10	05	16th Week
5	SEE	18th to 20th Week	100%	100	50	20th Week

9.27 Summary of Internal Assessment, Semester End Examination and Evaluation Schedule is provided in the table given below (for theory courses having Credit 1).

Summary of Internal Assessment and Evaluation Schedule

Sl. No.	Type of Assessment	When	Syllabus Covered	Max Marks	Reduced to	Date by which the process must be completed
1	Test-1	During 8th week	First 50%	25	12.5	8th week
2	Test -2	During 15th Week	Remaining 50%	25	12.5	15th Week
5	SEE	18th to 20th Week	100%	50	25	20th Week

10 Assessment of Students Performance in Practical Courses

Lab courses are of two types: integrated labs and separate labs.

The performance in the practice tasks / experiments shall be assessed on the basis of:

a. Knowledge of relevant processes;
b. Skills and operations involved;
c. Results / products including calculation and reporting

10.1 Assessment of lab courses

10.1.1 Assessment of Separate lab course

The 50 marks meant for Internal Assessment (IA) of the performance incarrying out practical shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	20 marks
ii	Maintenance of lab records	10 marks
iii	Performance of internal lab test to be conducted after completion of all the experiments before last working day of the semester	20 marks
	Total	**50 marks**

10.1.2 Assessment of integrated lab course

The 10 marks meant for Internal Assessment (IA) of the performance incarrying out Integrated lab course shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the	05 marks
	semester	
ii	Maintenance of lab records and performance of internal lab test to be conducted after completion of all the experiments before last working day of the semester	05 marks
	Total	**10 marks**

10.2 The 50 marks meant for Semester End Examination (SEE) in case of separate lab course shall be allocated as under:

i	Conduction of practical (experiment)	30 marks
ii	Write up about the experiment/tabulation/results/inference	10 marks
iii	Viva Voce	10 marks
	Total	**50 marks**

Note: No Separate SEE for integrated lab course

10.3 The duration for semester-end practical examination shall be decided by the concerned School Board.

10.4 For MOOC and Online Courses assessment shall be decided by the BOS of the School.

For >= 2 credit courses

i	IA-I	25 marks
ii	IA-2	25 marks
iii	Semester end examination by the concern school board (demo, test, viva voice etc.)	50 marks
	Total	**100 marks**

For 1 credit courses

i	IA (Performance of internal test to be conducted after completion of entire syllabus)	25 marks
iii	Semester end examination by the concern school board (demo, test, viva voice etc.)	25 marks
	Total	**50 marks**

11. Evaluation of Minor Project / Major Project / Dissertation:

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to theregular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

Component – I	Periodic Progress and Progress Reports (25%)
Component – II	Demonstration and Presentation of work (25%)
Component – III	Evaluation of Report (50%)

12. Evaluation of mandatory courses: Students should maintain minimum of 75% attendance to appear for SEE of Mandatory course. The SEE should be conducted in MCQ pattern and students should get minimum pass grade to obtain the degree. There is no internal assessment

13. Evaluation of **Skill Development Courses:** The concerned BoS shall recommend to conduct test/demo/viva-voce/MCQ to test the student knowledge.

14. Requirements to Pass a Course:

A candidate's performance from IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 50 , SEE = 50) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 30% (15 marks) in Semester End Examination (SEE) which is compulsory.

The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below:

Marks, P	Grade, G	Grade Point (GP=V x G)	Letter Grade
90-100	10	v*10	O
80-89	9	v*9	A+
70-79	8	v*8	A
60-69	7	v*7	B+
55-59	6	v*6	B
50-54	5.5	v*5.5	C+
40-49	5	v*5	C
0-39	0	v*0	F
ABSENT			AB

O - Outstanding; A+-Excellent; A-Very Good; B+-Good; B-Above Average; C+-Average; C-Satisfactory; F – Unsatisfactory.

Here, P is the percentage of marks (P=[IA + SEE]) secured by a candidate in a course whichis **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

a. Computation of SGPA and CGPA

The Following procedure to compute the Semester Grade Point Average (SGPA).
The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e : **SGPA (Si) = ∑(Ci x Gi) / ∑Ci** where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA

Illustration No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	3	A+	9	3X9=27
Course 2	3	A	8	3X8=24
Course 3	3	B+	7	3X7=21
Course 4	4	O	10	4X10=40
Course 5	1	C	5	1X5=5
Course 6	2	B	6	2X6=12
Course 7	3	O	10	3X10=30
	19			159

Thus, **SGPA = 159 ÷ 19 = 8.37**

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	A	8	4X8=32
Course 2	4	B+	7	4X7=28
Course 3	3	A+	9	3X9=27
Course 4	3	B+	7	3X7=21
Course 5	3	B	6	3X6=18
Course 6	3	C	5	3X5=15
Course 7	2	B+	7	2X7=21
Course 8	2	O	10	2X10=20
	24			175

Thus, SGPA = 175 ÷ 24 = 7.29

Illustration No.3

Course	**Credit**	**Grade Letter**	**Grade Point**	**Credit Point (Credit x Grade point)**
Course 1	4	O	10	4 x 10 = 40
Course 2	4	A+	9	4 x 9 = 36
Course 3	3	B+	7	3 x 7 = 21
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	B+	7	3 x 7 = 21

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade point)
Course 7	2	A+	9	2 x 9 = 18
Course 8	2	A+	9	2 x 9 = 18
	24			**199**

Thus, **SGPA = 199 ÷ 24 = 8.29**

b. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completionof the required number of credits (160) for B. Tech degree in Engineering & Technology is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e : **CGPA = ∑(Ci x Si) / ∑Ci**

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Illustration:

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	21	6.83	21 x 6.83 = 143.43
2	23	7.29	23 x 7.29 = 167.67
3	22	8.11	22 x 8.11 = 178.42
4	24	7.40	24 x 7.40 = 177.6
5	22	8.29	22 x 8.29 = 182.38
6	24	8.58	24 x 8.58 = 205.92
7	22	9.12	22 x 9.12 = 200.64
8	10	9.25	10 x 9.25 =92.50
Cumulative	**168**		**1348.56**

Thus,

$$CGPA = \frac{2222\times66.8888+2288\times77.2222+2222\times88.2222+2222\times77.2244+2222\times88.2222+2222\times88.5588+2222\times22.2222+2244\times22.2255}{226666} = \frac{22882266.5588}{226688} = 8.02$$

c. **Conversion of grades into percentage:**

Conversion formula for the conversion of CGPA into Percentage is:Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.02 x 10=80.2

d. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA securedby the candidate and is given as follows.

CGPA	Grade (Numerical Index) G	Letter Grade	Performance	FGP Qualitative Index
9 >= CGPA 10	10	O	Outstanding	Distinction

8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
> 5 CGPA < 5.5	5.5	C+	Average	
> 4 CGPA <5	5	C	Satisfactory	Pass
< 4 CGPA	0	F	Unsatisfactory	Unsuccessful

Overall percentage=10*CGPA

e. **Provisional Grade Card**: The tentative / provisional grade card will be issued by the Controller of Examinations at the end of every semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average (SGPA).**

f. **Final Grade Card:** Upon successful completion of B Tech Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Controller of Examinations.

14.2 Attendance Requirement

14.2.1. All students must attend every lecture, tutorial and practical classes.

14.2.2. In case a student is on approved leave of absence (e g:- representing the University in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

14.2.3. Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc, during a semester shall not be permitted toappear to the end semester examination and such student shall seek re-admission

15. Re-Registration and Re-Admission:

15.1 In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for semester end examination and he / she shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

15.2 In such case where in a candidate drops all the courses in a semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seek re-admission to such dropped semester.

16. Absence during Internal Test:

In case a student has been absent from an internal tests due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned

Director of the School, for conducting a separate internal test. The Director of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special internal test for such candidate(s) well in advance before the Semester End Examination of that respective semester. Under no circumstances internal tests shall be held / assignments are accepted after Semester End Examination.

17. Provision for Appeal

If a candidate is not satisfied with the evaluation of Internal Assessment components (Internal Tests and Assignments), he/she can approach the Grievance Cell with the written submission together with all facts, the assignments, and test papers, which were evaluated. He/she can do so before the commencement of respective semester-end examination. The Grievance Cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the University on the candidate if his/her submission is found to be baseless and unduly motivated. This Cell may recommend for taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the Grievance committee is final.

i. Grievance Committee:

In case of students having any grievances regarding the conduct of examination, evaluation and announcement of results, such students can approach Grievance Committee for redressal of grievances.

For every program there will be one grievance committee. The composition of the grievance committee is as follows:-

- The Controller of Examinations - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

18. Eligibility to Appear for Semester End Examination (SEE)

Only those students who fulfil a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc., as part of the program shall be eligible to appear for Semester End Examination

19. Provision for Supplementary Examination

In case a candidate fails to secure a minimum of 30% (15 marks) in Semester End Examination (SEE) and a minimum of 40% marks together with IA and SEE to declare pass in the course, such candidate shall seek supplementary examination of only such course(s) wherein his / her performance is declared unsuccessful. The supplementary examinations are conducted after the announcement of even semester examination results. The candidate who is unsuccessful in a given course(s) shall appear for supplementary examination of odd and even semester course(s) to seek for improvement of the performance.

20. Provision to Carry Forward the Failed Subjects / Courses:

Students who have failed in courses totaling 16 credits or fewer across both odd and even semesters combined will be allowed to proceed to the next semester of the following year(s)of their academic program.

For vertical progression, students have to clear all the courses of first year to be eligible to take admission to third year and they have to clear all the courses till second year to be eligible to take admission to fourth year. For lateral entry students, they have to clear all the courses of second year to be eligible to take admission to fourth year.

Case 1: A student who has failed in a maximum of 16 credits in 1st and 2nd semester together shall move to the 3rd semester of the succeeding year.

Case 2: A student who has failed in a maximum of 16 credits from semester 1 to 4 together shall move to the 5th semester of the succeeding year only if he/she successfully completes all the courses of first and second semester.

Case 3: A students who has failed in a maximum of 16 credits from semester 3 to 6 together shall move to the 7th semester of the succeeding year only if he/she successfully completes all the courses of third and Fourth semester.

21. Re-evaluation of Answer Scripts and Announcement of Re-evaluation Results

After declaration of the results of programs within next 10 days, if any candidate wishes to apply for Photocopy/Revaluation (only theory courses), s/he shall apply to the Controller of Examinations, by paying the prescribed fees notified by the University from time to time. The photocopies of the said answer books shall be made available within next TEN working days after the last date prescribed for receipt of the application at the Office of the Controller of Examinations. Photocopies will not be issued for practical/drawing/audit courses.

22. Results of Re-Evaluation will be announced within TWENTY working days (except for third evaluation).

23. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

24. All assessments must be done by the respective Schools as per the guidelines issued by the Controller of Examinations. However, the responsibility of announcing final examination results and issuing official transcripts to the students lies with the office of the Controller of Examinations.

25. Re-joining a Program: A student who discontinues the academic program for any reason and re-joins the program at a later date shall be governed by the rules, regulations, courses of study and syllabi in force at the time of his/her re-joining the program.

ABOUT THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

The school has a rich blend of experienced and committed faculty who are well qualified in various aspects of Computer Science and Engineering apart from the numerous state-of-the-art digital classrooms and laboratories having modern computing equipment. The school offers B.Tech. in Computer Science and Engineering, B.Tech in Artificial Intelligence and Data Science, B. Tech in Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology), M.Tech in Computer Science and Engineering (Full Time) and M.Tech in Computer Science and Engineering (Part-Time).

In addition, the school has a unique academic collaboration with the University of Alabama in Huntsville to jointly offer an MS program in Computer Science. In addition, the department has a research center in which students can conduct cutting edge research leading to a Ph.D degree.

Curricula of both undergraduate and postgraduate programs have been designed through a collaboration of academic and industry experts in order to bridge the growing gap between industry and academia. This makes the program highly practical-oriented, and thus industry-resilient. The B.Tech program aims to create quality human resources to play leading roles in the contemporary, competitive industrial and corporate world.

The master's degree focus on quality research and design in the core and application areas of computing to foster a sustainable world and to enhance the global quality of life by adopting enhanced design techniques and applications. This thought is reflected in the various courses offered in the masters' programs.

Vision

Department of Computer Science and Engineering aspires to create a pool of high-calibre technologists and researchers in the field of computer science and engineering who have potential to contribute for development of the nation and society with their expertise, skills, innovative problem-solving abilities and strong ethical values.

Mission

MD1: To create center of excellence where new ideas flourish and from which emerge tomorrow's researchers, scholars, leaders, and innovators.

MD2: Provide quality education in both theoretical and applied foundations of computer science and engineering, related inter-disciplinary areas and train students to effectively apply the knowledge to solve real-world problems.

MD3: Amplify student's potential for life-long high-quality careers and make them competitive in ever-changing and challenging global work environment.

MD4: Forge research and academic collaboration with industries and top global universities in order to provide students with greater opportunities.

MD5: Support the society by encouraging and participating in technology transfer.

Program Educational Objectives (PEOs)

The program helps to develop critical, analytical, innovative, creative and problem-solving abilities amongst its graduates. The programme makes the graduates employable as Software Engineers across sectors. With further education and earning of higher-level degrees help the graduates to pursue a career in academics or scientific organisations as researchers.

The Program Educational Objectives (PEOs):

After few years of graduation, the graduates of B. Tech. Computer Science and Engineering(Internet of Things and Cyber Security including Block Chain Technology) will:

- PEO-1: Have a successful professional career in industry, government, academia and defence as an innovative engineer in a team.
- PEO-2: Develop code and solutions to industry and societal needs in a rapid changing technological environment and communicate with clients as an entrepreneur.
- PEO-3: Pursue higher studies and continue to learn by participating in conferences, seminars, etc.

Program Outcomes (POs)

On successful completion of the program, the graduates of B. Tech. Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology) program will be able to:

PO-1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals for the solution of complex problems in Computer Science and Engineering using IoT, Cybersecurity and Blockchain technologies.

PO-2: Problem analysis: Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.

PO-3: Design/development of solutions: Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4: Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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

PO-7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9: Individual and teamwork: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

PO-10: Communication: Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations and give and receive clear instructions.

PO-11: Project management and finance: Demonstrate knowledge and understanding of engineering and management principles and apply these to one’s own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

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

Programme Specific Outcomes (PSOs)

On successful completion of the program, the graduates of B. Tech. Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology) program will be able to:

PSO-1: Demonstrate the knowledge of Data structures and Algorithms, Operating Systems, Embedded Systems, Artificial Intelligence and Machine Learning, Internet of Things, Cyber Security, Blockchain and Networking for efficient design of intelligent systems.

PSO-2: Use of modern tools and techniques in the areas of the Internet of Things, Cyber Security and Blockchain technologies.

PSO-3: Pursue advanced skills and research to innovate novel tools and systems for societal needs.

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

HANDBOOK

First Year B. Tech. Artificial Intelligence and Data Science

2023-27

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SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

SCHEME OF INSTRUCTIONS (2023 – 2027 BATCH)

B. Tech AI&DS

I Semester (Physics Cycle)

Sl. No	Course Code	Title of the Course	HC/FC /SC/ OE/ MC/ SDC	Credit Pattern L	T	P	Total Credit	Contact Hours /Week	Examination CIE Marks	SEE Marks	Total Marks	Course category (As per AICTE)
1	B23AS0103	Multivariable Calculus and Linear Algebra	FC	3	0	0	3	3	50	50	100	BSC
2	B23AS0106	Physics for Computer Science	FC	3	0	0	3	3	50	50	100	BSC
3	B22EN0102	Introduction to Accounting	FC	1	0	0	1	1	25	25	50	HSMC
4	B23CS0104	Introduction to Data Science	HC	2	0	0	2	2	50	50	100	ESC
5	B22EE0101	Basics of Electrical and Electronics Engineering	HC	3	0	0	3	3	50	50	100	ESC
6	B22ED0101	Elements of Civil Engineering and Mechanics	HC	3	0	0	3	3	50	50	100	ESC
7	B22ME0101	Computer Aided Engineering Drawing	HC	2	0	1	3	4	50	50	100	ESC
8	B22AS0109	Physics for Computer Science Lab	FC	0	0	1	1	2	25	25	50	BSC
9	B23CS0108	Data Science Lab	HC	0	0	1	1	2	25	25	50	ESC
10	B22EE0102	Basics of Electrical and Electronics Lab	HC	0	0	1	1	2	25	25	50	ESC
TOTAL				17	0	4	21	25	400	400	800	

TOTAL SEMESTER CREDITS	**21**
TOTAL CUMULATIVE CREDITS	**21**
TOTAL CONTACT HOURS	**25**
TOTAL MARKS	**800**

II Semester (Chemistry Cycle)

	Course Code	Title of the Course	HC/FC / SC/OE /MC	Credit Pattern				Contact Hours / Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B23AS0203	Probability and Statistics	FC	3	0	0	3	3	50	50	100	BSC
2	B23AS0104	Engineering Chemistry	FC	3	0	0	3	3	50	50	100	BSC
3	B22AH0103	Communication Skills	FC	0	0	1	1	2	25	25	50	HSMC
4	B22CI0104	Programming with C	HC	3	0	0	3	3	50	50	100	ESC
5	B22ME0103	Elements of Mechanical Engineering	HC	3	0	0	3	3	50	50	100	ESC
6	B22EN0101	IoT and Applications	HC	1	0	1	2	3	50	50	100	ESC
7	B23ME0102	Innovation & Entrepreneurship	FC	1	0	1	2	3	50	50	100	HSMC
8	B22AS0105	Engineering Chemistry Lab	FC	0	0	1	1	2	25	25	50	BSC
9	B22CI0108	Programming with C Lab	HC	0	0	1	1	2	25	25	50	ESC
10	B22ME0104	Engineering Workshop	HC	0	0	1	1	2	25	25	50	ESC
11	B22CS0201	Skill Development Course-1	SDC	0	0	2	2	4	50	50	100	SDC
12	B22ME0105	Tree Plantation in Tropical Region: Benefits and Strategic Planning	FC	1	0	0	1	1	25	25	50	HSMC
TOTAL				**15**	**0**	**8**	**23**	**30**	**475**	**475**	**950**	
TOTAL SEMESTER CREDITS					**23**							
TOTAL CUMULATIVE CREDITS					**44**							
TOTAL CONTACT HOURS					**30**							
TOTAL MARKS					**950**							

Nomenclature:**L:** Lecture, **T:** Tutorial, **P:** Practical/Practice/Hands-on, **HC**: Hard Core, **SC**: Soft Core, **FC**: Foundation Core, **OE**: Open Elective, **SDC:** Skill Development Course, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination, **BSC**: Basic Science Course, **HSMC**: Humanities, Social science and Management Course, **ESC**: Engineering Science Course, **PCC**: Program Core Course, **PEC**: Professional Elective Course, **MC**: Mandatory Course, **PROJ**: Project work/Internship

***Note*:**SDC-1 will be hands-on based skill enhancement course that create expertise in the domain of respective engineering.

III SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE/MC/SDC	Credit Pattern				Contact Hours / Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22AS0301	Discrete Mathematics and Graph Theory	FC	3	0	0	3	3	50	50	100	BSC
2	B22CS0301	Professional Ethics	FC	2	0	0	2	2	50	50	100	HSMC
3	B22CI0309	Entrepreneurship	FC	1	0	0	1	1	25	25	50	HSMC
4	B22AS0303/ B22AS0403	Environmental Science	MC	2	0	0	0	2				HSMC
5	B22EF0301	Operating systems	HC	3	0	0	3	3	50	50	100	PCC
6	B22EF0302	Object oriented Programming with Java	HC	3	0	0	3	3	50	50	100	PCC
7	B22EF0303	Data Structures	HC	3	0	0	3	3	50	50	100	PCC
8	B22EH0301	Digital Logic and Design	HC	3	0	0	3	3	50	50	100	PCC
9	B22EF0305	Java Programming lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EF0306	Data Structures lab using C	HC	0	0	1	1	2	25	25	50	PCC
11	B22EH0302	Digital Logic and Design Lab	HC	0	0	1	1	2	25	25	50	PCC
Total				20	0	3	21	26	400	400	800	
TOTAL SEMESTER CREDITS					21							
TOTAL CUMULATIVE CREDITS					65							
TOTAL CONTACT HOURS					26							
TOTAL MARKS					800							

IV SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE /MC/ SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22EH0401	Foundations of Artificial Intelligence and Machine learning	HC	2	0	0	3	2	50	50	100	HSMC
2	B22EE0310	Universal Human Values	FC	2	0	0	2	1	25	25	50	PCC
3	B22EN0308	Technical Documentation	MC	1	0	0	1	2				HSMC
4	B22MEM301	Indian Constitution	HC	2	0	0	0	3	50	50	100	PCC
5	B22EF0401	Design and Analysis of Algorithms	HC	3	0	0	3	3	50	50	100	PCC
6	B22EF0402	Database Management Systems	HC	3	0	0	3	3	50	50	100	PCC
7	B22EF0403	Computer Organization and Architecture	HC	3	0	0	3	3	50	50	100	PCC
8	B22EFS41X	Professional Elective 1	PE	3	0	0	3	3	50	50	100	PEC
9	B22EH0402	Foundations of Artificial Intelligence and Machine Learning Lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EF0404	Algorithms Lab	HC	0	0	1	1	2	25	25	50	PCC
11	B22EF0405	Database Management Systems Lab	HC	0	0	1	1	2	25	25	50	PCC
12	B22EH0403	Skill Development course 2	SDC	0	0	2	2	4	50	50	100	SDC
TOTAL				20	0	5	23	30	450	450	900	
TOTAL SEMESTER CREDITS					23							
TOTAL CUMULATIVE CREDITS					88							
TOTAL CONTACT HOURS					30							
TOTAL MARKS					900							

V SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/ OE/MC /SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22XXO51X	Open Elective -1 (multidisciplinary)	OE	3	0	0	3	3	50	50	100	POE
2	B22ED0501	Indian Heritage and Culture (MC)	MC	2	0	0	0	2				HSMC
3	B22EF0501	Theory of Computation	HC	3	0	0	3	3	50	50	100	PCC
4	B22EF0502	Big Data Analytics	HC	3	0	0	3	3	50	50	100	PCC
5	B22EF0503	Computer Networks	HC	3	0	0	3	3	50	50	100	PCC
6	B22EH0501	Cloud Computing	HC	3	0	0	3	3	50	50	100	PCC
7	B22EHS51X	Professional Elective 2	SC	3	0	0	3	3	50	50	100	PEC
8	B22EHS52X	Professional Elective 3	SC	3	0	0	3	3	50	50	100	PEC
9	B22EH0505	Big Data Analytics Lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EF0506	Computer Networks lab	HC	0	0	1	1	2	25	25	50	PCC
11	B22EH0502	Cloud Computing Lab	HC	0	0	1	1	2	25	25	50	PCC
12	B22EH0503	Skill Development course 3	SDC	0	0	2	2	4	50	50	100	SDC
TOTAL				23	0	5	26	33	475	475	950	
TOTAL SEMESTER CREDITS					26							
TOTAL CUMULATIVE CREDITS					114							
TOTAL CONTACT HOURS					33							
TOTAL MARKS					950							

VI SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE /MC/SDC	Credit Pattern L	T	P	Total Credit	Contact Hours / Week	Examination CIE Marks	SEE Marks	Total Marks	Course category (As per AICTE)
1	B22XXO61X	Open Elective – 2 (general)	OE	3	0	0	3	3	50	50	100	POE
2	B22EH0601	Neural Networks and Deep Learning	HC	3	0	0	3	3	50	50	100	PCC
3	B22EH0602	Business Intelligence and Analytics	HC	3	0	0	3	3	50	50	100	PCC
4	B22EF0602	Web Technology	HC	3	0	0	3	3	50	50	100	PCC
5	B22EF0603	Agile Software Development and DevOps	HC	3	0	0	3	3	50	50	100	PCC
6	B22EHS61X	Professional Elective – 4	SC	3	0	0	3	3	50	50	100	PEC
7	B22EHS62X	Professional Elective – 5	SC	3	0	0	3	3	50	50	100	PEC
8	B22EF0606	Web Technology Lab	HC	0	0	1	1	2	25	25	50	PCC
9	B22EH0603	Business Intelligence and Analytics Lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EH0604	Neural Networks and Deep Learning Lab	HC	0	0	1	1	2	25	25	50	PCC
11	B22EH0605	Mini Project/ Summer Internship	HC	0	0	2	2	4	50	50	50	PCC
Total				21	0	5	26	31	475	475	900	
TOTAL SEMESTER CREDITS				26								
TOTAL CUMULATIVE CREDITS				140								
TOTAL CONTACT HOURS				31								
TOTAL MARKS				900								

VII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE/MC/SDC	Credit Pattern L	T	P	Total Credit	Contact Hours/Week	Examination CIE Marks	SEE Marks	Total Marks	Course category (As per AICTE)
1	B22XXO71X	Open elective –3	OE	3	0	0	3	3	50	50	100	POE
2	B22XXO72X	Open Elective - 4 (MOOC)	OE	3	0	0	3	3	50	50	100	POE
3	B22EH0701	Cryptography and Network Security	HC	3	0	0	3	3	50	50	100	PCC
4	B22EH0702	Skill Development course - 4 (NPTEL)	SDC	1	0	1	2	3	50	50	100	SDC
5	B22EH0703	Internship	HC	0	0	2	2	4	50	50	100	PCC
6	B22EH0704/5	Project – Phase 1/Startup	HC	0	0	3	3	6	50	50	100	PCC
Total				10	0	6	16	22	300	300	600	
TOTAL SEMESTER CREDITS				16								
TOTAL CUMULATIVE CREDITS				156								
TOTAL CONTACT HOURS				22								
TOTAL MARKS				600								

VIII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE/ MC/SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22EH0801	Project Phase 2/Startup	HC	0	0	12	12	24	50	50	100	PCC
Total				0	0	12	12	24	50	50	100	

TOTAL SEMESTER CREDITS	12
TOTAL CUMULATIVE CREDITS	168
TOTAL CONTACT HOURS	24
TOTAL MARKS	100

Professional Electives

AI&DS	T1 (ARTIFICIAL INTELLIGENCE)	T2 (DATA SCIENCE)	T3 (IoT & SECURITY)	T4 (COMPUTING)	T5 (PROGRAMMING)
IV(PE1)	Data mining and Data warehousing B22EHS411	Applied Statistics B22EHS412	System Software B22EHS413	Operation Research B22EHS414	Introduction to Python Programming B22EHS415
V(PE2)	Pattern Recognition B22EHS511	Predictive Analytics B22EHS512	System Modeling and Simulation B22EHS513	Quantum Computing B22EHS514	R programming B22EHS515
V(PE3)	Human Computer Interaction B22EHS521	Natural Language Processing B22EHS522	IOT Architecture and Protocols B22EHS523	Cognitive Computing B22EHS524	Augmented Reality and Virtual Reality B22EHS525
VI(PE4)	Computer Vision B22EHS611	Bioinformatics B22EHS612	Cyber law and Digital Forensics B22EHS613	Soft Computing B22EHS614	Computer Graphics and Multimedia B22EHS615
VI(PE5)	Stochastic Modelling and the Theory of Queues B22EHS621	Social Network Analysis B22EHS622	Robotic Process and Automation B22EHS623	Advanced Deep Learning B22EHS624	Genomics B22EHS625

Open Electives

V Sem	Open Elective 1	Introduction to python programming B22EH0511	R Programming B22EH0512			
VI Sem	Open Elective 2	Introduction to Artificial intelligence and Machine learning B22EHO611	Business Intelligence B22EHO612			
VII Sem	Open Elective 3	Neural Networks and Deep Learning B22EH0711	Big Data Analytics B22EH0712			
VII Sem	Open Elective 4	NPTEL/SWAYAM Courses (General)				

<table>
<tr><td>Course Title</td><td colspan="4">Multivariable Calculus and Linear Algebra</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B23AS0103</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5"></td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>practice</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The course Differential Calculus deals with the basic aspects differential calculus. The students of Computer Science are equally benefited with this course as stepping stone to the broad areas of calculus. This course familiarize students with important concepts coming under differential calculus and to develop strong foundations on these concepts. In Computer Science, Calculus is used for machine learning, data mining, scientific computing, image processing, and creating the graphics and 3D visuals for simulations. Calculus is also used in a wide array software program that require it. Linear algebra provides concepts that are crucial to many areas of computer science, including graphics, image processing, cryptography, machine learning, optimization, graph algorithms, information retrieval and web search.

COURSE OBJECTIVE (S):

1. Explain the scalar and vector point functions and their operations.
2. Illustrate how to find angle between polar curves with a suitable example.
3. Demonstrate the use of radius of curvature of the curves can be best suited for machine learning techniques with big data analytics.
4. Describe the concepts of Linear algebra and calculus theory.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	Pos	PSOs
CO-1	Apply Taylor's and Maclaurin's series for finding series expansions of functions and approximating values.	1,2,4	1
CO-2	Identify the curve forms and evaluate the radius of curvature of the given curve.	1,2,4	1
CO-3	Evaluate the limit using L' Hospital rule after identifying an indeterminate form.	1,2,4	1
CO-4	Solve the given system of equations by Gauss elimination and Gauss Jordon method for the consistent equations.	1,2,4	1
CO-5	Determine the Eigen values, the corresponding Eigen vectors and diagonalize the given square matrix.	1,2,4	1
CO-6	Apply Rayleigh's Power method to find the largest Eigen value and the corresponding Eigen vector.	1,2,4	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO-1			√			
CO-2			√			
CO-3					√	
CO-4			√			
CO-5					√	
CO-6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3		1									1		
CO-2	3	3		2									1		
CO-3	3	2		1									1		
CO-4	3	3		1									1		
CO-5	3	3		1									1		
CO-6	3	2		1									1		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
UNIT – 1 **Vector Calculus:** Velocity, Acceleration, Tangent and normal vectors, Gradient, Divergence, Curl, Solenoidal and Irrotational vectors, Scalar potential, Vector identities(Basic identities)**.** ****** *Applications: vector theory for data transmission, social network analysis*.
UNIT – 2 **Differential Calculus**: nth derivatives of standard function (without proof, *simple problems), Leibnitz theorem(without proof)-simple problems, Taylors series and McLaurin's series expansion for a function of one variable (only problems), Indeterminate forms 'solve using L- Hospital's rule. ***** Applications: creating graphs or visuals, simulations, coding in applications, creating statistic solvers.***
UNIT– 3 **LinearAlgebra-1:** Echelon form, Normal form of a matrix, Rank of Matrix, Gauss-Jordon method to find inverse of a matrix, Gauss elimination and Gauss-Jordon method to solve system of equations. Linear Algebra for statistics. ****** *Application: Image processing, computer graphics, encryption, and decryption of the codes.*
UNIT – 4 **Linear Algebra-2:** Linear transformation, Eigen values and Eigen Vectors up to 3*3 matrices, Diagonalization for 2*2 matrices, Rayleigh power method to determiner largest Eigen value and the corresponding Eigen vector, Complex matrices. ****** *Application: Matrix operation in Machine Learning, Face recognition using eigen values and eigen vectors.*

****** *Application: (i) Additional information providing to students only for knowledge.*

(ii) Major part of assignments questions chosen from applications.

(iii) Students' presentations/seminars topics chosen from applications.

TEXT BOOKS:

1. Theodore Shifrin, "Multi-Variable Calculus and Linear Algebra with Applications", Wiley, 1st edition, Volume 2, 2018.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43^{nd} edition, 2015.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9^{th} edition,2013.
4. Ron Larson, "Multivariable Calculus, Cengage Learning", 10th Edition, 2013.

REFERENCE BOOKS:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Reprint edition, 2013.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 4th edition, 2016.
3. Stanley I. Grossman, "Multivariable Calculus, Linear Algebra, and Differential Equations", 2nd edition, Academic Press 1986.

JOURNALS/MAGAZINE:

https://www.sciencedirect.com/journal/linear-algebra-and-its-applications

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/111/107/111107108/

2. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ma07/

3. https://nptel.ac.in/courses/111/106/111106051/

4. https://nptel.ac.in/courses/111/104/111104092/

5. https://nptel.ac.in/courses/111/104/111104085/

SELF-LEARNING EXERCISES:

Vector spaces, Curvilinear co-ordinates: Cylindrical and spherical co-ordinates

LIST OF EXPERIMENTS

EXP. NO.	LIST OF EXPERIMENT
1.	Finding gradient, divergent, curl and their geometrical interpretation
2.	2D plots for Cartesian and polar curve
3.	Finding Curvature and Radius of Curvature of a Given Curve
4.	Find Higher order derivative of the given function.
5.	Evaluate the given limit of function (L-Hospital's rule).
6.	Find Rank of the given matrix
7.	Numerical solution of system of linear equations, test for consistency and graphical method.
8.	Solution of system of linear equations using Gauss-Elimination method
9.	Solution of diagonally dominant system of linear equations using Gauss-Siedel iteration
10.	Compute Eigen value and Eigen vectors and find the largest and smallest eigen value by Rayleigh power method.

<table>
<tr><td>Course Title</td><td colspan="3">Physics for Computer Science</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B23AS0106</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIA</td><td rowspan="2">SEE</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td></td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW

This course introduces the basic concepts of Physics and its applications to Computer Science Engineering courses by emphasizing the concepts underlying four units: Wave Mechanics, Lasers and optical fibers, EM wave and spectrum, Display Technology and Quantum computation. The subject has basic laws, expressions and theories which help to increase the scientific knowledge to analyze upcoming technologies.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Impart the knowledge about wave mechanics, electromagnetic waves, and its applications.
2. Demonstrate the different applications of lasers, and optical fibers.
3. Discuss different types of display technologies, touch screen techniques and its applications.
4. Explain the importance of quantum computation as an emerging technology.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply knowledge of wave mechanics, its importance, and applications.	1,2,3	1
CO2	Understand the wave function and applications of Schrödinger wave equation for energy Eigen values of a free particle.	1,2,3	1
CO3	Understand the light-matter interaction and requirement for lasing action.	1,2,3	1
CO4	Classify EM waves based on the frequency range, optical fibers and derive expression for NA, number of Modes and attenuation.	1,2,3	1
CO5	Summarize capacitive and resistive display technologies.	1,2,3	1
CO6	Analyze the working and application of quantum computation	1,2,3	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2		√				
CO3		√				
CO4		√				
CO5	√					
CO6			√			

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3											1	
CO2	3	2	1											1	
CO3	3	2	1											1	
CO4	3	2	1											1	
CO5	3	2	2											1	
CO6	3	2	3											1	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

Contents
UNIT – 1 **Wave mechanics**: Introduction to Wave mechanics, De-Broglie hypothesis. Expression for de-Broglie wavelength of an electron in terms of accelerating potential. Phase velocity and group velocity, Relation between phase velocity and group velocity. **Quantum Physics:** Wave function, properties of wave function and physical significance. Probability density and Normalization of wave function, Schrodinger time- dependent and independent wave equation, Eigen values and Eigen functions. Applications of Schrödinger wave equation – energy Eigen values of a free particle, Particle in one dimensional infinite potential well with numerical examples. Quantum mechanics applications in computer science. (
UNIT – 2 **Lasers:** Lasers Interaction between radiation and matter (induced absorption, spontaneous and stimulated emission). Expression for energy density at thermal equilibrium in terms of Einstein's coefficients. Characteristics of laser light,

Conditions for laser operation (population inversion and Meta stable state). Requisites of laser system, semiconductor laser and its applications.

Electromagnetic Waves: Basic idea of displacement current, Electromagnetic waves, their characteristics, Electromagnetic spectrum (7 types of EM waves) including elementary facts. Applications of EM waves

UNIT – 3

Optical fibers: Construction and light propagation mechanism in optical fibers (total internal reflection and its importance), Acceptance angle, Numerical Aperture (NA), Expression for numerical aperture in terms of core and cladding refractive indices, Condition for wave propagation in optical fiber, V-number and Modes of propagation, Types of optical fibers, Attenuation and reasons for attenuation, Applications: Explanation of optical fiber communication using block diagram, Optical source (LED) and detector (Photodiode) and their applications. Advantages and limitations of optical communications.

UNIT – 4

Display technology: Touch screen technologies: Resistive and capacitive touch screen and Displays: CRT, Field emission display, Plasma display, LED display, OLED display, LCD display, 3D digital billboard, introduction to haptics.

Quantum Computation: nano films (two-dimensional), Quantum wires (one-dimensional), Quantum dots (zero-dimensional). Classical bits, the idea of "Qubit", geometric visualization of the qubit via Bloch sphere, Quantum logic gates, Qubit as a two-level system.

TEXT BOOKS:

1. William T. Silfvast, "Laser Fundamentals", Cambridge University press, New York, 2004
2. 2.D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", 10th edition, John Wiley and Sons, New York, 2013
3. R. K. Gaur and S.L. Gupta, "Engineering Physics", DhanpatRai Publications (P) Ltd, New Delhi. 2014.
4. M.N. Avadhanulu and P.G. Kshirsagar, "A textbook of Engineering Physics", S. Chand and Company, New Delhi, 2014.
5. P. Lorrain and O. Corson, "EM Waves and Fields",3rd edition, CBS Publishers.

REFERENCE BOOKS:

1. Charls Kittel, "Introduction to Solid State Physics", 8th Edition Wiley, Delhi, ,2004
2. Arthur Beiser, "Concepts of modern Physics", 8th edition, Tata McGraw Hill publications, New Delhi, 2011
3. S. O. Pillai, "Solid State Physics", New Age International publishers, New Delhi, 2010
4. Janglin Chen, Wayne Cranton, Mark Fihn, "Handbook of Visual Display Technology", 2nd edition Springer Publication, 2012.

JOURNALS/MAGAZINE:

1. https://www.codemag.com/Magazine/ByCategory/Python
2. http://ijaerd.com/papers/special_papers/IT032.pdf
3. https://iopscience.iop.org/article/10.1088/176596/423/1/012027https://ieeexplore.ieee.org/document/4160250
4. Python for scientific computing

SWAYAM/NPTEL/MOOCs:

1. https://www.mooc.org/
2. https://www.coursera.org/

Self-Learning Exercises:

Introduction to optics, nano devices, quantum tunneling, semiconductor energy gap. characteristics of materials used in manufacture of laptops/desktops (display, internal circuit connection), laser printer working.

Course Title	Introduction to Accounting				Course Type		FC	
Course Code	B22EN0102	Credits	1		Class		I semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	1	1	1				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practice	-	-	-				
	Total	**1**	**1**	**1**	**14**	**-**	**50%**	**50%**

COURSE OVERVIEW

The course introduces the basic framework of accounting to all students to understand accounting concepts and constraints, and help them in preparation of financial records, statements and analysis of the major financial statements.

COURSE OBJECTIVES:

This course enables graduating students to

1. Educate students about the accounting principles and practices.
2. Orient about accounting recording and identification of income, expenses, Assets and Liabilities.
3. Get detailed knowledge of the practice of accounting in different forms of business
4. Gain the ability of using accounting information as a tool in applying solutions for managerial problems, evaluating the financial performance, and interpreting the financial structure.
5. Make students to Apply quantitative skills to analyse and solve business problems and to take advantage of business opportunities.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Acquire conceptual knowledge of basics of accounting and Identify events that need to be recorded in the accounting records	1,2,4,11	1
CO2	Identify and analyse the reasons for the difference between cash book and pass book balances	1,2,4,11	1
CO3	Equip with the knowledge of accounting process and preparation of final accounts	1,2,4,11	1
C04	Develop the ability to use accounting information to solve a variety of business problems	1,2,4,11	1
C05	Describe, explain, and integrate fundamental concepts underlying accounting and finance management	1,2,4,11	1
C06	Explain the need for the bank reconciliation statement and cash balance.	1,2,4,11	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓	✓	✓			
CO2	✓	✓	✓			
CO3	✓	✓	✓			

C04	✓	✓	✓			
C05	✓	✓	✓			
C06	✓	✓	✓			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1		1							1		1		
CO2	1	1		1							1		1		
CO3	1	1		1							1		1		
C04	1	1		1							1		1		
C05	1	1		1							1		1		
C06	1	1		1							1		1		

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY

Contents
UNIT – 1 **INTRODUCTION TO ACCOUNTING & ACCOUNTING PROCESS** Introduction – Meaning and Definition-Objectives of Accounting – Functions of Accounting – Users of Accounting information-Limitations of Accounting – Accounting Principles –Accounting Concepts and Conventions. Meaning – Process of Accounting – Kinds of Accounts – Rules – Transaction Analysis – Journal – Ledger – Balancing of Accounts – Trail Balance Problems, Accounting Concepts: Entity, Money Measurement, Going Concern, Accounting Period, Cost Concept, Dual Aspect, Accounting Mechanism – Single Entry and Double Entry. (Only Theory)
UNIT – 2 **RECORDING OF BUSINESS TRANSACTIONS** - Voucher and Transactions: Origin of Transactions – Source documents and Vouchers, Preparation of vouchers; Accounting equation approach – Meaning and Analysis of transactions using accounting equation; Rules of debit and credit- Capital & Revenue Transactions. The Accounting Process Recording of Transactions: Books of original entry – Journal (Simple problems), types of subsidiary books (i) Cash book – Simple, Cashbook with bank column and Petty cashbook, (ii) Purchases book, Sales book, Purchases returns book, Sale returns book; Ledger: Meaning, Utility, Format; Posting from journal and subsidiary books; Trial Balance- P& L Account and Balance sheet -Bank Reconciliation Statement: Meaning, Need and Preparation, Correct cash balance. (Simple problems)

Reference Books:

1. Tulsian, P.C. "Financial Accounting", 20th Edition, Pearson Education, 2016
2. S.N. Maheshwari, and. S. K. Maheshwari. "Financial Accounting". 5th Edition, Vikas Publishing House, New Delhi, 2012.
3. Dr. Jawaharlal, " Accounting theory and practices", 4th Edition, HPH, 2022.
4. Bhushan Kumar Goyal and HN Tiwari," Financial Accounting", International Book House, 2021

Course Title	Introduction to Data Science				Course Type		HC	
Course Code	**B23CS0104**	**Credits**	**2**		**Class**		**I Semester**	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	2	2	2				
	Tutorial	-	-	-				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Total	**2**	**2**	**2**	**28**	**-**	**50%**	**50%**

COURSE OVERVIEW:

Data Science is an interdisciplinary, problem-solving oriented subject that is used to apply scientific techniques to practical problems. The course orients on preparation of datasets and programming of data analysis tasks. This course covers the topics: Set Theory, Probability theory, Tools for data science, ML algorithms and demonstration of experiments either by using MS-Excel/Python/R.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamental concepts of Excel.
2. Illustrate the use of basic concepts of Data Science in the real-world applications.
3. Demonstrate the use of SQL commands in real world applications.
4. Discuss the functional components of Data Science for real world applications.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the basic concepts of Data Science in developing the real-world applications.	1 to 4, 12	1,2,3
CO2	Apply the SQL commands in developing the real-world applications.	1 to 5,12	1,2,3
CO3	Build the data analytics solutions for real world problems, perform analysis, interpretation and reporting of data.	1 to 5	1, 2, 3
CO4	Demonstrate visualization of Data using python libraries	1 to 5, 8 to 10	1,2, 3
CO5	Find modeling Error in Linear Regression.	1 to 5	1, 2, 3
CO6	Use statistical principles to solve mean and standard deviations for given data.	1 to 4, 12	1,2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember(L1)	**Understand(L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1			✓			
CO2			✓			
CO3			✓	✓		
CO4			✓	✓	✓	✓
CO5		✓				
CO6			✓			

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2								2	3	1	1
CO2	2	3	2	1	2	2						2	3	2	2
CO3	2	3	3	2	2								3	3	3
CO4	3	3	3	2	2			2	2	2			3	3	3
CO5	2	3	2	2	2								3	3	3
CO6	3	3	2	2								2	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT
THEORY

Contents

UNIT – 1

Introduction to Microsoft Excel:

History and importance of Microsoft Excel, Creating Excel tables, understand how to Add, Subtract, Multiply, Divide in Excel. Excel Data Validation, Sorting, Filtering, Grouping, Ungrouping and Subtotal. Introduction to formulas and functions in Excel. Logical functions (operators) and conditions. Visualizing data using charts in Excel. Import XML Data into Excel, How to Import CSV Data (Text) into Excel, How to Import MS Access Data into Excel, Working with Multiple Worksheets.

UNIT – 2

Introduction to Data Science:

What is Data Science? Applications of Data Science, Data science life cycle, Tools for data science, definition of AI, types of machine learning (ML), list of ML algorithms for classification, clustering, and feature selection. Probability theory, bayes theorem, bayes probability; Cartesian plane, equations of lines, graphs; exponents.

Introduction to SQL: SQL Commands experimental demonstrations-DDL, DML, DCL, TCL, DQL. Import SQL Database Data into Excel.

UNIT – 3

Data Relationship Methods:

Introduction to Correlation, Description of linear regression and Logistic Regression, Introducing the Gaussian, Introduction to Standardization, Standard Normal Probability Distribution in Excel, Calculating Probabilities from Z-scores, Central Limit Theorem, Algebra with Gaussians, Markowitz Portfolio Optimization, Standardizing x and y Coordinates for Linear Regression, Standardization Simplifies Linear Regression, Modeling Error in Linear Regression, Information Gain from Linear Regression.

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UNIT – 4

Data visualization using scatter plots, charts, graphs, histograms, and maps: Statistical Analysis: Descriptive statistics-Mean, Standard Deviation for Continuous Data, Frequency, Percentage for Categorical Data.

Introduction to Python: Python basics, Strings, Lists, Tuples, Sets, Dictionaries. Introduction to python libraries - Numpy, Matplotlib, Pandas, Scikit-Learn, Implementation of ML.

TEXT BOOKS:

1. B.S. Grewal, “Higher Engineering Mathematics”,43rdEdition, Khanna Publishers, 2015.
2. Ramakrishnan and Gehrke, “Database Management systems”, 3rdEdition, McGraw Hill Publications, 2003.
3. “Mastering Data Analysis in Excel” - https://www.coursera.org/learn/analytics-excel.
4. Kenneth N. Berk, Carey, “Data Analysis with Microsoft Excel”, S. Chand & Company,2004.

5. Joel Grus,"Data science from scratch - First principles with Python" , OâReily, 2015.

REFERENCE BOOKS:

1. B.V. Ramana, "Higher Engineering Mathematics", 19th edition, Tata McGraw Hill Publications, 2013.
2. ErwinKreyszig, "Advanced Engineering Mathematics", 9th edition, Wiley Publications, 2013.
3. Seymour Lipschutz, John J. Schiller, "Schaum's Outline of Introduction to Probability and Statistics", McGraw Hill Professional, 1998.

JOURNALS/MAGAZINES:

1. https://www.journals.elsevier.com/computational-statistics-and-data-analysis
2. https://www.springer.com/journal/41060International Journal on Data Science and Analytics
3. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8254253IEEE Magazine on Big data and Analytics

SWAYAMNPTEL/MOOCs

1. Excel Skills for Business: Essentials, Macquarie University (https://www.coursera.org/learn/excel-essentials)
2. SQL for Data Science, University of California, Davis(https://www.coursera.org/learn/sql-for-data-science)
3. Data Science Math Skills, Duke Universityhttps://www.edx.org/course/subject/data-science
4. https://onlinecourses.nptel.ac.in/noc19_cs60/preview

SELF-LEARNINGEXERCISES:

1. Relational database management system.
2. Advanced MS-Excel

Course Title	Basics of Electrical & Electronics Engineering				Course Type		HC	
Course Code	B22EE0101	Credits	3		Class		I Semester	
	LTP	Credits	Contact	Work	Total Number of Classes		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	**Practical**	CIE	SEE
	Practice	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW

Basic Electrical & Electronics Engineering covers basic concepts of electrical engineering and electromagnetism. This course introduces the student to the working AC and DC Machines. It also helps the student to understand the basics in digital electronics by applying the knowledge of logic gates and learning the applications of diodes in rectifiers, filter circuits. Further, it has a self-learning component on BJT's.

COURSE OBJECTIVES

The objectives of this course are to:

1) Explain and to make the students familiar about the basics of Electrical Circuits.
2) Illustrate the basics of magnetic circuits and construction, working principle of DC machines, Transformers.
3) Illustrate the characteristics of Diodes and their applications.
4) Discuss the characteristics and applications of BJT's.
5) To familiarize the students about Number systems.
6) To validate the logical expressions using Boolean algebra.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO-1	Summarize the basics of electrical engineering terminology and the usage.	1-2	1
CO-2	Apply KCL and KVL to Solve Electrical Circuits		
CO-3	Demonstrate the working principle of DC Machines and Transformers and provide applications of DC Machines, Transformers.	1-2,4	1
CO-4	Analyze the characteristics of PN junction diode, Zener diode and their application	1-2,4	1
CO-5	Analyze the working principle and characteristics in three configurations of BJT	1-2	1
CO-6	Apply the concept of Number system and Arithmetic operations in digital system	1-2	1

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1											1		
CO-2	3	3		2									1		
CO-3	3	2		2									1		
CO-4	3	3											1		
CO-5	3	2											3		
CO-6	3	2	3										3		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
UNIT – 1
Introduction to Electrical Engineering: Basics of DC Circuits: Ohms law, Kirchhoff's Current Law, Kirchhoff's Voltage law, Numerical examples as applicable. Basics of AC Circuits: Sinusoidal voltage and currents, Magnitude and phase, polar and rectangular

representation, RL, RC and RLC series and parallel circuits, power factor, phasor diagrams, three phase AC –types of three phase connection (star and delta), Comparison between single phase and three phase AC, Numerical examples as applicable.

UNIT – 2

Magnetic Circuits and Electrical Machines: Magnetic Circuits: Definition of magnetic circuit and basic analogy between electric and magnetic circuits, Faradays laws, permittivity, permeability, EMF, MMF equations, Reluctance. Electrical machines: DC Generator, DC Motors, Transformers - Principle of operation, Construction and EMF equations, types and applications. Induction motor: Concept of RMF, Working principle, types and applications Numerical examples as applicable

Unit-3

Semiconductor Diodes and Transistors: Semiconductor Diodes :P-N junction diode, V-I Characteristics, Half-wave rectifier, Full-wave rectifier, Bridge rectifier, Capacitor filter circuit, Zener diode voltage regulators, Clipping and clamping circuit, Numerical examples as applicable.

Transistors: Bipolar junction Transistors BJT configuration: BJT Operation, Common Base, Common Emitter and Common Collector, Characteristics, Numerical examples as applicable.

Unit-4

Digital Electronics and Number System: Introduction, Switching and Logic Levels, Digital Waveform. Number Systems and its conversions: Decimal Number System, Binary Number System, Octal Number System, Hexadecimal Number System. Binary addition, Binary subtraction. Boolean Algebra Theorems, De Morgan's theorem. Digital Circuits: Logic gates, Algebraic Simplification, Realization of all logic and Boolean expressions.

TEXT BOOKS

1. Nagrath I.J. and D. P. Kothari, "Basic Electrical and Electronics Engineering", Second Edition Tata McGraw Hill, 2020.
2. Hayt and Kimberly, "Engineering Circuit Analysis", 8th Edition, Tata McGraw Hill, 2013.
3. Kulshreshtha D.C., "Basic Electrical Engineering", Second Edition, Tata McGraw Hill, 2019.
4. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, 2008.
5. D.P. Kothari, I. J. Nagrath, "Basic Electronics", Second Edition, McGraw Hill Education (India) Private Limited, 2017.

REFERENCE BOOKS

1. Hughes, "Electrical Technology", International Students 9th Edition, Pearson, 2005.
2. Robert L. Boylestad and Louis Nashelsky, "Introduction to Electricity, Electronics and Electromagnetics" Prentice Hall, 5th edition, 2001

SWAYAM/NPTEL/MOOCS

1. https://nptel.ac.in/courses/108108076
2. **https://nptel.ac.in/courses/108101091**
3. **https://www.udemy.com/course/basic-electrical-engineering-part-1**

Course Title	**Elements of Civil Engineering and Mechanics**				**Course Type**		**HC**	
Course Code	**B22ED0101**	**Credits**	**3**		**Class**		**I Semester**	
	LTP	Credits	Contact	Work	Total Number of Classes		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	**Practical**	CIE	SEE
	Practice	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course introduces the students to basic concepts of Engineering Mechanics, which are essential for all Engineers. The course familiarizes students shall be learning about mechanical interaction between bodies. That is, we will learn how different bodies apply forces on one another and how they then balance to keep each other in equilibrium, and forces and types of forces, centroid and moment of inertia Students will learn about basic concept of forces, force systems, beams, trusses, properties of geometric shapes.

COURSE OBJECTIVE (S):

The objectives of this course are to

1. Understand a broad concept of Engineering Mechanics.
2. Enable students to apply fundamentals and basic concepts of rigid body mechanics to solve problems of bodies in rest.
3. Enable the students to apply conditions of static equilibrium to analyze physical system of coplanar forces.
4. Analyze the civil engineering structures namely determinate beams and trusses.
5. Provide an overview of centroid and moment of inertia of plane area
6. Understand the concept of dynamics and fluid mechanics in civil engineering.

COURSE OUTCOMES (COs)

After completion of this course, the students will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand basics of mechanics related to Particle, Continuum and Rigid body; Forces, Couple & moment of couple.	1,2	2
CO2	Compute the resultant of system of forces in plane and space acting on bodies.	1,2,5	2,4
CO3	Analyze civil engineering structures using static equilibrium conditions.	1,2,3,4,5	2,4
CO4	Compute the reactions developed at the supports of beams and member forces of trusses.	1,2,3,4,5	2,4
CO5	Determine the centroid and moment of inertia of different geometrical shapes.	1,2,3,4,5	2,4
CO6	Solve the engineering problems using dynamic equilibrium condition.	1,2,3,4,5	2,4

BLOOM'S LEVEL OF THE COURSE OUTCOME

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓	✓				
CO2	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	
CO6	✓	✓	✓	✓	✓	

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3												1		
CO2	3	3			1									3		1
CO3	3	3	1	1	3									3		3
CO4	3	3	2	1	3									3		3
CO5	3	3	2	1	3									3		2
C06	3	3	1	1	3									3		3

Note: 1-Low, 2-Medium, 3-High

Contents

Unit-1

Introduction to Civil Engineering: Scope of Civil Engineering. Effect of the infrastructural facilities on socio-economic development of a country.

Introduction to Engineering Mechanics:

Basic idealizations; Force and its characteristics, Force System and its classification, Principle of superposition of forces, Principle of transmissibility of forces, Moment of a force, couple, moment of a couple, characteristics of couple, Equivalent force - couple system (theory only). Analysis of Force Systems: Resolution of forces, Composition of forces - Definition of Resultant, Composition of coplanar -concurrent force system, Parallelogram Law of forces.

Unit-2

Analysis of Force system: Composition of coplanar - non- concurrent force system, Varignon's principle of moments; Numerical problems on composition of coplanar concurrent and non-concurrent force systems.

Equilibrium of Coplanar Forces: Definition of static equilibrium, Conditions of static equilibrium for different coplanar force systems, Concept of Free Body Diagram and Lami's theorem with problems.

Unit-3

Centroid: Introduction to the concept, Centroid of plane figures, Locating the centroid of rectangle, triangle and semicircle using method of integration, Centroid of composite sections; Numerical problems.

Moment of Inertia: Introduction to the concept, polar moment of inertia, Radius of gyration, Perpendicular axis theorem and Parallel axis theorem, Moment of Inertia of rectangle, circle, semi-circle and triangle from method of integration, Moment of inertia of composite areas: Numerical problems.

Unit-4

Analysis of structures: Types of beams, loads, support and problems on beams. Plane trusses: Method of joints with numerical.

Introduction to Dynamics: Introduction to Kinematics and Kinetics, Rectilinear motion: uniform motion, uniformly accelerated motion, motion under gravity, Concept of Dynamic Equilibrium with problems.

Introduction to Fluid Mechanics:

Introduction, method of describing fluid motion, definitions of types of fluid flow, stream line, path line and stream tube.

Text Books:

1. T R Jagadeesh, “Elements of Civil Engineering”, Sapna book house
2. BK Kolhapure, “Elements of Civil Engineering”, Eastern Book Promoters
3. M.N. Shesha Prakash and Ganesh.B. Mogaveer, “Elements of Civil Engineering and Engineering Mechanics”, PHI Learning, 3rd Revised edition.
4. Engineering Mechanics by RS Khurmi, S Chand and Company.
5. Fluid Mechanics by P.N. Modi and R.K. Bansal.

Reference Books:

1. A. Nelson, “Engineering Mechanics-Statics and Dynamics”, Tata Mc-Graw Hill Education Private Ltd, New Delhi, 2009
2. S. S. Bhavikatti, “Elements of Civil Engineering”, New Age International Publisher, New Delhi, 3rd edition 2009.
3. Hydraulics and Fluid Mechanics Including Hydraulics Machines by Dr. P.N. MODI & S.M. SETH (Author).

Course Title	Computer Aided Engineering Drawing				Course Type		HC	
Course Code	B22ME0101	Credits	3		Class		I Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	2	2	2				
	Tutorial	-	-	-	Theory	Practical	IA	SEE
	Practice	1	2	2				
	Total	3	4	4	28	28	50 %	50 %

COURSE OVERVIEW

Engineering Graphics or Drawing is known as language of engineers. All phases of engineering process require the conversion of new ideas and design concepts into the basic line language of graphics. There are many areas such as civil, mechanical, electrical, architectural, computer, electronics and industrial applications where knowledge and skills of the drawing play major roles in the design and development of new products or construction. This course emphasizes on orthographic projection of point, line, plane surfaces and solids. It also provides knowledge about representing the object in terms of 3D view and also development of the objects.

COURSE OBJECTIVES

The objectives of this course are to

1. Introduce the concepts like dimensioning, conventions and standards of engineering drawings in order to become professionally efficient.
2. Enable students to learn about the software tool for preparing engineering drawings
3. Teach the concepts and principles of orthographic projections, development of lateral surfaces and isometric projection of simple solids.
4. Communicate the concepts/ideas through the language of technical drawing and sketching.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Draw orthographic projection of point, line manually and also by using CAD software.	1,2,5,10	1
CO2	Draw orthographic projection of plane surfaces manually and also by using CAD software.	1,2,5, 10	1
CO3	Draw orthographic projection of simple solids manually and also by using CAD software.	1,2,5, 10	1
CO4	Draw sectional views of prisms, pyramids, cone and cylinder manually and also by using CAD software.	1,2,5, 10	1
CO5	Draw the development of lateral surfaces of the solids manually and also by using CAD software.	1,2, 3,5,10	1
CO6	Create isometric view of the solids manually and also by using CAD software.	1,2,3,5,10	1

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1			2					3			3		
CO2	3	2			2					3			3		
CO3	3	2			2					3			3		
CO4	3	2			2					3			3		
CO5	3	2	2		2					3			3		
CO6	3	1	2		2					3			3		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
Unit-1 **Introduction** – Geometrical constructions, engineering drawing standards, Introduction to CAD Software. Points, Line and Plane Surface: Orthographic projection of points in first and third Quadrant only. Orthographic projection of straight lines inclined to both horizontal and vertical planes. Orthographic projection of regular plane surfaces when the surface is inclined to both HP and VP.
Unit-2 **Solids:** Orthographic projection of regular solids like prisms, pyramids cone and cylinder when the axis is inclined to both HP and VP.
Unit-3 **Sections of solids:** Drawing sectional views and true shape of section, Development of Lateral Surfaces of Solids: Parallel line method for prisms and cylinders, Radial line method for pyramids and cones
Unit-4 **Isometric Projections:** Isometric projections of simple and combined solids.

PRACTICE:

Sl. No	Practice	Tools and Techniques	Expected Skill /Ability
1.	Use of solid edge software and familiarization of tools	Solid Edge Software	Use of commands to draw the drawings
2.	Draw the projection of point locating in first and third quadrant	Solid Edge Software	Analysing and software skill
3.	Draw the projection of lines locating in first quadrant	Solid Edge Software	Draw the views of the line and software skill
4.	Draw the projection of rectangular and pentagonal lamina inclined to both HP and VP	Solid Edge Software	analysing and software skill
5.	Draw the projection of hexagonal and circular lamina inclined to both HP and VP	Solid Edge Software	analysing and software skill

Sl. No	Practice	Tools and Techniques	Expected Skill /Ability
6.	Draw the projection of prisms inclined to both HP and VP	Solid Edge Software	Interpretation and software skill
7.	Draw the projection of pyramids inclined to both HP and VP	Solid Edge Software	Interpretation and software skill
8.	Draw the projection of cone and cylinder inclined to both HP and VP	Solid Edge Software	Interpretation and software skill
9	Draw the projection of section of solids in simple position	Solid Edge Software	Analysing and Software Skill
10	Develop the lateral surface of prisms and cylinder	Solid Edge Software	Creative and Software Skill
11	Develop the lateral surface of pyramids and cone	Solid Edge Software	Creative and Software Skill
12	Draw the isometric projection of simple plane surface and simple solids	Solid Edge Software	Analysing and software skill
13	Draw the isometric projection of two co-axial solids	Solid Edge Software	Analysing and software skill

TEXT BOOKS

1. K S Narayanswamy and Mahesh L, "Engineering Drawing", WILEY Publishers, 1st Edition, 2017.

2. K. R. Gopalakrishna and Dr. M S Reddy, "Engineering Graphics-1", Subhas Publications, 2015.
3. Bhatt N.D., Panchal V.M and Ingle P.R, "Engineering Drawing", Charotar Publishing House Pvt. Ltd, 53rd Edition, 2019.
REFERENCE BOOKS

1. Luzadder and Duff, "Fundamental of Engineering Drawing", Printice Hall of India Pvt. Ltd. 11th Edition, 2001.
2. Shah, M.B. and Rana B.C., "Engineering Drawing and Computer Graphics", Pearson Education, 2008.
SWAYAM/NPTEL/MOOCS

1. https://nptel.ac.in/courses/112/103/112103019/
2. https://www.udemy.com/course/ed/

<table>
<tr><td>Course Title</td><td colspan="4">Physics for Computer science Lab</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B22AS0109</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Workload</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>Total</td><td>1</td><td>2</td><td>2</td><td>0</td><td>28</td><td>50%</td><td>50%</td></tr>
</table>

COURSE DESCRIPTION:

Engineering Physics is very important and necessary basic subject for all branches of engineering students. It provides the fundamental knowledge of basic principles of Physics which is required for basic foundation in engineering education irrespective of branch. This course introduces the experimental concepts of Physics and its applications to Computer Science Engineering courses by emphasizing the following concepts: electrical properties, semiconductor physics, dielectrics, and optical properties. This course provides This course provides basic understanding about the working of different electronic components. This course also teaches students to simulate the working of some electronic components.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Demonstrate the principles covered in your study material in physics.
2. Provide familiarity with apparatus and enable them to handle the instruments and apparatus with purpose.
3. Identify the process to study conditions for a given experiments.
4. Develop an attitude of perfection in practical tasks.
5. Simulate the working of different electronic components using mobile or a computer.

COURSEOUTCOMES (COs)

After the completion of the course the student will be able to:

CO#	CourseOutcomes	POs	PSOs
CO1	Constructing simple circuits and perform experiments to study voltage-current response.	1, 2,3 4	1,2,3
CO2	Determine the band gap of a semiconducting material.	1,2, 3,5	2, 3
CO3	Determine the dielectric constant of the material.	2,3, 4, 8,	1, 2, 3
C04	Analyze the response of the circuit by combining the electrical/electronic components.	2,3, 4,8,	1, 2, 3
CO5	Determineparticle size of the powder and wavelength of the LASER.	1 to 5	1, 2, 3
CO6	Simulate the working of electronic circuits	1 to 5, 8 to 10	1,2, 3

BLOOM'SLEVELOFTHECOURSEOUTCOMES

CO#	Bloom'sLevel					
	Remember (L1)	**Understand (L2)**	**Apply(L3)**	**Analyze(L4)**	**Evaluate(L5)**	**Create(L6)**
CO1						✓
CO2			✓	✓		
CO3			✓	✓		
C04			✓	✓	✓	✓
CO5				✓	✓	
CO6			✓	✓	✓	✓

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2						3	3			1		
CO2	3	3	2						3	3			2		
CO3	3	2							3	3			1		
CO4	3	2		2					3	3			1		
CO5	3	2							3	3			2		
CO6	3	2				2			3	3			1		

List of Experiments

No	Title oftheExperiment	Tools and Technics	Expected Skill/Ability
1	Determine the value of Planck's constant using LEDs.	LED's, voltmeter and power-supply, Planck's constant apparatus set up, patch cards	Circuit construction and mathematical calculations
2	Study the i-v characteristics of a Zener diode.	Zener diode, DC supply, Ammeters and voltmeters	Circuit construction and mathematical calculation, graph plotting
3	Study the i-v characteristics of a "npn" Transistor in common emitter configuration.	Transistor, DC supply, Ammeters and voltmeters.	Circuit construction, Perform, and plotting of data.
4	Study the i-v characteristics of a Photo Diode.	Photo diode, LED light source, DC supply, Ammeters and voltmeters	Circuit construction, Perform, and plotting of data
5.	Determine the electrical resistivity by 4-probe method	4 probe set up, ammeter, voltmeter, heater,	Circuit construction, Perform, and plotting of data
6	Determine the resonance frequency and quality factor of the given LCR connected in a) Series & b) Parallel.	Signal generator, inductor, capacitor, resistor and ameter	Circuit construction, Perform, and plotting of data
7	Determine numerical aperture of the given optical fiber.	Diode laser, digital dc micrometer two OFC (1.5m &2.5m), optical sensor	Circuit construction, Perform, and plotting of data
8	Calculate the particle size by forming diffraction haloes using LASER.	Lycopodium Powders, glass plate, diode laser, screen	Circuit construction, Perform, and plotting of data
9	Determine the dielectric constant by the method of charging and discharging of a capacitor	Capacitor, timer, voltmeter	Circuit construction, Perform, and plotting of data
10	Determine of wavelength of the light emitted by the given LASER using a grating.	Diode laser, grating, screen	Circuit construction, Perform, and plotting of data

Part B: Demo and Simulation.

No	Title of the Experiment	Tools and Technics	Expected Skill/Ability
1	Calculate the band gap of the material of the given semiconductor component.	Beaker with hot water, thermometer, component and multimeter	Circuit construction, Perform, and plotting of data
2	Verify Stefan's law of black body radiation.	Incandescent bulb, ammeter and voltmeter	Circuit construction, Perform, and plotting of data
3	Simulate the characteristics of simple electronic components (Resistor, Diode, Zener Diode, Transistor, Tunnel diode, LCR and JFET)	Everycircuit (android app) Tina (Online simulator)	Visualize, simulate and analyse

Text Books

1. M.N. Avadhanulu and P.G. Kshirsagar, "A Text book of Engineering Physics", S. Chand & Company Ltd, New Delhi, 10th revised Ed

2. Gaur and Gupta, "Engineering Physics", Dhanpat Rai Publications 2017

REFERENCE BOOKS:

1. Arthur Beiser, "Concepts of Modern Physics", Tata McGraw Hill Edu Pvt Ltd- New Delhi, 6 th Ed 2006

2. S O Pillai, "Solid State Physics", New Age International Publishers, 8th Ed

3. S M Sze, Physics of Semiconductor devices, Wiley, 2004

<table>
<tr><td>Course Title</td><td colspan="4">Data Science Lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B23CS0108</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Workload</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>Total</td><td>1</td><td>2</td><td>2</td><td>0</td><td>28</td><td>50</td><td>50</td></tr>
</table>

COURSE DESCRIPTION:

Data Science is an interdisciplinary, problem-solving oriented subject that is used to apply scientific techniques to practical problems. The course orients on preparation of datasets and programming of data analysis tasks. This course covers the topics: ML algorithms, SQL and demonstration of experiments by using MS-Excel and MySQL and Python .

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamental concepts of Excel.
2. Explain the algorithms of Machine learning.
3. Demonstrate the use of SQL commands in real world applications.
4. Discuss the functional components of Data Science for real world applications.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the concepts of Microsoft Excel in developing the real-world applications.	1 to 5, 8 to 10	1,2,3
CO2	Apply the SQL Queries in developing the real-world applications.	1 to 5, 8 to 10	2, 3
CO3	Build the solutions for real world problems, perform analysis, interpretation and reporting of data using regression algorithms.	1 to 5, 8 to 10	1, 2, 3
C04	Design ER diagrams for database.	1 to 5, 8 to 10	1, 2, 3
CO5	Use Excel to solve Multiple Linear Regression.	1 to 5, 8 to 10	1, 2, 3
CO6	Demonstrate visualization of Data using python libraries	1 to 5, 8 to 10	1,2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply(L3)**	**Analyze(L4)**	**Evaluate(L5)**	**Create(L6)**
CO1			✓			
CO2			✓			
CO3			✓	✓		
C04			✓	✓	✓	✓
CO5		✓				
CO6			✓			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2			1	3	3			3	3	3
CO2	2	2	2	2	2			1	3	3			3	3	3
CO3	3	3	2	2	2			1	3	3			3	3	3
CO4	3	3	3	2	2			1	3	3			3	3	3
CO5	3	3	3	2	2			1	3	3			3	3	3
CO6	3	3	3	2	2			1	3	3			3	3	3

Practice:

No	**Title of the Experiment**	**Tools and Technics**	**Expected Skill/Ability**
1	The height (in cm) of a group of fathers and sons are given below, Findthe lines of regression and estimate the height of son when the height of father is 164 cm. **Hgt of Father**: 158, 166, 163, 165, 167, 170, 167, 172, 177, 181 **Hgt of Son**: 163, 158, 167, 170, 160, 180, 170, 175, 172, 175	MS Excel	Create and perform operations on Excel data set by applying Linear regression
2	Using the data file DISPOSABLE INCOME AND VEHICLE SALES,perform the following: **i)** Plot a scatter diagram. **ii)** Determine the regression equation. **iii)** Plot the regression line (hint: use MS Excel's Add Trend line feature. **iv)** Compute the predicted vehicle sales for disposable income of $16,500 and of $17,900. **v)** Compute the coefficient of determination and the coefficient of correlation	MS Excel	Perform prediction and visualiza-tion of data

<table>
<tr><td>3</td><td>Managers model costs in order to make predictions. The cost data in the data file INDIRECT COSTS AND MACHINE HOURS show the indirect manufacturing costs of an ice-skate manufacturer. Indirect manufacturing costs include maintenance costs and setup costs. Indirect manufacturing costs depend on the number of hours the machines are used, called machine hours. Based on the data for January to December, perform the following operations.

i) Plot a scatter diagram.
ii) Determine the regression equation.
iii) Plot the regression line (hint: use MS Excel's Add Trend line feature).
iv) Compute the predicted indirect manufacturing costs for 300 machine hours and for 430 machine hours.
v) Compute the coefficient of determination and the coefficient of correlation.</td><td>MS Excel</td><td>Perform prediction and visualiza tion of data</td></tr>
<tr><td>4</td><td>Apply multiple linear regression to predict the stock index price which is a dependent variable of a fictitious economy based on two independent / input variables interest rate and unemployment rate.
<table>
<tr><th>Year</th><th>Month</th><th>Interest rate</th><th>Un employment rate</th><th>Stock index price</th></tr>
<tr><td>2022</td><td>10</td><td>2.75</td><td>5.3</td><td>1464</td></tr>
</table></td><td>MS Excel</td><td>Perform prediction and visualization of data</td></tr>
<tr><td>5.</td><td>Calculate the total interest paid on a car loan which has been availed from HDFC bank. For example, Rs.10,00,000 has been borrowed from a bank with annual interest rate of 5.2% and the customer needs to pay every month as shown in table below. Calculate the total interest rate paid for availed of Rs.10, 00,000during 3 years.
<table>
<tr><th>Sl.no</th><th>A</th><th>B</th></tr>
<tr><td>1</td><td>Principal</td><td>Rs.10,00,000</td></tr>
<tr><td>2</td><td>Annual interest rate</td><td>5.2%</td></tr>
<tr><td>3</td><td>Year of the loan</td><td>3</td></tr>
<tr><td>4</td><td>Starting payment number</td><td>1</td></tr>
<tr><td>5</td><td>Ending payment number</td><td>36</td></tr>
<tr><td>6</td><td>Total interest paid during period</td><td>?</td></tr>
</table></td><td>MS Excel</td><td>Create Excel data and perform EMI estimator</td></tr>
<tr><td>6</td><td>Create a supplier database of 10 records with SUPPLIER_ID as primary key, SUPPLIER_NAME, PRODUCTS, QUANTITY, ADDRESS, CITY, PHONE_NO and PINCODE, Where SUPPLIER_NAME, PRODUCTS, QUANTITY and PHONE_NO should not be NULL.</td><td>SQL</td><td>Creating Tables</td></tr>
<tr><td>7</td><td>Create the customer database of a big Market with CUSTOMER_ ID as primary key, CUSTOMER_NAME, PHONE_NO, EMAIL_ID, ADDRESS, CITY and PIN_ CODE. Store at least twenty customer's details where CUSTOMER_NAME and PHONE_NO are mandatory and display the customer data in alphabetical order.</td><td>SQL</td><td>Creating and retrieving Tables</td></tr>
<tr><td>8</td><td>Apply the linear regression, compare the average salaries of batsman depending on the run rate scored/ recorded in the matches. Assume your own database.</td><td>MS Excel</td><td>Apply Linear regression</td></tr>
<tr><td>9</td><td>Apply Multiple linear regression to predict the factory products which is A, B and C are independent variables and cost dependent variable.</td><td>MS Excel</td><td>Apply Linear regression</td></tr>
<tr><td>10</td><td>Logistic Regression-case study</td><td>MS Excel</td><td>Apply Logistic regression</td></tr>
<tr><td>11</td><td>Design the ER diagram and create schema of the REVA library Management system.</td><td>Entity Relationship</td><td>Entity Relationship</td></tr>
</table>

12	form Exploratory Data Analysis to predict customer churn in telecommunications company using Python libraries such as Pandas, and Matplotlib to aid in this process? (Use datasets from Kaggle/NCBI.)	Jupyter/Colab - Python	Apply Exploratory Data Analysis

PART_B:Projects

No	Title of the Experiment	Tools and Technics	Expected Skill/Ability
1	Big Mart sales forecasting	MS Excel	Apply Linearregression
2	Bangalore crime analysis	MS Excel	Apply Linearregression

TEXT BOOKS:

1. B.S. Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publishers, 2015.
2. Ramakrishnan and Gehrke, "Database Management systems", 3rd Edition, McGraw Hill Publications, 2003.
3. "Mastering Data Analysis in Excel" - https://www.coursera.org/learn/analytics-excel.
4. Kenneth N. Berk, Carey, "Data Analysis with Microsoft Excel", S. Chand & Company,2004.

REFERENCE BOOKS:

1. B.V. Ramana, "Higher Engineering Mathematics", 19th edition, Tata McGraw Hill Publications, 2013.
2. ErwinKreyszig, "Advanced Engineering Mathematics", 9th edition, Wiley Publications, 2013.
3. Seymour Lipschutz, John J. Schiller, "Schaum's Outline of Introduction to Probability and Statistics", McGraw Hill Professional, 1998.

JOURNALS/MAGAZINES:

1. https://www.journals.elsevier.com/computational-statistics-and-data-analysis
2. https://www.springer.com/journal/41060 International Journal on Data Science and Analytics
3. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8254253 IEEE Magazine on Big data and Analytics

Course Title	Basics of Electrical & Electronics Lab				Course Type		HC	
Course Code	B22EE0102	Credits	1		Class		I Semester	
Course Structure	LTP	Credits	Contact	Work	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practice	1	2	2				
	Total	**1**	**2**	**2**	**-**	**28**	**50%**	**50%**

COURSE OVERVIEW

Basic Electrical & Electronics Engineering lab covers the concept of various types of electrical apparatus, tools and conduction of experiments to Analyze, Design of KCL & KVL, two-way switch or staircase wiring, Determination of VI characteristics Zener Diode, Silicon Diode, Half Wave rectifier using Diode, study& analyses of Lead & lag component, verification of logic gates.

COURSE OBJECTIVES

The objectives of the course are to

1. Establish a broad concept of various types of electrical apparatus, tools and instrumentation.
2. Provide hands on experience with electrical apparatus and electrical safety norms.
3. Train students to read and understand schematics so as to make electrical connection for different appliances.
4. Train students in collecting and interpreting experimental data.
5. Enhance written skills of students.

COURSE OUTCOMES (CO'S)

On successful completion of this course; the student shall be able to:

CO#	Course Outcomes	PO's	PSO's
CO-1	Use appropriate electrical tools for electrical connections and repair of electrical equipment's.	1,2,4,5,9,10	1
CO-2	Recognize various symbols in a schematic and make connection as per the schematic	1,2,9,10	1
CO-3	List out various safety procedures	4,5,9,10	1
CO-4	Make use of various measuring instruments to collect experimental data	2,4,9,10	1
CO-5	Analyse the results obtained from experiments.	2,3,9,10	1
CO-6	Demonstrate the ability to critically evaluate the performance of electrical appliances.	1,2,9,10	1

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3		3	3				3	3			1		
CO-2	3	3							3	3			1		
CO-3				3	3				3	3			1		
CO-4		3		3					3	3			1		
CO-5		3	2						3	3					
CO-6	3	2							3	3					

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

List Experiment

Sl. No.	Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
1	To verify KCL and KVL	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
2	Study and Analysis of Lead & Lag networks by using R-C components.	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
3	Two-way switch/ staircase wiring. To study & verify the connection procedure for two-way switch or staircase wiring	Two-way switch or staircase wiring Kit	Connection, Working & application of Two-way switch
4	Study and analysis the Characteristics: light sensor and temperature sensor	Sensor kit	Characteristics of sensors
5	Study and analysis of V-I Characteristics of Zener PN Junction diodes (Both Forward and Reverse Characteristics).	VI characteristics of Zener Diode kit	VI characteristics of Zener Diode
6	Study and analysis of Transistor as switch	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
7	Design half wave, Full wave-center tap and Bridge rectifier with and without capacitive filter and measure efficiency and ripple factor.	Rectifier kit	Determine the efficiency, Voltage regulation, ripple factor of rectifiers
8	Design of Clippers and clampers with reference voltages	Measuring instruments (Ammeter, Multimeter, CRO) and design equations	Design and circuit debugging. Working in a team
9	Study and analysis of input output characteristic of CE configuration of BJT.	Characteristics of BJT in Common Emitter Configuration	Input & Output Characteristics of BJT
10	Verification of basic logic gates using discrete components	Trainer kit	Universal gates will be realized using basic gates

Demo:

1. To Study the importance of Earthing during accidental shorting of line wire and the body of equipment.
2. To study the Importance and mechanism of MCB.

TEXT BOOKS

1. Nagrath I.J. and D. P. Kothari, “Basic Electrical Engineering”, Third Edition Tata McGraw Hill, 2009.
2. Hayt and Kimberly, “Engineering Circuit Analysis”, 8th Edition, Tata McGraw Hill, 2013.
3. Kulshreshtha D.C., “Basic Electrical Engineering”, Tata McGraw Hill, 2009.
4. Rajendra Prasad, “Fundamentals of Electrical Engineering”, Prentice Hall, India, 2009.

REFERENCE BOOKS

1. Theodore Wildi, “Electrical Machines, Drives, and Power, 5thSystems”, Pearson Edition, 2007.
2. Hughes, “Electrical Technology”, International Students 9th Edition, Pearson, 2005.

SWAYAM/NPTEL/MOOCs

1. https://nptel.ac.in/courses/108108076
2. https://nptel.ac.in/courses/108101091
3. https://www.udemy.com/course/basic-electrical-engineering-part-1

Chemistry Cycle

	Course Code	Title of the Course	HC/FC/ SC/OE /MC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B23AS0203	Probability and Statistics	FC	3	0	0	3	3	50	50	100	BSC
2	B23AS0104	Engineering Chemistry	FC	3	0	0	3	3	50	50	100	BSC
3	B22AH0103	Communication Skills	FC	0	0	1	1	2	25	25	50	HSMC
4	B22CI0104	Programming with C	HC	3	0	0	3	3	50	50	100	ESC
5	B22ME0103	Elements of Mechanical Engineering	HC	3	0	0	3	3	50	50	100	ESC
6	B22EN0101	IoT and Applications	HC	1	0	1	2	3	50	50	100	ESC
7	B23ME0102	Innovation & Entrepreneurship	FC	1	0	1	2	3	50	50	100	HSMC
8	B22AS0105	Engineering Chemistry Lab	FC	0	0	1	1	2	25	25	50	BSC
9	B22CI0108	Programming with C Lab	HC	0	0	1	1	2	25	25	50	ESC
10	B22ME0104	Engineering Workshop	HC	0	0	1	1	2	25	25	50	ESC
11	B22CS0201	Skill Development Course-1	SDC	0	0	2	2	4	50	50	100	SDC
12	B22ME0105	Tree Plantation in Tropical Region: Benefits and Strategic Planning	FC	1	0	0	1	1	25	25	50	HSMC
TOTAL				**15**	**0**	**8**	**23**	**30**	**475**	**475**	**950**	
TOTAL SEMESTER CREDITS					**23**							
TOTAL CUMULATIVE CREDITS					**44**							
TOTAL CONTACT HOURS					**30**							
TOTAL MARKS					**950**							

<table>
<tr><td>Title</td><td colspan="4">Probability and Statistics</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B23AS0203</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">II semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The course Probability and Statistics for Computer Science treats the most common discrete and continuous distributions, showing how they find use in decision and estimation problems, and constructs computer algorithms for generating observations from the various distributions. Probability in the design and analysis of randomized algorithms. Common randomized algorithms are things like Quicksort and Quickselect. Probabilistic method can also useful to prove various important results. Probabilistic methods used to prove some partition theorems that were then used to create efficient data structure.

COURSE OBJECTIVE (S):

1. Describe Curve fitting and regression in various problems in Computer Science and engineering fields.
2. Illustrate the applications of Probability and statistics in various computer science and engineering Fields like data mining, classification problems etc
3. Discuss Sampling theory concepts to solve various engineering problems like structured and unstructured data models
4. Demonstrate Stochastic problem as Markov model as a problem solving methods for systematic model buildings.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO-1	Solve the problems of Curve fitting and regression in various problems in Computer Science and Engineering fields.	1,2,4	1
CO-2	Apply the concepts of Probability and statistics in various computer science engineering fields like data mining, classification problems etc	1,2,4	1
CO-3	Develop a stochastic problem as Markov model as a problem solving methods for systematic model buildings.	1,2,4	1
CO-4	Make use of sampling theory concepts to solve various engineering problems like structured and unstructured data models.	2,3,4	1
CO-5	Use Discrete time Markov chain to model computer systems.	1,2,4	1
CO-6	Analyse queuing models using queuing theory.	1,2,4	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		1									3		
CO2	3	3		1									3		
CO3	3	3		1									2		
CO4		3		1									1		
CO5	2			1									1		
CO6		3		1									2		

Note: 1-**Low**, 2-Medium, 3-High

COURSE CONTENT
THEORY

Contents

UNIT – 1

Curve Fitting: Curve fitting by the method of least squares and fitting of the curves of the form,
$y = ax + b$, $y = ax^2 + bx + c$, $y = ae^{bx}$ (*$y = ax^b$ and $y=ab^x$)

Statistical Methods: Correlation-Karl Pearson's coefficient of correlation- problems. Regression analysis- lines of regression, problems. Rank correlation.

** ***Application:*** *Curve fitting and statistics for data science*

UNIT – 2

Probability distributions: Random variables, Discrete and continuous probability distributions. Binomial, Poisson, normal distributions (only problems) and *exponential (definition with one /two examples).

** ***Application:*** *Probability distribution in machine learning, Computer vision: object recognition and image segmentation Computer graphics: behaviour of light and other physical phenomena in computer graphics*

UNIT – 3

Joint Probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance, correlation coefficient.

Stochastic processes- Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability-simple problems.

** **Application:** *Stochastic processes and Markov processes in Operating System*

UNIT – 4

Sampling theory: Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, confidence limits for means, student's t-distribution. Chi-square distribution as a test of goodness of fit.

** ***Application***: **S***ampling process in computer graphics, sampling theory in machine learning*

** *Application: (i) Additional information providing to students only for knowledge.*

(ii) Major part of assignments questions chosen from applications.

(iii) Students' presentations/seminars topics chosen from applications.

TEXT BOOKS:

1. B.S. Grewal, "Higher Engineering Mathematics", 43rd edition Khanna Publishers, 2015.
2. ErwinKreyszig, "Advanced Engineering Mathematics", 9th edition Wiley Publications, 2013.
3. Seymour Lipschutz, John J. Schiller., "Schaum's Outline of Introduction to Probability and Statistics", McGraw Hill Professional, 1998.

REFERENCE BOOKS:

1. B.V. Ramana, "Higher Engineering Mathematics", 19th Reprint edition, Tata McGraw Hill Publications, 2013.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", 4th edition, Narosa Publishing House, 2016.
3. V.Sundarapandian, "Probability, Statistics and Queueing theory", PHI Learning, 2009
4. Dr. B. Krishna gandhi, Dr. T.K.V. Iyengar, Dr. M.V.S.S.N. Prasad&S. Ranganatham.,"Probability and Statistics"S. Chand Publishing, 2015.
5. J. K. Sharma "Operations Research theory and applications", 5th edition, Macmillan publishers, ,2013.

JOURNALS/MAGAZINES

1. https://www.hindawi.com/journals/jps/
2. https://www.journals.elsevier.com/statistics-and-probability-letters
3. http://www.isoss.net/japs/

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/browse/data-science/probability-and-statistics
2. https://nptel.ac.in/courses/111/105/111105041/
3. https://onlinecourses.swayam2.ac.in/cec20_ma01/preview

SELF-LEARNING EXERCISES:

1. Curve fitting for application problems, Regression analysis for a bivariate data.
2. Probability distribution- Geometric, gamma- distributions, Joint probability distribution of continuous random variables.
3. Sampling analysis of real time problems. Applications to computer science: Data mining, classification problems etc

LIST OF EXPERIMENTS

EXP. NO.	LIST OF EXPERIMENT
1.	Compute of a Table of Grouped Frequency, Mean, Mode and Median
2.	Compute Variance and Standard Deviation for Grouped Data
3.	Fit a curve for the given data by least square method
4.	Use correlation analysis to determine whether two quantities are related to justify fitting the data.
5.	Generate binomial random variables using the default parameter values, plot its PMF
6.	Generate Poisson random variables using the default parameter values, plot its PMF
7.	Generate normal random variables using the default parameter values, plot its PDF.
8.	Select sample of size n from the population N with replacement, without replacement
9.	Generate random numbers for given sampling distribution by using t distribution
10.	Generate random numbers for given sampling distribution by using Chi-square distribution

<table>
<tr><td>Course Title</td><td colspan="4">Engineering Chemistry</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B23AS0104</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

Engineering chemistry covers very relevant topics compatible with ECE students and make them aware of importance of various aspects of basic science in engineering. The subject of Engineering chemistry covers area of light and matter interaction, clean energy storage and conversion devices, corrosion phenomenon and control which is widely an interdisciplinary subject of discussion. Further the course focus on the chemistry of engineering materials, and various applications. This area of science is very much interdisciplinary in its nature and gives a platform for students to strengthen their engineering knowledge to enlighten on the energy conversion and storage devices, which have become very attractive field of research in engineering stream. The subject deals with various engineering materials, their properties and applications in the field of engineering.

COURSE OBJECTIVE (S):

The Engineering chemistry course is designed to fulfil the following objective;

1. It provide the basic knowledge on Interaction of light and matter to know the electronic transitions in materials and storage and conversion devices.
2. Corrosion and metal finishing, explains the phenomenon of corrosion and its Prevention. It also covers the importance of metal finishing in various industries and fabrication of PCB
3. Polymers are all about the properties of various polymeric materials and their Commercial significance. The chapter reveals about technical and commercial Importance of composite materials.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the phenomenon of light and matter interaction to study the materials	1,2,3	1
CO2	Demonstrate the electrochemical processes & illustrate the method of preparation of solar grade silicon.	1,2,3,7	1
CO3	Select different materials in controlling the corrosion & fabrication of printed circuit boards (PCB).	1,2,3,7	1
CO4	Illustrate the properties of polymers, nano materials, composite materials and their applications in various fields.	1,2,3	1
CO5	Know the doping in photovoltaic devices & applications of Jablonski energy diagram.	1,2,3,6	1
CO6	Use of promising materials for electrochemical energy storage and engineering, and environmental remedies.	1,2,3,7	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√		√		
CO3		√				
CO4		√				
CO5		√				
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**1**										**1**		
CO2	**2**	**1**	**1**				1						**1**		
CO3	**1**	**2**	**1**				1						**1**		
CO4	**3**	**2**	**1**										**1**		
CO5	2	2	1			1							**1**		
CO6	3	2	1				1						**1**		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
UNIT - 1
Light and Matter Interaction Electro-magnetic spectrum-Applications in Engineering, Interaction of EM radiation with matter, work function of matter, Electrons in matter. Bonding theories: MOT, Band structure of matters HOMO-LUMO. Photochemical and thermal reactions: Laws of photochemistry, quantum yield, high and low quantum yield reactions. Jablonski diagram – photo physical and photochemical processes, photo-sensitization, photo- polymerization and commercial application of photochemistry.
UNIT - 2
Clean Energy Storage and Conversion Devices Introduction to electrochemistry, basic concepts of Batteries and characteristics. Classification: Primary (Dry cell, $Li-MnO_2$) and Secondary (Pb-acid, Li-ion) batteries. Super capacitors: classification, construction and applications in hybrid **vehicles**. Fuel cells: Alkaline fuel cells, Solid oxide fuel cells and phosphoric acid fuel cell. Photo-conversion devices: Photovoltaic cell and antireflective coating. Production of single crystal semiconductor by Crystal pulling technique (Czochralski technique), difference between single and polycrystalline materials, zone refining process of Si.

UNIT - 3

Concepts of Corrosion

Thermodynamics and Kinetics of electrochemical corrosion – Theory for corrosion, galvanic series, thermodynamics aspects of corrosion reactions, Nernst equation, dry and wet corrosion and the cell formation, potential- pH diagram (Fe and Al), kinetics of corrosion reactions, Over voltage, polarization, passivity, immunity.

Types of corrosion – Galvanic corrosion, pitting, crevice corrosion, and intergranular corrosion.

Corrosion control – Cathodic protection (Sacrificial anode and impressed current methods), Anodic protection. Protective coatings – Metal coatings (hot dip: tinning and galvanizing), spray techniques, role of inhibitors. Metal finishing: Introduction, technological importance. Electroplating: Variables of electroplating bath, Electroplating of Gold. Electroless plating: Distinction between electroplating and electroless plating processes. Electroless plating of copper and applications.

UNIT – 4

Chemistry of Engineering Materials

Polymer composites: Carbon fiber, Kevlar synthesis and applications, Conducting polymers: synthesis, electron transport mechanism and applications in poly acetylene and poly aniline. **Liquid crystals:** Introduction classification and applications in electronic display devices. **Nano materials:** Introduction, classification based on dimensionality, quantum confinement. Size dependent properties- surface area, magnetic properties (GMR phenomenon), and thermal properties. Synthesis, Properties and applications of Fullerenes, CNT and Graphene.

Sensors: Physical and chemical sensors, Biosensors for bio electronic applications.

Text Books:

1. Jain and Jain, "Engineering Chemistry", Dhanapat Rai Publications, 16th Edition, 2015.
2. SS Dara and SS Umare," Engineering Chemistry,"S. Chand Publications, 17th Edition, 2014.
3. R.V. Gadag & Nithyananda Shetty, "Engineering chemistry", Ik International Publishing house, 3rd Edition, 2014.

Reference Books:

1. Fontana. M.G., "Corrosion Engineering", Tata McGraw Hill, 3rd Edition, 2005.
2. Charles P. Poole Jr and Frank J. Owens," Introduction to Nanotechnology", Wiley-Interscience, 1st edition, 2003.
3. V.R. Gowrikar, N.N. Vishwanathan and J. Sreedhar," Polymer chemistry", NEW AGE International Pvt Ltd, 2021.

JOURNALS/MAGAZINES:

https://www.sciencedirect.com/journal/water-science-and-technology

https://iwaponline.com/wst

https://www.scitechnol.com/nanomaterials-molecular-nanotechnology.php

https://www.journals.elsevier.com/journal-of-energy-storage

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/105/105/105105201/
2. https://nptel.ac.in/courses/112/108/112108150/

Course Title	Communication Skills				Course Type		FC	
Course Code	B22AH0103	Credits	1		Class		II Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	**1**	**2**	**2**	**28**	**0**	**50%**	**50%**

Course Description: This course is aimed to develop basic communication skills in English in the learners, to prioritize listening and reading skills among learners, to simplify writing skills needed for academic as well as workplace context, to examine that the learners use the electronic media such as internet and supplement the learning materials used in the classroom.

COURSE OBJECTIVE (S):

The Course objectives are to

1. Develop basic communication skills in English.
2. Emphasize the development of speaking skills amongst learners of Engineering and Technology
3. Impart the knowledge about the use of electronic media such as the internet and supplement the learning materials used in the classroom.
4. Inculcate the habit of reading and writing leading to effective and efficient communication.

COURSE OUTCOMES: (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate speaking ability with clarity, confidence, and comprehension an communicate with one or many listeners using appropriate communicative strategie (Speaking Skills).	10	
CO2	Develop the ability to write cohesively, coherently, and flawlessly avoidin grammatical errors, using a wide vocabulary range, organizing their ideas logically o a topic (Writing skills).	10	
CO3	Make use of reading different genres of texts by adopting various reading strategie (Reading Skills).	10	
CO4	Take part in interviews confidently and develop accurate writing skills.	10	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
CO1	✔	✔				
CO2	✔	✔				
CO3	✔	✔				
CO4	✔	✔				

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1										3					
CO2										3					
CO3										3					
CO4										3					

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
UNIT – 1 **Functional English:** Language as a Tool of Communication, - Effective Communication-Modes of Communication- Email communication - Giving Instructions.
UNIT – 2 **Interpersonal Skills:** Traits of good Listener types of Listening-- Formal letters (Accepting/ inviting/ declining); Personal letters (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends/relatives, - Process descriptions (general/specific).
UNIT - 3 **Multitasking Skills:** Types of Speaking- Paralinguistic Features-Types of paragraphs (cause and effect / compare and contrast / narrative / analytical); Report Writing (Feasibility/ Project report - report format – recommendations/ suggestions, PPT).
UNIT – 4 **Persuasive Skills:** Reading and Interpretation- SQ3R**-** Making inference from the reading passage; predicting the content of a reading passage, - Different types of Essay Writing, applying for a job; Writing a cover letter with résumé / CV.

Text Books:

1. Thorpe, Edgar and Showick Thorpe" Objective English". Pearson Education, 2013.
2. Dixson, Robert J. "Everyday Dialogues in English". Prentice Hall India Pvt Ltd., 1988.
3. Turton, Nigel D. "ABC of Common Errors" Mac Millan Publishers, 1995.
4. Ashraf Rizvi, "Effective Technical Communication" McGraw-Hill Education (India) Pvt. LTD., New Delhi, 2018.

Reference Books:

1. Bansal, R.K. and J.B. Harrison. Spoken English. Orient Blackswan, 2013.
2. 2.Raman, Meenakshi and Sangeeta Sharma. Technical Communication. Oxford University Press, 2015.
3. 3.Samson, T. (ed.) Innovate with English. Cambridge University Press, 2010.

<table>
<tr><td>Course Title</td><td colspan="4">Programming with C</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22CI0104</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

Algorithms and flowcharts are the fundamental tools for problem solving which can be used by the computers. The computer programs can be developed using algorithms and flowcharts to provide solutions to problems. C Language is a general-purpose, structured and procedure oriented programming language. It is one of the most popular computer languages today because of its structure and higher-level abstraction C. This course introduces algorithms, flowcharts and various C Programming language constructs for the development of real world applications.

COURSE OBJECTIVE (S):

The objectives of this course are to

1. Explain algorithms, flowcharts and different programming constructs of C to be used for Development of applications.
2. Illustrate the use of iterative statements and conditional Statements for solving the real world problems.
3. Demonstrate the use of functions with parameter passing mechanisms for solving the real world problems.
4. Discuss the use of structures, unions, pointers and file operations for solving the real world Problems.
5. Learn new algorithms and technologies in C Programming and apply for suitable application development.
6. Develop solutions by using C Programming to the complex problems, either individually or as a part of team and report the results.

COURSE OUTCOMES (COs)

On successful completion of this course; the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the programming constructs of C language to solve a given problem.	1-3	1
CO2	Apply the concepts of matrices to develop data processing and analysis solutions in various application domains.	1-5	1
CO3	Develop text processing based applications using string operations.	1-3,5	2,3
CO4	Create solutions for real world problems using Pointers, Union, Structures and file operations.	1-5	2,3
CO5	Use algorithms and technologies in C Programming for suitable application development	1-5	2,3
CO6	Develop solutions by using C Programming to the complex problems, either individually or as a part of the team and report the results	1-5,9	2,3

BLOOM'S LEVEL OF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1				✓		
CO2			✓			
CO3			✓			
CO4						✓
CO5		✓	✓			
CO6						✓

COURSE ARTICULATIONMATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3										3		
CO2	1	3	2	2	2								3		
CO3	2	2	2		1									3	3
CO4	3	3	3	1	1									3	3
CO5	3	3	3	2	2										
CO6	3	3	3	2	2				3				3	3	2

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY

Contents
UNIT-1
Algorithm: Definition, Purpose of writing an algorithm, Rules for writing an algorithm, Advantage of writing algorithm and examples. Flowchart: Definition, Notations used to write a flow chart, Advantage and disadvantages of writing the flowchart and examples. Introduction to "C": Introduction to GitHub, Structure of C program with example, C language & its features, C tokens, data types in C, variables, constants, input and output functions
UNIT-2
Operators and Expressions: Unary operator, assignment operator, arithmetic operator, relational operators, logical operators &bitwise operator, conditional operator, increment and decrement operator, special operator. Conditional Statements: if statement, if-else statement, nested if, switch statement. Unconditional Statements: break and continue statement, goto statement, return statement Iterative Statements (loops): while loop, do-while, for loop, differences between while, do-while and for loop.
UNIT-3
Arrays, functions & Strings: one dimensional array, two dimensional array, Linear and binary search and bubble sorting. Functions: Structure of a function, types of functions, parameter passing mechanisms, Command line arguments. Strings: string operations with and without using inbuilt string functions.

UNIT-4

Structures & Union: Derived types- structures- declaration, definition and initialization of structures, accessing structures, neste structures, arrays of structures, union, typedef.

Pointers: Introduction to pointers.

File Operations: Formatted Input & Output, Character Input and Output Functions, Direct Input and Output Functions, File Positioning Functions, Error Functions

TEXT BOOKS:

1. B.W. Kernighan & D.M. Ritchie, "C Programming Language", 2nd Edition, PRENTICE HALL
2. SOFTWARE SERIES, 2005.
3. Herbert Schildt, "C: The Complete Reference", 4th edition, TATA McGraw Hill, 2000.
4. B.S. Anami, S.A. Angadi and S. S. Manvi, "Computer Concepts and C Programming: A
5. Holistic Approach", second edition, PHI,2008.

REFERENCE BOOKS:

1. Balaguruswamy," Programming in ANSI C", 4th edition, TATA MCGRAW Hill, 2008.
2. Donald Hearn, Pauline Baker," Computer Graphics C Version", second edition, Pearson Education, 2004.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6294 (IEEE Journal/Magazine on IT Professional)
2. https://ieeexplore.ieee.org/document/1267572 (IEEE Computing in Science and Engineering)

SWAYAM/NPTEL/MOOCs:

1. https://online courses.nptel.ac.in/noc20_cs06/preview (Problem Solving through Programming in C)
2. https://www.edx.org/course/c-programming-getting-started (C Programming Getting started)
3. https://www.coursera.org/specializations/c-programming (Introduction to C programming)

SELF-LEARNINGEXERCISES

1. **Fundamentals of computer graphics**: output primitives–Line, Circle and Ellipse drawing algorithms-Attributes of output primitives.
2. **Inline Assembly Language Program:** Simple inline assembly, Extended Assembly Syntax Microsoft C Compiler.

<table>
<tr><td>Course Title</td><td colspan="3">Elements of Mechanical Engineering</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22ME0103</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="6"></td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes
Per Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW

Elements of Mechanical Engineering is a basic course of Mechanical Engineering discipline. It focuses on overall view of mechanical engineering area's like thermal, design and manufacturing streams. The course is designed to understand basic concept like formation of steam and compute the steam properties like specific volume, enthalpy, and internal energy using steam tables. The students are introduced to internal combustion engines, turbines (water, steam and gas) and refrigeration-air conditioning system. The students will be imparted to calculate BP, IP, mechanical efficiency of IC engines. The students are exposed to the machine elements like springs, belt drives and gear drives. Acquainted with different machine tools like lathe, drilling machines and CNC machines. The students will be exposed to joining processes like Soldering, Brazing and Welding and various power transmission systems. Students are introduced to the engineering materials and modern manufacturing Technology like 3D printing technology.

COURSE OBJECTIVES

The objectives of this course are to

1. Develop the basic knowledge on heat & work, steam formation, working principle of boilers, turbines, IC engines and refrigeration - air conditioning systems.
2. Incorporate the concept of different types of machine elements like springs, belt drives & chain drives.
3. Give exposure in the field of engineering materials and manufacturing processes.
4. Incorporate the concepts of modern manufacturing processes like CNC, 3D printing technology and its applications
5. Acquire a basic understanding role of Mechanical Engineering in the industry and society.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Evaluate the properties of steam and performance parameters of IC engines.	1, 2	1,2
CO2	Describe the working principle of boilers, turbines, refrigeration and air conditioning systems	1	1
CO3	Classify the engineering materials and discuss the concept of casting, CNC machine, laser engraving and 3D printing technology.	1	1
CO4	Compare the different kinds of machine tools and select the suitable machine tool for processing the materials and different metal joining process for the different applications	1,2	1,2
CO5	Discuss the application of machine elements and Calculate the speed ratio of belt drives and Gear Drives.	1,2	1,2
CO6	Describe the need of mechatronics approach in industry and application of robots.	1	1

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1											**1**		
CO2	2												1		
CO3	2												1		
CO4	3	1											1	1	
CO5	3	1											1	1	
CO6	1												1		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
UNIT-1 **Introduction to Energy Systems:** Concept of heat and work, Steam formation, Types of steam, Steam properties, numerical on steam properties, Introduction to boilers, working of Babcock and Wilcox boiler.
UNIT-2 **Prime Movers:** Types and working principle of turbines, IC Engines, numerical on IC engines. **Introduction to Refrigeration and Air Conditioning:** Working principle of refrigeration system, working of domestic refrigerator and window air conditioner
UNIT-3 **Materials and Manufacturing Processes:** Introduction to engineering materials and classifications, casting, Machine Tools- lathe & drilling machine, metal joining process-welding, brazing and soldering, modern manufacturing technology-CNC machines, laser engraving and 3D printing.
UNIT-4 **Machine Elements:** Types and applications of springs, belt drives, gear drives and chain drives, numerical on belt drives and gear trains. **Introduction to Mechatronics and Robotics:** Need of Mechatronics in industries, measurement system, open and closed loop control system, Robot anatomy, applications of Robotics.

TEXT BOOKS

1. K R Gopala Krishna, Sudheer Gopala Krishna and S C Sharma, "Elements of Mechanical Engineering", Subhash Publishers, 13th Edition, 2015.

2. Roy & Choudhury, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt. Ltd, 2000.

REFERENCE BOOKS

1. SKH Chowdhary, AKH Chowdhary and Nirjhar Roy, "The Elements of Workshop Technology - Vol I & II", Media Promotors and publisher, 11th edition, 2001.
2. William Bolton, "Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering", Pearson, 2015.
3. K. K. Appukuttan, "Introduction to Mechatronics", Oxford University Press, 2007.

JOURNALS/MAGAZINES

1. International Journal of Machine Tools and Manufacture
2. International Journal of Refrigeration.

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
2. https://www.my-mooc.com/en/categorie/mechanical-engineering

Course Title	IoT and Applications				Course Type		HC	
Course Code	B22EN0101	Credits	2		Class		II Semester	
	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment Weightage	
	Lecture	1	1	1				
	Tutorial	-	-	-				
	Practical	1	2	2	Theory	Practical	CIE	SEE
	Total	**2**	**3**	**3**	**14**	**28**	**50%**	**50%**

COURSE OVERVIEW:

The Internet of Things (IoT) expands access to the world-wide web from computers, smart phones, and other typical devices to create a vast network of appliances, toys, apparel, and other goods that are capable of connecting to the Internet. This introductory course focuses on IoT architecture, its domains and communication protocols. The course is supported with hands on sessions that incorporates different types sensors interfaced with IoT board to build IoT projects to solve real time problems. The case study of deployment of IoT in various applications are provided.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the architecture of Internet of Things.
2. Inculcate knowledge of IoT devices, Sensors and Communication Protocols in various application domains.
3. Gain expertise in interface of various sensors to IoT Boards.
4. Discuss the various applications of IoT.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Describe the component of IoT architecture	1,2,3,4,5	1,2
CO2	Interpret various Applications of IoT	1,2,3,4,5	1,2
CO3	Identify IoT development boards, sensors & actuator	1,2,3,4,5	1,2
CO4	Identify communication technologies, protocols, and cloud services	1,2,3,4,5,9,10	1,2
CO5	Demonstrate the interfacing of sensors & actuators to IoT board	1,2,3,4,5,9,10	1,2
CO6	Develop simple IoT projects and modules	1,2,3,4,5,9,10	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2	√	√	√			
CO3	√	√	√			
CO4	√	√	√	√		
CO5	√	√	√	√		
CO6	√	√	√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1								3	3	
CO2	2	3	1	1	1								3	3	
CO3	3	2	1	1	3								2	2	
CO4	3	2	1	1	3				2	2		2	1	1	
CO5	3	1	2	1	2				2	2		2	2	1	
CO6	3	2	2	1	2				2	2	2	2	1	1	

Note: 1-Low, 2-Medium, 3-High

Course Content Theory:

Contents
UNIT – 1 **IoT Basics** Previous technologies before IoT, Introduction to IoT, How IoT works, Components of IoT Infrastructure, Basic elements of general IoT Architecture, Characteristics of IoT, benefits and challenges of IoT, Applications of IoT.
UNIT – 2 **IoT Enabling Technologies** IoT Development Boards: Arduino, Add-on ESP module, Node MCU, Raspberry Pi; Sensors and Actuators: Temperature Sensor, PIR Sensor, Ultrasonic senor; Communication Technologies: Bluetooth, ZigBee, LoRa, WiFi, Cellular; Protocols: HTTP, MQTT, CoAP; IoT Cloud Platforms: Arduino Cloud, Thing Speak, Blink Cloud

PRACTICE:

Sl. No.	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
	Introduction to Arduino Board & getting stared with Arduino IDE software	Hardware & software	Identifications of various parts of Arduino
1	Write a program to blink an LED a) Infinite number of times with ON & OFF duration of 1 sec b) infinite number of times with ON time duration 2 sec and OFF time duration 0.5 sec c) Only 3 times with ON and OFF duration 2 sec	Arduino UNO, Arduino IDE, LED's	Arduino coding

<table>
<tr><td>2</td><td>Write a program to blink 4 LED in the given pattern
<table><tr><th colspan="4">Pattern</th></tr><tr><th>L1</th><th>L2</th><th>L3</th><th>L4</th></tr><tr><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td></tr><tr><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td></tr><tr><td>ON</td><td>ON</td><td>ON</td><td>OFF</td></tr><tr><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr><tr><td>OFF</td><td>ON</td><td>ON</td><td>ON</td></tr><tr><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr><tr><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td></tr><tr><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td></tr></table>
<table><tr><th colspan="4">Pattern</th></tr><tr><th>L0</th><th>L1</th><th>L2</th><th>L3</th></tr><tr><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td></tr><tr><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td></tr><tr><td>ON</td><td>ON</td><td>ON</td><td>OFF</td></tr><tr><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr><tr><td>ON</td><td>ON</td><td>ON</td><td>OFF</td></tr><tr><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td></tr><tr><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td></tr><tr><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td></tr></table></td><td>Arduino UNO, Arduino IDE, LED’s</td><td>Arduino coding, Looping structure</td></tr>
<tr><td>3</td><td>Write a program to blink an LED with different times and duration using the concept of user defined function</td><td>Arduino UNO, Arduino IDE, LED’s</td><td>Arduino coding, user define function</td></tr>
<tr><td>4</td><td>Write a program to interface motion sensor and display its status using g LED. If motion is detected it turn on LED otherwise keeps the turn off the LED.</td><td>Arduino UNO, Arduino IDE, LED,
PIR sensor</td><td>Interface PIR sensor</td></tr>
<tr><td>5</td><td>a) Write a program to increase and decrease the brightness of LED.
b) Write a program to control the brightness of LED using</td><td>Arduino UNO, Arduino IDE, LED,
Potentiometer</td><td></td></tr>
<tr><td>6</td><td>a) Write a program to interface LDR to Arduino board and display the voltage across LDR on serial monitor
b) Write a program to control the brightness of LED based on the intensity of light on LDR</td><td>Arduino UNO, Arduino IDE, LED, LDR</td><td>Interface LDR sensor</td></tr>
<tr><td>7</td><td>a) Write a program to interface temperature sensor and display the values on the serial monitor
b) Write a program display range of temperature on LCD</td><td>Arduino UNO, Arduino IDE, LCD, Temperature sensor</td><td>Interface Temperature sensor</td></tr>
<tr><td>8</td><td>Write a program to interface ultrasonic sensor and display the distance from an object.</td><td>Arduino UNO, Arduino IDE, Ultrasonic sensor</td><td>Interface Ultrasonic sensor</td></tr>
<tr><td></td><td>Challenging Experiments</td><td></td><td></td></tr>
<tr><td>9</td><td>a) Introduction to ESP module & programming using Arduino IDE software
b) Write a program to demonstrates how to use Wifi module ESP8266-01 to blink LED (with simple LED)</td><td>ESP8266 Arduino Uno, LED, Arduino IDE</td><td>Interface of LED to ESP Module, Program ESP using Arduino IDE</td></tr>
<tr><td>10</td><td>Write a program to demonstrate how ESP8266 can be used as an HTTP client and HTTP server to control and monitor the status of an LED</td><td>ESP8266, Arduino Uno, LED, Arduino IDE</td><td>Understand about Client Server Model</td></tr>
<tr><td>11</td><td>Write a program demonstrate how ESP8266 can be used as HTTP Webserver and get commands from the client (mobile/Laptop) directly.</td><td>ESP8266, Arduino Uno, LED, Arduino IDE</td><td>Understand about Client Server model, Create Webserver</td></tr>
<tr><td>12</td><td>Write a program to demonstrate how to implement Publisher/Subscriber method (MQTT) to control and monitor the ESP8266 GPIO2 LED</td><td>ESP8266, Arduino Uno, LED, Arduino IDE</td><td>Understand about Publisher/Subscriber Model</td></tr>
<tr><td>13</td><td>Write a program to demonstrate how ESP8266 can be used to log sensor data into thinkspeak cloud.</td><td>ESP8266, Arduino Uno, LED, Arduino IDE, ThingSpeak Cloud Service</td><td>Connect to cloud and storing data.</td></tr>
<tr><td colspan="4">Part-B (Case Study/ Projects - Sample Topics)</td></tr>
</table>

1. **IoT based Automated Table Lamp** ***2.*** **IoT based Light Dimmer and Speed Controller** ***3.*** **IoT based Energy Monitor and Over Current Cut-off** ***4.*** **IoT based Smart Home Controller Using Blynk** ***5.*** **IoT based Motion Detector Using Cayenne** ***6.*** **IoT based Air Pollution Meter** ***7.*** **IoT based Smart Camera** ***8.*** **IoT based Pet Feeder** ***9.*** **IoT based Electronic Door Opener** ***10.*** **IoT based Underground Cable Fault Detector** ***11.*** **IoT based Air & Sound Pollution Monitoring System** ***12.*** **IoT based Weather Reporting System** ***13.*** **IoT based Toll Booth Manager System** ***14.*** **IoT based Heart Attack Detection & Heart Rate Monitor** ***15.*** **IoT based Person/Wheelchair Fall Detection** ***16.*** **IoT based Water Quality Monitoring System**	***17.*** **IoT based Patient Health Monitoring** ***18.*** **IoT based Garbage Monitoring System** ***19.*** **IoT based Liquid Level Monitoring System** ***20.*** **IoT based Biometric Attendance System** ***21.*** **IoT based Irrigation Monitoring & Controller System** ***22.*** **IoT based Gas Pipe Leakage Detector** ***23.*** **IoT based Alcohol & Health Monitoring System** ***24.*** **IoT based Streetlight Controller System** ***25.*** **IoT based Traffic Signal Monitoring & Controller System** ***26.*** **IoT based Fire Department Alerting System** ***27.*** **IoT based Antenna Positioning System** ***28.*** **IoT based Garbage Monitoring with Weight Sensing** ***29.*** **IoT based Colour Based Product Sorting Machine** ***30.*** **IoT based Smart Mirror with News & Temperature** ***31.*** **IoT based Car Parking System** ***32.*** **IoT based Automatic Vehicle Accident Detection and Rescue System**

TEXTBOOKS:

1. Vijay Madisetti, Arshdeep Bahga , “Internet of Things: A Hands-On- Approach “ Second edition 2014, ISBN: 978 0996025515.

REFERENCE BOOKS:

1. Raj Kamal,” Internet of Things: Architecture & design Principle”, McGraw Hill Education 2017.

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/learn/iot
2. https://www.coursera.org/learn/interface-with-arduino

<table>
<tr><td>Course Title</td><td colspan="3">Innovation & Entrepreneurship</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B23ME0102</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
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<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
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<tr><td>Total</td><td>2</td><td>3</td><td>3</td><td>14</td><td>28</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW

NEN Ignite is an entrepreneurship program based on experiential learning that aims to support startups' founders through a structured pathway from Idea Discovery to Pitch Deck. A 14 weeks, 36-42 hours of classroom/digital, highly experiential and practice based entrepreneurship training Course, by Wadhawani Foundation and will be delivered by WF facilitators / NEN Trained Entrepreneurship Faculty.

COURSE OBJECTIVES

The objectives of this course are to:

1. Discover an entrepreneurial opportunity
2. Articulate a compelling value proposition
3. Build a sustainable business model and business plan
4. Create and validate an MVP with potential customers
5. Select an appropriate Go-to-Market Strategy
6. Pitch the business idea to different stakeholders

COURSE OUTCOMES (CO'S)

On successful completion of this course; the student shall be able to:

CO	Course Outcomes	POs	PSOs
CO1	Identify the different aspects that can impact their business	**3,9,10,11,12**	**1**
CO2	Acquire in-depth knowledge about tools to build any business idea	**3,9,10,11,12**	**1**
CO3	Acquire in-depth knowledge about the different growth tools to grow their business.	**3,9,10,11,12**	**1**
CO4	Create a financial plan for their business	**3,9,10,11,12**	**1**
CO5	Create a pitch deck for their business and present it to different stakeholders	**3,9,10,11,12**	**1**

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			**2**						**2**	**2**	**3**	**2**	**2**		
CO2			**2**						**2**	**2**	**3**	**2**	**2**		
CO3			**2**						**2**	**2**	**3**	**2**	**2**		
CO4			**2**						**2**	**2**	**3**	**2**	**2**		
CO5			**2**						**2**	**2**	**3**	**2**	**2**		

UNIT -1

Introduction to Entrepreneurship: Entrepreneurs; entrepreneurial personality and intentions - characteristics, traits and behavioural; entrepreneurial challenges. Taking product or service ideas to creating value: Why should one choose to become an entrepreneur, Entrepreneurial mind-set, Intrapreneurship.

Orientation for WE Ignite program, Ice Breaking session, self-work Instructions and timelines Platform Demo Introduction to Ignite program flow and milestones , Introduction to Entrepreneurship and Human centred Approach to Design Thinking , Are you enterprising?. New generations of entrepreneurship viz. social entrepreneurship, Edupreneurship, Health entrepreneurship, Tourism entrepreneurship, Women entrepreneurship etc., Barriers to entrepreneurship, Creativity and entrepreneurship, Innovation and inventions, Skills of an entrepreneur, Decision making and Problem Solving

100 Rupee Venture; Debrief of Group Activity- Presentation and Sharing Learning Experience

Unit - 2

Entrepreneurial Opportunities: Opportunities. Discovery/ creation, Pattern identification and recognition for venture creation: prototype and exemplar model, reverse engineering. Problem Identification and Opportunity Discovery.
Entrepreneurial Process and Decision Making: Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches, Effectuation and Causation
Customer and Markets : Customer Discovery: Exploring Customer Personas & Market Estimation for your Ideas, Create a compelling value proposition & Competitive Advantage

UNIT- 3

Build your MVP : Building a MVP that customers Love
Crafting business models and Lean Start-ups: Introduction to business models; Creating value propositions-conventional industry logic, value innovation logic; customer focused innovation; building and analysing business models; Business model canvas, Introduction to lean start-ups, Business Pitching
Business Model: Developing strong business models Create and present your Lean Canvas

Financial Feasibility: Introduction to Business plan and its components; Basics of Finance.

Unit 4

Institutional Support for Entrepreneurship:

Organization Assistance to an entrepreneur, New Ventures, Industrial Park (Meaning, features, & examples), Special Economic Zone (Meaning, features & examples), Financial assistance by different agencies, MSME Act Small Scale Industries, Carry on Business (COB) license, Environmental Clearance, National Small Industries Corporation (NSIC), e-tender process, Excise exemptions and concession, Exemption from income tax, The Small Industries Development Bank of India(SIDBI), Incentives for entrepreneurs

Go To market Strategy: Getting products to market: Channels & Strategies; Managing growth and Targeting Scale: Understand the Unit economics for your venture; Funding Strategy: Securing funding for your Startup and Preparing for pitch.

Contents:

TEXT BOOK:

1.Wadhwani Foundation Curriculum K. Ramachandran, "Entrepreneurship Development", Tata Mc. Graw Hill, 2008

2.Sangeeta Sharma, "Entrepreneurship Development" PHI Publications, 2016

REFERENCE BOOKS:

1.Baringer and Ireland, "Entrepreneurship", Pearson, 11th Edition, 2020.

2.Drucker F Peter: "Innovation and Entrepreneurship", 1985.Heinemann, London.

3.Doanld F Kuratko & Richard M Hodgeth, "Entrepreneurship in the New Millennium", India Edition - South-Western,

4.Cengage Learning Entrepreneurship –by Robert D. Hisrich (Edition-9)

5.Entrepreneurship- Theory, Process & Practice –by Kuratko & Hodgetts, Thompson South-Western Publication

6.Technology Entrepreneurship Taking Innovation to the Marketplace – by Thomas N. Duening, Robert D. Hisrich and Michael A. Lechter, Elsevier

JOURNALS/MAGAZINES

1. International Small Business Journal: **https://journals.sagepub.com/home/isb**

2. Journal of Development Entrepreneurship: **https://www.worldscientific.com/worldscinet/jde**

SWAYAM/NPTEL/MOOCs:

1.Entrepreneurship: **https://nptel.ac.in/courses/110/106/110106141/**

<table>
<tr><td>Course Title</td><td colspan="4">Engineering Chemistry Lab</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B22AS0105</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
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<tr><td>Total</td><td>1</td><td>2</td><td>2</td><td>-</td><td>28</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

Engineering chemistry LAB covers very relevant experiment which is related to the topics compatible with ECE students and make them aware of importance of various aspects of basic science in engineering. The practice gives insights on areas of light and matter interaction, optical properties of materials, clean energy, electrical conduction in solutions, corrosion phenomenon and control which is widely an interdisciplinary subject of discussion. Further the course focus on the chemistry of engineering materials, and various applications. This area of science is very much interdisciplinary in its nature and gives a platform for students to strengthen their engineering knowledge to enlighten on the importance of science which very essential for research in engineering stream.

COURSE OBJECTIVE (S):

The Engineering chemistry lab course is designed to fulfil the following objective;

Engineering chemistry lab covers the very basic knowledge and experimental required for engineering students to understand its importance of Science in technology.

1. It provide the basic knowledge and experimental skill on Interaction of light and matter to know the electronic transitions in materials and storage and conversion devices.
2. Corrosion and metal finishing, explains the phenomenon of corrosion and its Prevention. It also covers the importance of metal finishing in various industries and fabrication of PCB.
3. Electrochemical methods will be used to fabricate materials as thin films and various sensing techniques for lab analysis
4. Preparation of semiconducting and conducting materials, polymers and understand their Commercial significance.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	Pos	PSOs
CO1	Estimate the amount of metal ions present by interaction of light source.	1,2,3,9,10	1
CO2	Demonstrate the electrolytic process in electrochemical cell for the purpose of energy storage and energy conversion devices.	1,2,3,9,10	1
CO3	Describe the corrosion phenomenon and list out various precautions to be taken in the selection of materials in controlling corrosion.	1,2,3,9,10	1
CO4	Preparation of commercially important polymers, Nano materials, composite materials and their applications	1,2,3,9,10	1
CO5	Analyse various water quality parameters in daily life suitable for portability.	1,2,3,8	1
CO6	Preparation of thin film and bulk solid state conductors and semiconductors relevant to device applications	1,2,3,9,10	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	√			
CO2		√		√		
CO3		√			√	
CO4		√				
CO5		√		√		
CO6		√				

COURSE ARTICULATION MATRIX

CO / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1						3	3			1		
CO2	2	1	2						3	3			1		
CO3	1	2	1						3	3			1		
CO4	2	2	3						3	3			1		
CO5	2	2	2					3	3	3			1		
CO6	1	2	1						3	3			1		

Note: 1-Low, 2-Medium, 3-High

Practice

No	Title of the Experiment	Tools and Technics	Expected Skill/Ability
1	Verification of Beer-Lambert's Law by detection of Copper by spectroscopy.	Calorimeter, Visible spectroscopy, cuvettes	Understand the theory of interaction of light with matter and the electronic transitions in material .Experimentally verify the Beer Lambert law and quantify the amount of

			substance
2	Estimation of Iron by Potentiometric sensor.	Potentiometer, electrodes, reference electrodes	Understand the theory of potential changes and measure and interpret the potential changes associated with change in chemical composition. This is relevant in electrochemical energy storage and conversion devices like batteries, capacitors, fuel cells
3	Estimation of concentration of acid mixture by Conductometric sensor.	Conductometer, conducting electrolytes	Understand the theory, circuit connection and perform the experiment, Interpret the ionic conductivity in the solution
4	Determination of pH/pKa of solutions using glass membrane electrode sensor.	pH meter, glass electrodes, pH sensing electrochemical cell setup	Understand the electrochemical theory, perform the experiment to sense and evaluate the pH of the give solution. Interpret the importance of pH in engineering materials and their application
5	Faraday's law verification by using Electrodeposition of Cu/Ni/Zn on stainless steel.	DC power supply units, Electrochemical cells, different coating substrate	Understand the theory of soft electrochemical deposition of thin films and perform the experiment on deposition different conductive substrates
6	Determination of percentage of iron in corrosion products.	Ostwald Viscometer	Understand the theory of viscosity and perform the experiment to estimate viscosity of different fluids.
7	Estimation of percentage of Copper in brass alloy by iodometric method	Cu-Zn containing alloy, Iodometric technique	Understand the theory and perform the experiment, collect the data and interpret amount of copper present in the given engineering material
8	Evaluation of Dissolved Oxygen by Winkler's method and hence assessment of quality of water.	Indicators, Industrial and domestic effluents	Understand the theory of Winkler's method and the iodometric estimation.
9	Estimation Of Total Hardness Of Water By Complexometric Method Using EDTA	Hard water, Complexing agents	Understand the theory and perform the experiment to understand and interpret water quality. Devise the easy method for removing the hardness causing agent through complexometry
10	Preparation of semiconducting nanomaterials and characterization.	UV-Vis Spectrophotometer	Understand the theory and perform the experiment to estimate the alkalinity of the industry feed water. Understand the need neutral water, adverse effects of alkaline water
11	Determination of band gap of bulk and Semiconducting materials by UV-Visible spectroscopy.	UV-Visible Spectrophotometer	A better understanding the optical band gap of the materials. Able to perform experiment with UV-Vis spectrophotometer and interpret the spectra and relate with the electronic band structure
12	Synthesis of Conducting Polyaniline from aniline by Chemical method.	Simple oxidation method.	A better understanding of conducting polymers and their relevant applications in devices
13	Preparation of Conducting polyaniline thin film by electro	C power supply units, electrochemical reduction techniques, different	To demonstrate the soft and simple electrochemical method for preparation of thin

	polymerization.	conducting substrate	conductive films on desired substrates
14	Preparation of Dye – sensitized solar cell.	FTO, Dyes, Electrolytes, I-V measurement unit, Solar simulation setup	To demonstrate the fabrication of lab scale DSSC and understand the function of photoelectrochemical cell

PART_B: Projects

No	**Title of the Experiment**	**Tools and Technics**	**Expected Skill/Ability**
1	Investigation of ionically conducting media	Conductometer, different ionic conductance media	To demonstrate the effect of ionic conductance and understand the importance in electrochemical energy devices
2	pH and Potentiometric sensor	pH meter, Potentiometer	To demonstrate the effect of pH on engineering materials and the potential changes with change in chemical composition
3	Assembly of energy storage devices	Batteries, DC power supply units	To assemble and perform cell voltage and discharge experiments

Text Books

1. V R Gowariker, N V Viswanathan, Jayadev Sreedhar," Polymer Science", Wiley eastern ltd, 4th Edition, 2021.
2. Sudha Rani, S.K. Bashin, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing Company; 3rd edition, 2012.

Reference Books:

1. J. Mendham, Vogel's "Quantitative Chemical Analysis", 6th Edition, 2009

<table>
<tr><td>Course Title</td><td colspan="4">Programming with C Lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22CI0108</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
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</table>

COURSE OVERVIEW:

Algorithms and flowcharts are the fundamental tools for problem solving which can be used by the computers. The computer programs can be developed using algorithms and flowcharts to provide solutions to problems. C Language is a general-purpose, structured and procedure oriented programming language. It is one of the most popular computer languages today because of its structure and higher-level abstraction C. This course introduces algorithms, flowcharts and various C Programming language constructs for the development of real world applications.

COURSE OBJECTIVE (S):

1. Explain algorithms, flowcharts and different programming constructs of C to be used for Development of applications.
2. Illustrate the use of iterative statements and conditional Statements for solving the real world problems.
3. Demonstrate the use of functions with parameter passing mechanisms for solving the real world problems.
4. Discuss the use of structures, unions, pointers and file operations for solving the real world Problems.
5. Learn new algorithms and technologies in C Programming and apply for suitable application development.
6. Develop solutions by using C Programming to the complex problems, either individually or as a part of team and report the results.

COURSE OUTCOMES (COs)

On successful completion of this course; the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the programming constructs of C language to solve a given problem.	1-3	1
CO2	Apply the concepts of matrices to develop data processing and analysis solutions in various application domains.	1-5	1
CO3	Develop text processing based applications using string operations.	1-3,5	2,3
CO4	Create solutions for real world problems using Pointers, Union, Structures and file operations.	1-5	2,3
CO5	Use algorithms and technologies in C Programming for suitable application development	1-5	2,3
CO6	Develop solutions by using C Programming to the complex problems, either individually or as a part of the team and report the results	1-5,9	2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1				✓		
CO2			✓			
CO3			✓			
CO4						✓
CO5		✓	✓			
CO6						✓

COURSE ARTICULATIONMATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3						3	3			3		
CO2	1	3	2	2	2				3	3			3		

CO3	2	2	2		1				3	3				3	3
CO4	3	3	3	1	1				3	3				3	3
CO5	3	3	3	2	2				3	3					
CO6	3	3	3	2	2				3	3			3	3	2

Note:1-Low,2-Medium,3-High

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1	Calculator allows you to easily handle all the calculations necessary for everyday life with a single application. Write a C program using switch statement to design a basic calculator that performs the basic operations such as addition, subtraction, multiplication and division.	Condition statement	Apply switch and if-else
2	People frequently need to calculate the area of things like rooms, boxes or plots of land where quadratic equation can be used. Write a C program to find the coefficients of a quadratic equation and compute its roots.	Conditional branching statement	If or if-else or else-if ladder
3	Consider the age of 3 persons in a family, Write a C program to identify the eldest person among three of them.	Condition checking	Apply if-else
4	Consider student’s marks in Computer based Test. Write a C Program to display the grade obtained by a student in Computer Test based on range of marks.	Condition checking	Apply if-else, switch
5	In a stock market at the end of the day, summation of all the transactions is done. Write a C program using arrays to a) Display transactions IDs from1 to ‘n’. b) Find the sum of ‘n’ natural numbers	Looping, sum	Apply for loop and arrays
6	In computer based applications, matrices play a vital role in the projection of three dimensional image into a two dimensional screen, creating the realistic seeming motions. Write a C program using 2-dimensional array to check for compatibility of two matrices and perform matrix Multiplication.	Condition checking, matrix operations	Apply if-else, looping and 2-D array
7	Implement a Program to read N integer numbers into a single dimensional array, sort them in ascending order using bubble sort technique and print both the given array and the sorted array with suitable headings.	Sorting	Use 1-D array, looping
8	Suppose students have registered for workshop, and their record is maintained in ascending order based on student ID’s. Write a C program to find whether a particular Student has registered for that particular workshop or not using binary search.	Searching	Use 1-D array, looping
9	In a memory game, you first enter a first string and again enter second string, Write a C program to check whether both the strings are same or not.	Comparison, condition	Use string, if

10	Write a C program to define a structure named Student with name and DOB, where, DOB in turn is a structure with day, month and year. Using the concept of nested structures display your name and date of birth.	Nested structure	Use structure to store the data

TEXT BOOKS:

1. B.W. Kernighan & D.M. Ritchie, "C Programming Language", 2nd Edition, PRENTICE HALL
2. SOFTWARE SERIES, 2005.
3. Herbert Schildt, "C: The Complete Reference", 4th edition, TATA McGraw Hill, 2000.
4. B.S. Anami, S.A. Angadi and S. S. Manvi, "Computer Concepts and C Programming: A
5. Holistic Approach", second edition, PHI,2008.

REFERENCE BOOKS:

1. Balaguruswamy," Programming in ANSI C", 4th edition, TATA MCGRAW Hill, 2008.
2. Donald Hearn, Pauline Baker," Computer Graphics C Version", second edition, Pearson Education, 2004.

Course Title	**Engineering Workshop**				**Course Type**		**HC**	
Course Code	**B22ME0104**	**Credits**	**1**		**Class**		**II Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	tutorial	-	-	-	Theory	Practical	IA	SEE
	Practice	**1**	**2**	**2**				
	Total	1	2	2	0	28	50 %	50 %

COURSE OVERVIEW

Workshop practice provides the basic working knowledge of the production and properties of different materials used in the industry. It also explains the use of different tools, equipment's, machinery and techniques of manufacturing, which ultimately facilitate shaping of these materials into various usable forms. Also to provide the basic knowledge on working and function of two wheeler and four wheeler vehicle engine and power transmission system.

COURSE OBJECTIVES

1. To make student familiar with automobile engine terminology and to have visualization of shape, size and working of engine parts.

2. To introduce the use of tools and instrument and their selection for carrying out the fitting, sheet metal work and welding work.

2. To introduce the processes used of convert of raw material in to product.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Visualise the parts of two wheeler engine and analyse the sequence of parts connected and their functional relationship.	1, 2, 9	1
CO2	Identify and explain the function of the major components of engine and power transmission system of Toyota Innova and Toyota Fortuner cars	1,2,9	1,2
CO3	Prepare the fitting model as per the given engineering drawing by using appropriate fitting tools.	1, 2, 9	1

CO4	Develop the simple sheet metal models as per drawing specification using sheet metal tools.	1,2,3,9	1,2
CO5	Demonstrate the working and application of laser engraving, 3D printing and welding processes.	1, 9	1,2
CO6	Draw the layout of workshop and prepare a technical document about the process to be followed in engineering workshop.	1,10	1

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1							2				1		
CO2	2	1							2				1	1	
CO3	2	1							2				1		
CO4	2	1	1						2				1	1	
CO5	2								2				1	1	
CO6	2									3			1		

Note: 1-Low, 2-Medium, 3-High

Part-A

1. Dismantling and assembly of 2-wheeler (2–stroke) engine Parts.

2. Identification of parts of an engine of Toyota Innova and Toyota Fortuner

3. Calculation of speed ratio of belt, chain and gear drives.

4. Study of power train of bicycle, 2-wheeler and 4-wheeler.

5. Demonstration of laser engraving process and 3D printing process.

Part-B

1. Study of fitting tools and preparation of fitting models.

2. Study of sheet metal tools and development of pen stand and funnel

3. Hands on training on welding.

4. Study of power tools.

TEXT BOOKS

1. K.R. Gopalkrishna, "Elements of Mechanical Engineering", Subhash Publishers, 12th Edition, 2012.
2. SKH Chowdhary, AKH Chowdhary and Nirjhar Roy, "The Elements of Workshop Technology - Vol I & II", Media Promotors and publisher, 11th Edition, 2001.

REFERENCE BOOKS

1. David A. Crolla, "Automotive Engineering-Powertrain, Chassis System and Vehicle Body", Butterworth-Heinemann is an imprint of Elsevier, 1st Edition, 2009.
2. R.S.Parmar, "Welding Processes and Technology", Khanna Publishers, New Delhi, 2003.

JOURNALS/MAGAZINES

1. International Journal of Machine Tools and Manufacture

2. https://www.shutterstock.com/search/disassembled-bike-engine

3. https://pdfcoffee.com/ex5-assembly-and-disassembly-of-ic-engine-parts-pdf-free.html

SWAYAM/NPTEL/MOOCs

1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
2. https://www.my-mooc.com/en/categorie/mechanical-engineering
3. https://nptel.ac.in/course

<table>
<tr><td>Course Title</td><td colspan="4">Tree Plantation in Tropical Region: Benefits and Strategic Planning</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B22ME0105</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5"></td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
<tr><td>Lecture</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>1</td><td>1</td><td>1</td><td>14</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

Course Description: This course introduces significance of trees that provide us with a great many ecosystem services, including air quality improvement, energy conservation, stormwater interception, and atmospheric carbon dioxide reduction. These benefits must be weighed against the costs of maintaining trees, including planting, pruning, irrigation, administration, pest control, liability, cleanup, and removal.

Students are expected to involve in planting a tree and nurturing till the completion of their degree program. Successful maintenance of tree is considered to be one of the eligibility criterions for the award of university degree.

This course is a part of "**REVA Vanamahotsava – One Student, One Tree"**

COURSE OBJECTIVE (S):

The Course objectives are to

1. Develop basic understanding of role of trees in climate change
2. Emphasize on the selection and placing a tree for maximum benefit to environment
3. Involve in planting a tree and nurture till the completion of the degree program
4. Generate experiential report on the tree plantation process involved

COURSE OUTCOMES: (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Interpret the possible key benefits of trees arresting climate change and global warming	7,9	

CO2	Develop the ability to identify the type of a tree to be planted in urban area agricultural fields and forestry areas	7,9	
CO3	Make use of reading different literature on climate change and global warming by adopting various reading strategies (Reading Skills)	7,9	
CO4	Take part in planting a tree and nurturing it and Generate report on tree plantatio process involved	7,9	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
CO1		✓		✓		
CO2		✓	✓	✓		
CO3		✓		✓		
CO4		✓		✓		✓

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1							3		3						
CO2							3		3						
CO3							3		3						
CO4							3		3						

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Contents
Unit 1: Introduction: The tropical region, Benefits and costs of urban and community forests
Unit 2: General Guidelines for Selecting and Placing Trees Guidelines for Energy Savings, Guidelines for Reducing Carbon Dioxide, Guidelines for Reducing Stormwater Runoff, Guidelines for Improving Air Quality Benefits, Guidelines for Avoiding Conflicts with Infrastructure, Guidelines for Maximizing Long-Term Benefits, Trees for Hurricane-Prone Areas **Activity based learning** Every student has to thoroughly understand the significance of planting a tree, identify type of tree and place to be planted, plant a tree and nurture till the completion of the degree.

Text Books:

1. Kelaine E. Vargas, E. Gregory McPherson, James R. Simpson, Paula J. Peper, Shelley L. Gardner, and Qingfu Xiao, "Tropical community tree guide: Benefits, Costs and Strategic Planting", U.S. Department of Agriculture, Forest Service Pacific Southwest Research Station Albany, California, 2008

Reference Books:

1. Peter Wohlleben, The Heartbeat of Trees, Penguin Books, 2021
2. Daniel Chamovitz, "What a Plant Knows: A Field Guide to the Senses", 2020

Evaluation of this course

As per 9.27 of the **"Academic Regulations UG -Engg 2022",** following evaluation procedure is applicable to this course.

9.27 Summary of Internal Assessment, Semester End Examination and Evaluation Schedule is provided in the table given below (for theory courses having Credit 1).

Summary of Internal Assessment and Evaluation Schedule

Sl. No.	Type of Assessment	When	Syllabus Covered	Max Marks	Reduced to	Date by which the process must be completed
1	Test-1	During 8th Week	First 50%	25	12.5	8th week
2	Test -2	During 15th Week	Remaining 50%	25	12.5	15th Week
5	SEE	18th to 20th Week	100%	50	25	20th Week

Additional guidelines for conducting this course

Since this course is aimed as a special drive to restore climate change and arresting global warming, following guidelines have been framed to conduct this course as activity-based learning to build greener nation through student community. Successful implementation of this drive meets one of the very important Sustainable Development Goals (SDG's) of UN Envision 2030 on Climate Change and Global warming. This is also one of the requirements in NEP 2020 and UGC/AICTE.

1. Classes will be conducted by the nominated faculty (one hour per week) as per the syllabus.
2. Flipped classes, field experiences, group discussions and seminars can be used by the faculty so as to engage the students through student centric learning mechanisms
3. Students should be involved into understanding cause and effects of climate change, types of pollutions, and environmental hazards
4. Quizzes and debates on climate change and global warming can be arranged for each section
5. Students should plant the suitable tree and nurture
6. "Team Vanamahotsava" – A Central assistance team from REVA University will support for identifying trees, place and organizing plantation drives.
7. Regular progress review is planned to be monitored by digital system – an advanced version of current progress monitoring App.
8. School Directors are responsible to oversee all the arrangements and progress monitoring of this drive.
9. Frequent school level and university level branding shall be arranged to give awareness of this noble drive among all

the stake holders such as parents, alumni, industry and academic partners, government sectors, NGO's, ministries, and the society.

10. Regular plant maintenance drive can be planned by "Team Vanamahotsava". However, planting a tree and its nurture responsibility solely rests on individual students.
11. Successful maintenance of tree is considered to be one of the eligibility criterions for the award of university degree.

2nd Year
Detailed Syllabus

III SEMESTER

III Semester

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE/MC/SDC	Credit Pattern L	T	P	Total Credit	Contact Hours / Week	Examination CIE Marks	SEE Marks	Total Marks	Course category (As per AICTE)
1	B22AS0301	Discrete Mathematics and Graph Theory	FC	3	0	0	3	3	50	50	100	BSC
2	B22CS0301	Professional Ethics	FC	2	0	0	2	2	50	50	100	HSMC
3	B22CI0309	Entrepreneurship	FC	1	0	0	1	1	25	25	50	HSMC
4	B22AS0303/ B22AS0403	Environmental Science	MC	2	0	0	0	2				HSMC
5	B22EF0301	Operating systems	HC	3	0	0	3	3	50	50	100	PCC
6	B22EF0302	Object oriented Programming with Java	HC	3	0	0	3	3	50	50	100	PCC
7	B22EF0303	Data Structures	HC	3	0	0	3	3	50	50	100	PCC
8	B22EH0301	Digital Logic and Design	HC	3	0	0	3	3	50	50	100	PCC
9	B22EF0305	Java Programming lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EF0306	Data Structures lab using C	HC	0	0	1	1	2	25	25	50	PCC
11	B22EH0302	Digital Logic and Design Lab	HC	0	0	1	1	2	25	25	50	PCC
Total				20	0	3	21	26	400	400	800	
TOTAL SEMESTER CREDITS				21								
TOTAL CUMULATIVE CREDITS				65								
TOTAL CONTACT HOURS				26								
TOTAL MARKS				800								

<table>
<tr><td>Course Title</td><td colspan="3">Discrete Mathematics and Graph Theory</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B23AS0301</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

Discrete Mathematics is the study of discrete objects. Discrete Mathematics is used to develop our ability to understand and create mathematical arguments and also used to provide the mathematical foundation for advanced mathematics and computer science courses.

Graphs (abstract networks) are among the simplest mathematical structures, which are used in most of the areas of Computer Science to solve the complex problems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain mathematical arguments using logical connectives and quantifiers.
2. Illustrate the operation on discrete structures such as sets, relations and functions.
3. Describe the theory and application of graphs, fundamental theorems and their proofs.
4. Demonstrate the use of graphs to model many types of relations and processes in physical, biological. Social and information system.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Construct mathematical arguments using logical connectives	1 ,2,3	2
CO2	Student should learn about predicate logic in mathematical statements. Student should understand the concept of logical inference and be able identify valid and invalid arguments.	1 ,2,3	2
CO3	To understand and to distinguish different types of relations and functions.	1 ,2,3	2
CO4	Student should develop the ability to use logical reasoning to prove properties of relations and functions.	1 ,2,3	2
CO5	Illustrate the concept of isomorphic graphs and isomorphism invariant properties of graphs	1 ,2,3	2

CO6	Develop a model using advanced concepts of graph for real world applications	1 ,2,3	2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4		√				
CO5		√				
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1											3	
CO2	3	2	3											3	
CO3	3	1	2											3	
CO4	3	2	3											3	
CO5	3	2	2											3	
CO6	3	2	2											3	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Mathematical Logic: Propositions, Logical Connectives and truth tables (Illustrative Examples), Logical equivalence, Laws of logic, Duality, NAND and NOR connectives (Circuits), Converse, Inverse and Contrapositive, Rules of Inference, Quantifier, Logical implication involving quantifiers.

Applications: Design of computing machines, artificial intelligence, definition of data structures for programming languages etc

UNIT – 2

Relations and Functions : Cartesian product of sets (Illustrative Examples), Matrices and Digraph of the relations, Properties of relations, Equivalence relations, Partial ordered relations, Posets, Hasse diagrams, Extremal elements in posets, Types of Functions, The pigeon hole principle, Sterling number of second kind.

Application: Data structures, Class-based object-oriented systems, Machine learning, Databases, Pattern matching, and by extension, compilers

UNIT – 3

Introduction to graph theory: Konigsberg's bridge problems, Utilities problem, Seating Problem, Graphs, Representation of Graphs. Directed graphs, Incidence, Adjacency, Degree, In degree, Out degree, Regular graphs, Complete graphs, Null Graph, Bipartite Graphs, Isomorphism, Directed Graphs, Sub graphs, Walk, Trail, Path, Circuit, Cycle, Connected and disconnected graphs.

Applications: Finding shortest routes in car navigation systems, Search engines use ranking algorithms based on graph theory, Analysis of social networks, Compilers use coloring algorithms to assign registers to variables, Path planning in robotics.

UNIT – 4

Euler and Hamiltonian graphs and Graph coloring: Definition of Euler Graphs, Hamiltonian Graphs, Standard Theorems on Euler and Hamiltonian graphs, planar graph, Dual of planar graphs, Graph coloring, Chromatic polynomial, Five Color Theorem, Matching, , Cut set, Network flow, and its applications.

Applications: Graph coloring especially used various in research areas of science such data mining, image segmentation, clustering, image capturing, networking etc.

TEXT BOOKS:

1. Ralph P Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, 2014.
2. Nasingh Deo, "Graph Theory with Applications to Engineering Computer Science", Prentice-Hall, 2014.

REFERENCE BOOKS:

1. Keneth H Rosen, "Discrete Mathematics and its applications", 5th Edition,, Tata McGraw Hill, 2014.
2. C L Liu, "Elements of Discrete Mathematics", 4th edition, Tata MacGraw Hill 2014.
3. Thomas Khoshy, "Discrete Mathematics with applications", Elsvier, 2012.
4. Ralph P Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, Asia, 2015.
5. Frank Harary, "Graph Theory", Norosa, 2013.
6. J. A. Bondy and V. S. R. Murthy,"Graph Theory with Applications", Macmillan, London, 2013.

JOURNALS/MAGAZINES:

1. https://www.journals.elsevier.com/discrete-mathematics
2. http://www.math.iit.edu/~kaul/Journals.html
3. https://www.siam.org/publications/journals/siam-journal-on-discrete-mathematics-sidma
4. https://onlinelibrary.wiley.com/journal/10970118
5. https://iopscience.iop.org/article/10.1088/1742-6596/1175/1/012069/meta
6. https://iopscience.iop.org/article/10.1088/1742-6596/1188/1/012065/meta
7. https://www.worldscientific.com/worldscinet/jml
8. https://www.scimagojr.com/journalsearch.php?q=12000154480&tip=sid

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/111/107/111107058/
2. https://nptel.ac.in/courses/106/103/106103205/
3. https://onlinecourses.swayam2.ac.in/cec20_ma02/preview

4. https://onlinecourses.nptel.ac.in/noc20_ma05/preview
5. https://onlinecourses.swayam2.ac.in/cec20_ma03/preview
6. https://www.coursera.org/learn/graphs

<table>
<tr><td>Course Title</td><td colspan="4">Professional Ethics</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22CS0301</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>2</td><td>2</td><td>2</td><td>28</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

To enable the students to imbibe and internalize the values and ethical behavior in the personal and professional lives

COURSE OBJECTIVE (S):

1. Understand the professional rules of conduct for Engineers.
2. Appreciate codes of conduct, professional rules of conduct.
3. Recognize the conflict of interest and develop strategies.
4. Understand the importance of communication with all stake holders.
5. Apply practical strategies for handling ethical dilemmas.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understanding basic purpose of profession, professional ethics and various moral and social issues.	1,2,6,8 to 12	
CO2	Awareness of professional rights and responsibilities of a Engineer, safety and risk benefit analysis of a Engineer.	1,2,4,6,8 to 12	
CO3	Acquiring knowledge of various roles of Engineer in applying ethical principles at various professional levels.	1,6,8,9,10, 12	
CO4	Professional Ethical values and contemporary issues.	1,6,8,12	
CO5	Apply practical strategies for handling ethical dilemmas.	1,4,6,8,10, 12	
CO6	Appreciate codes of conduct, professional rulesofconduct.	1,4,8,12	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4		√				
CO5			√			
CO6		√				

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	--	--	--	3	--	3	2	2	1	3			
CO2	2	3	--	1	--	2	--	3	2	2	1	3			
CO3	2	--	--	--	--	2	--	3	2	2	0	2			
CO4	2	--	--	--	--	1	--	3	--	--	--	2			
CO5	2	--	--	1	--	1	--	3	1	--	--	2			
CO6	2	--	--	1	--	--	--	3	--	--	--	2			

Note:1-Low,2-Medium,3-High

COURSE CONTENT

UNIT – I

Introduction to Professional Ethics: Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

UNIT-II

Basic Theories: Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.

UNIT-III

Professional Practices in Engineering: Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession

UNIT-IV

Work Place Rights & Responsibilities, Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment within the Nuclear Regulatory Commission (NRC), the Hanford Nuclear Reservation.

TEXT BOOKS:

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
2. Ethics in Engineering Practice & Research, CarolineWhitbeck,2e, Cambridge University Press 2015.

REFERENCE BOOKS:

1. Engineering Ethics, Concepts Cases: Charles EHarri Jr., Michael SPritchard, Michael J Rabins, 4e , Cengage learning, 2015.
2. Business Ethics concepts & Cases: ManuelGVelasquez,6e, PHI, 2008.

Course Title	**ENTREPRENEURSHIP**				**Course Type**		**FC**	
Course Code	B22CI0309	**Credits**	**1**		**Class**		**III semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**1**	**1**	**1**	**14**	**0**	**50%**	**50%**

COURSE OVERVIEW:

Course Description: This is an *introductory course* is designed to provide the foundational concepts of *entrepreneurship*, including the definition of *entrepreneurship*, the profile of the *entrepreneur*, and the role of venture creation in society. The course also provides a bird's eye view on the steps to start a venture, financing, marketing as well as support by various institutions towards entrepreneurship.

COURSE OBJECTIVE

1. To understand the basic terms, concepts in Entrepreneurship Development.
2. To apply for the supporting schemes towards women entrepreneurship.
3. To understand the various institutional support schemes for entrepreneurship.
4. Gain expertise to apply government schemes and support for entrepreneurship.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

#	Course Outcomes	POs	PSOs
CO1	Understand key terms, definitions, and concepts used in Entrepreneurship Development	1	1
CO2	Apply the concepts and build a business environment for which entrepreneurs act applicable for women empowerment.	1,2	1,2
CO3	Analyze the institutional schemes for startup and understand the sources for availing financial support from various schemes.	1,2	1,2
CO4	Plan a startup and understand the resources available for finance and the supporting schemes offered by state and central governments and other entrepreneurial development	1,2	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level

O#	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2	√	√	√			
CO3		√	√	√		
CO4		√	√	√		

COURSE ARTICULATION MATRIX

CO#/ Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
	2		1			1				1			2	1	
	2	2	1			1				1			2	1	
	2	2	1			1				1			2	1	
	2	2	1			1				1			2	1	

COURSE CONTENT

THEORY

UNIT-1

INTRODUCTION TO ENTREPRENEURSHIP

Evolution of term ‘Entrepreneurship’, Factors influencing entrepreneurship’, Psychological factors, Social factors, Economic factors, Environmental factors. Characteristics of an entrepreneur, Difference between Entrepreneur and Entrepreneurship, Types of entrepreneurs. New generations of entrepreneurship viz. social entrepreneurship, Entrepreneurship, Health entrepreneurship, Tourism entrepreneurship.

UNIT-2

WOMEN ENTREPRENEURSHIP

Women entrepreneurship, Barriers to entrepreneurship, Creativity and entrepreneurship, Innovation and inventions, Skills of an entrepreneur, Decision making and Problem Solving.

UNIT-3

INSTITUTIONAL SUPPORT FOR ENTREPRENEURSHIP

Organization Assistance to an entrepreneur, New Ventures, Industrial Park (Meaning, features, & examples), Special Economic Zone (Meaning, features & examples), Financial assistance by different agencies, MSME Act Small Scale Industries, Carry on Business (COB) licence, Environmental Clearance.

UNIT-4

GOVERNMENT SUPPORT FOR ENTREPRENEURSHIP

National Small Industries Corporation (NSIC), e-tender process, Excise exemptions and concession, Exemption from income tax, The Small Industries Development Bank of India(SIDBI), Incentives for entrepreneurs

TEXT BOOKS:

1. K. Ramachandran,” Entrepreneurship Development”, Tata Mc. Graw Hill, 2008.
2. Sangeeta Sharma, “Entrepreneurship Development”, PHI Publications, 2016.

REFERENCE BOOKS:

1. Baringer and Ireland, “Entrepreneurship”, 11th Edition, Pearson,2020.
2. P. Narayana Reddy, “Entrepreneurship – Text and Cases”, Cengage Learning India, Iedition,2010
3. Paul Burns," Corporate Entrepreneurship: Building The Entrepreneurial Organization", Palgrave Macmillan.
4. Drucker F Peter,:”Innovation and Entrepreneurship”, 1985.Heinemann,London.
5. Doanld F Kuratko & Richard M,” Entrepreneurship in the New Millennium”, India Edition.

JOURNALS/MAGAZINES

1. International Small Business Journal: https://journals.sagepub.com/home/isb
2. Journal of Development Entrepreneurship: https://www.worldscientific.com/worldscinet/jde

SWAYAM/NPTEL/MOOCs:

1. Entrepreneurship: https://nptel.ac.in/courses/110/106/110106141/

<table>
<tr><td>Course Title</td><td colspan="4">Environmental Science</td><td>Course Type</td><td colspan="2">MC</td></tr>
<tr><td>Course Code</td><td>B22AS0303/ B22AS0403</td><td>Credits</td><td colspan="2">0</td><td>Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>2</td><td>2</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>-</td><td>2</td><td>2</td><td>28</td><td>-</td><td>-</td></tr>
</table>

COURSE OVERVIEW:

Environmental Science is focussed on a holistic understanding of earth systems in order to learn from the past, comprehend the present and influence the future. It is the study of how physical, chemical and biological processes maintain and interact with life, and includes the study of how humans affect nature. As environmental science is at the cross-roads of the natural sciences, it provides an enriching alternative to a single-subject honours degree, and can open the door to an exciting range of career options. This approach enables us to tackle necessary problems, such as ensuring that human needs are met in a sustainable way, so that everyone has access to clean water and air, and the resources required for agriculture and industrial activity.

COURSE OBJECTIVE (S):
The objectives of this course are to:

1. Familiar with current and emerging environmental engineering and global issues and have an understanding of ethical and societal responsibilities.
2. Recognize the need for engaging in life-long learning.
3. Study various types of energy (conventional & non-conventional) resources and natural resources.
4. Acquire knowledge with respect to biodiversity, threats, conservation and appreciate the concept of ecosystem.
5. Know about sources, effects and control measures of environmental pollution, degradation, and waste management.
6. Explore the ways for protecting the environment.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand, analyse and execute favourable environmental conditions and the role of individual, government and NGO in environmental protection.	1,2,3,7	1
CO2	List the causes, effects & remedial measures of environmental pollution, degradation & find ways to overcome them by suggesting the pollution controlled products.	1,2,3,7	1
CO3	Get motivation to find new renewable energy resources with high efficiency through active research and innovation.	1,2,3,7	1
CO4	Critically analyse the ecological imbalances and provide recommendations to protect the environment.	1,2,3,7	1
CO5	Explore the condition of environmental degradation and waste management techniques and take promising measures to make our environment ecofriendly.	1,2,3,7	1
CO6	Identify new methodologies for conservation of our natural resources and ecosystem.	1,2,3,7	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1	✓	✓				
CO2	✓	✓				
CO3	✓					
CO4	✓					
CO5	✓	✓				
CO6	✓					

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	1				2						1		
CO2	3	2	2				2						1		
CO3	2	2	2				3						1		
CO4	2	2	1				3						1		

CO5	3	2	2				2						1		
CO6	2	1	1				3						1		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

ENVIRONMENT & ENVIRONMENTAL PROTECTION:

Basics of environment: Introduction & definition to Environment, objectives and guiding principles of environmental education, Components of environment, Structure of atmosphere, Sustainable environment/Development, Impact of technology on the environment in terms of modern agricultural practices and industrialization, Environmental Impact Assessment.

Environmental protection: Role of Government - Assignments of MOEF, Functions of central and state boards, Institutions in Environment and People in Environment, Environmental Legislations, Initiative and Role of Non-government organizations in India and world.

UNIT – 2

Environmental pollution, degradation & Waste management:

Environmental Pollution: Definition, sources and types, Pollutant-Definition & classification, Concepts of air pollution, water pollution, Automobile Pollution-Causes, Effects & control measures.

Environmental degradation: Introduction, Global warming and greenhouse effect, Acid rain-formation & effects, Ozone depletion in stratosphere and its effect, Montreal and Kyoto protocols, The Chemical Weapons Convention (CWC).

Waste management: Municipal solid waste, Bio-medical waste and Electronic waste (E-Waste).

UNIT – 3

Energy & Natural resources:

Energy: Definition, classification of energy resources, electromagnetic radiation-features and applications, Conventional/Non-renewable sources – Fossil fuels based (Coal, petroleum & natural gas), nuclear energy, Non-conventional/renewable sources – Solar, wind, hydro, biogas, biomass, geothermal, ocean thermal energy, Hydrogen as an alternative as a future source of energy.

Natural resources:

Water resource - Global water resource distribution, Water conservation methods, Water quality parameters, Uses of water and its importance

Mineral resources - Types of minerals, Methods of mining & impacts of mining activities

Forest wealth - Importances, Deforestation-Causes, effects and controlling measures

UNIT – 4

Ecology, ecosystem & field work:

Ecology - Definition, branches, objectives and classification, Concept of an ecosystem – Structure and functions, Components of ecosystem-abiotic and biotic

Levels of biological diversity: genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots.

India as a mega-biodiversity nation; Endangered and endemic species of India

Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity.

Biogeochemical cycles and its environmental significance – Carbon and nitrogen cycle, Energy flow in ecosystem, food chains – types, food web & Ecological Pyramids

Field work:

Visit to waste water/sewage treatment plant (STP) and biogas plant at REVA university campus, and/or Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.

REFERENCE BOOKS:

1. R.J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", Wiley India Private Ltd., New Delhi, Co-authored &Customised by Dr.MS Reddy & Chandrashekar, REVA University, 1st Edition, 2017.
2. R.J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", Wiley India Private Ltd., New Delhi, 2nd Edition, 2014.

3. Benny Joseph, “Environmental Studies”, Tata McGraw – Hill Publishing Company Limited, 2nd Edition, 2008.
4. Dr.S.M.Prakash, “Environmental Studies”, Elite Publishers, Mangalore, 2nd Edition, 2009.
5. Rajagopalan R, “Environmental Studies – from Crisis to cure”, Oxford University Press, 3rd Edition, 2016.
6. Anil Kumar Dey and Arnab Kumar Dey, “Environmental Studies”, New age international private limited publishers, 2nd Edition, 2007.
7. Michael Allaby, “Basics of environmental Science”, Routledge-Tayler & Francis E-Library, 2nd Edition, 2002.
8. Dr.Y.K Singh, “Environmental Science”, New age international private limited publishers, 1st Edition, 2006.

Online Resources/Links:

1. http://library.envirolink.org/
2. https://www.youtube.com/watch?v=5QxxaVfgQ3k
3. https://www.springer.com/journal/11356
4. Learn Environmental Science with Online Courses, Classes, & Lessons | edX

Course Title	**Operating Systems**				**Course Type**		**HC**	
Course Code	**B22EF0301**	**Credits**	**3**		**Class**		**III Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	3	3	3				
	Tutorial	-	-	-	**Theory**	**Practical**	**CIE**	**SEE**
	Practical	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

This course starts with a brief historical perspective of the evolution of operating system and then covers the major components of most of the operating systems. The operating system provides a well-known, convenient, and efficient interface between user programs and the bare hardware of the computer on which they run. The operating system is responsible for allowing resources (e.g., disks, networks, and processors) to be shared, providing common services needed by many different programs (e.g., file service, the ability to start or stop processes, and access to the printer) and protecting individual programs from one another. Emphasis is given to three major OS subsystems: process management (processes, threads, CPU scheduling, synchronization, and deadlock), memory management (segmentation, paging, swapping) and file systems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the major components and different services of Operating system.
2. Implement process management and scheduling schemes.
3. Discuss synchronization and deadlock techniques in real time applications.
4. Demonstrate memory management techniques for machine architecture.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify the major components and services of Operating System.	1 to 5,12	1
CO2	Summarize process scheduling, scheduling algorithm and multithreading of Operating System.	1 to 5,12	1,2
CO3	Assess the Performance of different CPU Scheduling algorithm for the given real-world applications.	1 to 5,12	1,2
CO4	Apply the concept of synchronization and deadlock process.	1 to 5,12	1,2
CO5	Build methods to overcome synchronization problems and to avoid deadlocks.	1 to 5, 9,12	1,2

CO6	Compare and contrast the physical and virtual memory management techniques.	1 to 5,12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓					
CO2		✓				
CO3						✓
CO4			✓			
CO5			✓			
CO6			✓			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	1	1							1	2		
CO2	2	2	2	2	1							1	3	1	
CO3	2	1	2	3	1							1	3	1	
CO4	2	1	2	2	1							1	2	1	
CO5	1	2	1		1							1	2	2	
CO6	1	2	2	1	1							1	1	1	

Note:1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Operating System Principles: Evolution of Operating Systems, Structural overview, Types of Operating System and operations, Computing environments, Operating System Services, User - Operating System interface, System calls and system programs, Operating System structure.

UNIT – 2

Process Management: Process concept, process scheduling, Operations on processes, Inter process communication; Multi-Threaded Programming, Overview, Multithreading models, Thread Libraries, threading issues. Process scheduling: Basic concepts, scheduling criteria, scheduling algorithms.

UNIT – 3

Synchronization and Deadlock: The Critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization: The Bounded-Buffer Problem, The Readers–Writers Problem. Deadlock definition, Deadlock characteristics, Deadlock Prevention, Deadlock Avoidance: banker's algorithm, Deadlock detection and Recovery.

UNIT – 4

Memory Management: Memory Management Strategies, Swapping, contiguous memory allocation, Paging, structure of page table, Segmentation. Virtual Memory Management: Background, Demand paging, copy-on-write, Page replacement, Allocation methods, Thrashing.

Self-learning components:

Virtual machines and Introduction to Linux Operating System, Introduction to Distributed computing, Parallel computing, grid computing, cloud computing, File System.

TEXT BOOKS:

1. Abraham Silberschatz, Peter Bear Galvin, Greg Gagne, Operating System Principles, Wiley Asia Student Edition, 2009.
2. William Stallings, Operating Systems: Internals and Design Principles, Prentice Hall of India, seventh edition, 2011.
3. D. M. Dhamdhere; Operating Systems: A Concept-Based Approach; Tata McGraw-Hill, Third edition 2012.

REFERENCE BOOKS:

1. Frederic Magoules, Jie Pan, Kiat-An Tan, Abhinit Kumar, Introduction to Grid Computing, CRC Press, Second Edition, 2014
2. Andrew Tanenbaum & Albert Woodhull, Operating Systems: Design and Implementation. Prentice-Hall, Third edition, 2014.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/1658969
2. https://ieeexplore.ieee.org/document/1646682
3. https://ieeexplore.ieee.org/abstract/document/402081

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc20_cs04/preview
2. https://www.coursera.org/lecture/os-power-user/introduction-r0c5h
3. https://onlinecourses.swayam2.ac.in/cec20_cs06/preview

Course Title	Object Oriented Programming with Java				Course Type		HC	
Course Code	B22EF0302	Credits	3		Class		III Semester	
	LTP		Contact	Work	Total Number of Classes		Assessment in	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	0	50%	50%

COURSE OVERVIEW:

In this course the students shall learn Java's unique architecture which enables them to develop a single application that can run across multiple platforms seamlessly and reliably. The students shall also gain extensive experience with Java, object-oriented features and GUI programming skills which helps them to provide solutions to solve real world problems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Impart elementary and the basic object-oriented programming concepts and apply them in problem solving.
2. Illustrate the concept of inheritance and Polymorphism to reuse code and the implementation of packages and interfaces.
3. Introduce the concepts of exception handling and Collection.
4. Demonstrate the concept of event handling used in GUI developed using swing.

COURSEOUTCOMES(COs)

After the completion of the course, the students will be able to

CO#	Course Outcomes	POs	PSOs
CO1	Illustrate the object-oriented programming features of JAVA.	1 to 5,9,10,12	1,2, 3
CO2	Make use of the concepts of inheritance and polymorphism to improve the code reusability.	1 to 5, 9,10,12	1,2, 3
CO3	Examine applications using packages, abstract classes, and interfaces in solving complex problems.	1 to 5, 9,10,12	1,2, 3
CO4	Analyze the usage of String, String constant pool and string methods, String Builder and String Buffer concepts	1 to 5, 9 to 12	1,2, 3
CO5	Explain the insights of Exception Handling, implementing customized exception and inner classes.	1 to 5, 9 to 12	1,2, 3
CO6	Develop the applications using Collection Framework and wrapper classes.	1 to 5, 9 to 12	1,2, 3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3				√		
CO4				√		
CO5					√	
CO6						√

COURSE ARTICULATION MATRIX

CO#/	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**3**	**1**	**3**				**3**	**1**		**3**	**3**		**3**
CO2	**3**	**2**	**3**	**1**	**3**				**3**	**1**		**3**	**3**	**3**	**3**
CO3	**3**	**2**	**3**	**2**	**3**				**3**	**2**		**3**	**3**	**3**	
CO4	**3**	**2**	**3**	**2**	**3**				**3**	**2**	**2**	**3**	**3**	**3**	**3**
CO5	**3**	**2**	**3**	**2**	**3**				**3**	**2**	**2**	**3**	**3**	**3**	**3**
CO6	**3**	**2**	**3**	**2**	**3**				**3**	**3**	**3**	**3**	**3**	**3**	**3**

Note:1-Low,2-Medium,3-High

COURSE CONTENT

Unit-1

OOPS CONCEPTS AND JAVA FUNDAMENTALS:

OOPs Concepts: Introduction to Software and types of software's, Procedural and object-oriented programming paradigm, Differences between C++ and java, Classes and objects, data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism.

Java programming: History of java, JDK, JRE, JVM Architecture, Java Programming environment, comments, data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions, control flow statements, jump statements arrays, console input and output, Introducing classes, Methods and Constructors, types of constructors.

Unit-2

INHERITANCE, POLYMORPHISM, PACKAGES AND INTERFACES:

Inheritance: Basic concepts, Types of inheritance, Member access rules, Usage of this and Super key word,

Polymorphism: Method Overloading, Method overriding, Abstract classes, Dynamic method dispatch, Usage of final keyword.

Packages and Interfaces: Defining package, Types of packages, Access protection, importing packages, Defining and Implementing interfaces, and Extending interfaces, marker interface.

Unit-3

STRINGS, EXCEPTION HANDLING AND INNER CLASSES:

Strings: Introduction to strings, String constant pool, strings methods, String Buffer class, String Builder class, Creating Immutable class, to String (), StrigTokenizer class.

Exception Handling: Fundamentals of exception handling, Exception types, Checked and Unchecked Exceptions, using try and catch, try with resource, multiple catch clauses, nested try statements, throw, rethrow, throws and finally, built- in exceptions, creating own exception sub classes, chained exceptions.

Inner classes: Introduction to inner classes, Types of Inner classes.

Unit-4

WRAPPER CLASSES AND COLLECTION FRAMEWORK:

Wrapper classes: Introduction to wrapper classes, Auto Boxing and Auto unboxing, types of wrapper classes

Collection Framework: Collections overview, Collection Interfaces, The Collection classes- Array List, Linked List, Hash Set, Tree Set, stack, vector, Priority Queue, Array Deque, Map interface, Hash Map, Linked Hash Map, Hash table, Sorted Map interface, Comparable and Comparator interface, Tree Map , java cursors, enum class .

TEXT BOOKS:

1. HerbertSchildt, “Java™:The Complete Reference”,McGraw-Hill,Twelfth Edition,2021.
2. Understanding OOP with Java, up dated edition, T.Budd, Pearson education.

REFERENCE BOOKS:

1. Kathy Sierra and Bert Bates Head First Java, O reilly, 2nd Edition, 2020.
2. Cay S. Horstmann, “Core Java™ Volume I—Fundamentals”, Prentice Hall, Tenth Edition, 2015.
3. Joshua Bloch, “Effective Java”,Addison-WesleyProfessional,ThirdEdition,2017.
4. David Gallardo, Ed Burnette, Robert Mcgovern,“Eclipse in Action a guide for java developers”, Manning Publications,2003.
5. Ed Burnette, “Eclipse IDE Pocket Guide: Using the Full-Featured IDE”, O'Reilly Media, Inc, USA,2005.
6. Ken Kousen, “Modern Java Recipes”, O'Reilly Media, Inc.,2017.
7. Oracle Java Documentation. (https://docs.oracle.com/javase/tutorial/)

JOURNALS/MAGAZINES:

1. https://www.javadevjournal.com/
2. https://blogs.oracle.com/javamagazine/
3. https://ieeexplore.ieee.org/document/5464387
4. https://files.eric.ed.gov/fulltext/EJ1075126.pdf
5. https://www.sciencedirect.com/science/article/pii/S0167642304000590
6. https://www.informingscience.org/Publications/4322?Source=%2FJournals%2FJITEIIP%2FArticles%3FVolume%3D0-0

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_cs84/preview
2. https://www.classcentral.com/course/swayam-programming-in-java-12930
3. https://swayam.gov.in/explorer?searchText=java

SELF-LEARNINGEXERCISES:

1. The Eclipse-IDE
2. Streams
3. Multithreading
4. JavaFX
5. Networking- JDBC

<table>
<tr><td>Course Title</td><td colspan="4">Data Structures</td><td colspan="2">Course Type</td><td colspan="2">Theory (HC)</td></tr>
<tr><td>Course Code</td><td>B22EF0303</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes
Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>--</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

This course covers basic data structures, techniques, and their implementation in C. The course introduces concepts of Dynamic Memory Management, Pointers, Structures, and Linked Lists and their types. This course also introduces Stacks, Queues, Trees and Graphs and their significance.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the basic Concepts of Data Structures with C.
2. Illustrate the creation and use of singly and doubly Linked list in C.
3. Demonstrate the use of Stacks and Queues in real world applications.
4. Discuss the concept and applications of Trees and Graphs.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of arrays, pointers, and structures concepts to solve real world problems	1 to 5,9,10,12	1

CO2	Construct different types of Linked Lists to solve real world problems	1 to 5, 9,10,12	1,2
CO3	Experiment with stacks to solve real world problems.	1 to 5, 9,10,12	1,2
CO4	Apply queues to solve real world problems.	1 to 5, 9,10,12	1,2
CO5	Develop solutions for real world problems using trees.	1 to 5, 9,10,12	1,2,3
CO6	Develop solutions for representing graphs.	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2				3	3		3	3		
CO2	3	2	3	3	2				3	3		3	3	3	
CO3	3	1	2	3	1				3	3		3	3	3	
CO4	3	1	3	3	2				3	3		3	3	3	
CO5	3	3	3	3	1				3	3		3	3	3	3
CO6	3	3	3	3	2				3	3		3	3	3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT – 1

Introduction: Introduction to Data Structures, Classification, Dynamic Memory Management in C: Dynamic Memory Allocation, Dynamic Memory Allocation Functions, Deallocating Memory Using the free Function, Dangling Pointers, Dynamic Memory Allocation Technologies, Pointer and Arrays, Pointers, and Structures.

UNIT – 2

Self-Referential Structures**, Linked Lists**: Singly linked List: SLL/CSLL without Header, SLL/CSLL with Header with detailed operations; Doubly linked List: DLL/CDLL without Header, DLL/CDLL with Header with detailed operations; Linked Stacks and Queues. Programming Examples.

UNIT – 3

Stacks: Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays and Linked Lists, Stack Applications: Polish notation, Infix to postfix conversion, evaluation of postfix expression.

Queues: Definition, Array Representation, Queue Operations, Circular Queues, Circular queues using Dynamic arrays and Linked Lists, Priority Queues, Multiple Stacks and Queues. Programming Examples.

UNIT – 4

Trees: Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Types, Binary Tree Traversals - Inorder, postorder, preorder; Binary Search Trees – Definition, Insertion, Deletion, Traversal, Searching. Programming Examples. **Graphs:** Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs,

TEXTBOOKS:

1. Richard Reese, Understanding and Using C Pointers, First Edition, O'Reilly, 2013.
2. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
3. Seymour Lipschutz, Data Structures With C, Schaum's Outlines, McGraw Hill Education, 2017.
4. Data Structures using C, E Balagurusamy ; McGraw-Hill Education (India), 2013

REFERENCE BOOKS:

1. Richard Gilberg, Behrouz Forouzan, "DataStructures: A Pseudocode Approach with C", Cengage Learning,2004.
2. DebasisSamanta, "Classic DataStructures", second edition, PHI Learning Private Limited,2011.

JOURNALS/MAGAZINES:

1. https://www.imedpub.com/scholarly/data-structure-journals-articles-ppts-list.php
2. https://www.mdpi.com/journal/algorithms/special_issues/Efficient_Data_Structures
3. https://ieeexplore.ieee.org/document/4055607
4. https://ieeexplore.ieee.org/abstract/document/6312216
5. https://www.sciencedirect.com/science/article/pii/0022000083900065
6. https://www.sciencedirect.com/journal/journal-of-algorithms

SWAYAM/NPTEL/MOOCs:

1. Coursera – Data Structures and Algorithms Specialization
2. Coursera – Data Structures, University of California San Diego
3. Data Structures and Algorithms, National Research University Higher School of Economics
4. https://nptel.ac.in/courses/106/102/106102064/
5. https://nptel.ac.in/courses/106/106/106106127/
6. https://nptel.ac.in/courses/106/103/106103069/

SELF-LEARNING EXERCISES:

1 Storing game entities in a array
2 Pseudo-random number generators
3 Reversing an array using a stack
4 Matching parentheses and HTML tags
5 Double ended queue
6 Application of tree traversals

<table>
<tr><td>Course Title</td><td colspan="4">Digital Logic and Design</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EH0301</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

This course provides an introduction to Logic design and the basic building blocks used in Digital systems, in particular Digital computers. It starts with the discussion of Combinational Logic: Logic gates, Minimization techniques and Arithmetic circuits. The course introduces theoretical foundation for Sequential circuits: Flip-flops and Design of Sequential circuits using Moore & Mealy models.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Make use of K Map and Quine McClusky methods for simplifying Boolean expressions;
2. Make choice of suitable data Processing circuits for a given application;
3. Know the behavior of Flip Flops and Use them in building Shift registers and counters.
4. Build Synchronous sequential circuits designed using Moore and Mealy Models.

COURSE OUTCOMES (COs)
After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply knowledge of binary systems, logic gates and Boolean functions to minimize and implement digital circuits	1,2,3,4,5,12	1,2,3
CO2	Understand working of combinational circuits used for Data processing applications	1,2,3,4,5,12	1,2,3
CO3	Analyze the Flip Flops and express their behavior in various forms.	1,2,3,4,5,12	1,2,3
CO4	Analyze and Implement Shift Register, Counters using Flip flops.	1,2,3,4	1,2,3

CO5	Demonstrate models used in the design of sequential circuits.	1,2,3,4,5,12	1,2,3
CO6	Use Moore and Mealy models for designing sequential circuits.	1,2,3,4,5,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2		√				
CO3				√		
CO4				√		
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO/ PO	Program Outcomes													
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PS O3
CO 1	3	3	3	2	1							1	3	3	3
CO 2	3	3	3	3	2							2	3	2	3
CO 3	3	3	2	2	1							1	3	2	3
CO 4	3	3	2									3	3	2	3
CO5	3	2	3	1	1							1	3	2	3
CO6	3	3	3	2	2							2	3	2	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Combinational Circuits: Minterms and Maxterms, SOP and POS, The Map Method, Two-Variable K-Map, Three-Variable K-Map, Four Variable K-Maps. Products of Sum Simplification, Sum of Products Simplification, Don't – Care Conditions, NAND and NOR Implementation, Simplification by Quine McClusky method**.**

UNIT – 2

Data Processing Circuits: Half adder, Full adder, Half subtractor, Full Subtractor, Binary Adder/ Subtractor, BCD Adder, Fast Adder, Multiplexers, De-Multiplexers, Decoders, Encoders, Magnitude Comparator. HDL Implementation.

UNIT – 3

Synchronous Logic: Latches, Flip-Flops-RS, JK , MSJK,T and D, Shift Registers- Types, Ring Counter and Johnson Counter, Counters- Ripple Counters –Analysis and design. HDL Implementation

UNIT – 4

Design of Synchronous Sequential Circuits: Synchronous Counters –Analysis and design, Model Selection, State Transition Diagram, State Synthesis Table, Design Equations and Circuit Diagram , Algorithmic State Machine

TEXT BOOKS:

1. D P Leach, A P Malvino, and Goutham Saha, Digital Principles and Applications, Tata McGraw-Hill, 8th edition, 2006.
2. Fundamentals of Logic Design, 5/e, Roth, Cengage.

REFERENCE BOOKS:

1. Digital Logic and Computer Design, M.Morris Mano, PEA.
2. Modern Digital Electronics, R.P. Jain, TMH

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108106177
2. https://nptel.ac.in/courses/117105080

SELF-LEARNING EXERCISES:

1. 5-variable K –Map simplification
2. Vending Machine

<table>
<tr><th>Course Title</th><th colspan="4">JAVA Programming Lab</th><th colspan="2">Course Type</th><th colspan="2">HC</th></tr>
<tr><td>Course Code</td><td>B20EF0305</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>1</td><td>2</td><td>2</td><td>-</td><td>14</td><td>25</td><td>25</td></tr>
</table>

COURSE OVERVIEW:

This Laboratory course supplements the material taught in the theory course programming with J2SE (Java2 standard Edition). The objective of this course is to get hands-on experience in JAVA programming and implementing the concepts learnt in the theory course. Laboratory exercises will normally be conducted using windows operating System with Eclipse Integrated Development Environment (IDE). The Students will experience the classes, objects, Exception handling, wrapper classes, strings and collection framework and also thread concepts.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Learn fundamentals of object-oriented programming in Java using hands-on.
2. Familiarize Java environment to create, debug and run simple Java programs using JDK, JRE, and JVM and also learn how to use Integrated Development Environment (IDE) either Eclipse /Net beans to create Java Application.

3. Demonstrate Primitives types as objects using wrapper classes and Collection Framework Data Structure and importance of strings, Exception Handling, Abstract classes and interfaces.
4. Develop an application to address real time issues.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply basic syntactic concepts of creating classes, Objects and constructors with all primitive types and Control statements.	1 to 3,5,9,10,12	1
CO2	Solve problems using Access Modifies, polymorphism, inheritance etc.	1 to 5, 9,10,12	1,3
CO3	Develop solutions using the concepts of abstract classes, interfaces, packages.	1 to 5, 9,10,12	1,2, 3
CO4	Interpret the concepts of Exception Handling, Strings.	1 to 5, 9,10,12	1,2, 3
CO5	Design Java applications using objects instead of primitives using wrapper classes and Collection Framework Data structure, Inter thread communication	1 to 6, 9,10,12	1,2, 3
CO6	Design and develop solution to address real time applications.	1 to 6, 9,10,12	1,2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
CO1			√			
CO2					√	
CO3						√
CO4					√	
CO5						√
CO6						√

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2		1				1	2		2	2		
CO2	1	2	2	2	1				2	2		2	2		3
CO3	1	2	1	1					2	2		2	2	3	
CO4	1	2	3	1	2				2	2		2	3	3	3
CO5	1	2	2	1	3	2			3	2		2	3	3	3

CO6	1	2	2	1	3	2			3	2		3	3	3	3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and	Expected Skill
	Part-A		
1.	Write a Java program using class and objects concept, to read two distances (in feet and inches) and print their sum in feet and inches, note that if total inches are more than 12 then it would be consider as 1 feet.	Windows/Linux OS, IDE	Understanding class and objects.
2.	Write a java program to find ncr and npr using recursion.	Windows/Linux OS, IDE	Applying concept of Recursion using java
3.	Write a java program to read 2 decimal numbers, convert decimal number to binary number and also find sum of 2 binary numbers.	Windows/Linux OS, IDE	Understanding the concept of Constructors, Control
4.	Write a java program to demonstrate the working of the banking system, where it consisting of the functionalities a. Display all account details b. Search by account number c. Deposit the amount	Windows/Linux OS, IDE	Understanding the concept of instance methods and instance variables
5.	Write a java program to check whether the given matrix is sparse matrix or not. And also find sum of all the elements of the sparse matrix	Windows/Linux OS, IDE	Usage of Arrays
6.	Write a java program to demonstrate the User defined exception.	Windows/Linux OS, IDE	eation of User defined Exception using Inheritance
7	Write a java program to demonstrate Serializable Marker interface.	Windows/Linux OS, IDE	derstanding Serialization and Deserialization using marker interface concepts

8	Consider Banking Application to pay the monthly EMI for the given principal amount, duration and rate of interest. Demonstrate this application using abstract class and interfaces. e: At least consider minimum three Banks classes	Windows/Linux OS, IDE	derstanding data abstraction using abstract classes and interface
9	Write a java program to swap (exchange) first and last character of each word in the given string.	Windows/Linux OS, IDE	age of immutable concepts using Strings.
10	Write a java program using Hash Map to check two strings are Anagram or not.	Windows/Linux OS, IDE	plication of Map Interface in strings
11	Write a Java program to Demonstrate Comparator interface and Array list to sort student's information by considering student names and students roll number.	Windows/Linux OS, IDE	eation of List interface to demonstrate the application of comparator interface.
12	Write a java program for producer and consumer problem.	Windows/Linux OS, IDE	eation of threads in inter process communication

Sl. No.	Part B Mini Project
1	Develop a project for Airline reservation system List with the following modules: 1. PASSENGER a) Add member b) Delete member c) Search for member d) Edit member 2. FLIGHT a. Add Flight b. Delete Flight c. Search Flight d. Display Flights RESERVATION a. Book b. Cancel

	Title: Airline Reservation system Problem Definition: *Airline Reservation System*" main aim is to provide the online ticket & seat reservation of National and International Flights and give the information about flight departures. Solution: Develop a project to implement an Airline reservation system with the following modules: 1. PASSENGER a. Add member b. Delete member c. Search for member d. Edit member 2. FLIGHT a. Add Flight b. Delete Flight c. Search Flight d. Display Flights RESERVATION a. Book b. Cancel

TEXT BOOKS:

1. Cay S. Horstmann, "Core Java® SE 9 for the Impatient", Addison Wesley, Second Edition, 2018.
2. HerbertSchild, "Java™: TheCompleteReference", McGraw-Hill, Tenth Edition,2018.
3. David Gallardo, Ed Burnette, Robert Mcgovern, "Eclipse in Action a guide for java developers", Manning Publications, 2003.
4. Ed Burnette, "Eclipse IDE Pocket Guide: Using the Full-Featured IDE", O'Reilly Media, Inc, USA, 2005.

Course Title	Data Structures Lab Using C				Course Type		HC	
Course Code	B22EF0306	Credits	1		Class		III Semester	
Course Structure	LTP	Credits	Contact	Work	Total Number of Classes		Assessment in	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	1	2	2	NIL	28	25 %	25 %

COURSE OVERVIEW:

The Data Structure Laboratory in C is designed to provide hands-on experience in implementing and manipulating various data structures using the C programming language. This lab course complements the theoretical knowledge gained in the Data Structures lecture, allowing students to apply their understanding to real-world scenarios. Through a series of practical exercises and projects, students will develop their programming skills, problem-solving abilities, and proficiency in working with fundamental data structures.

COURSE OBJECTIVES:

The objectives of this course are to

1. Understand the principles and importance of data structures in software development.
2. Implement fundamental data structures, such as arrays, linked lists, stacks, queues, trees, and graphs, in C.
3. Apply appropriate data structures to solve various computational problems.
4. Enhance problem-solving skills through hands-on programming exercises.
5. Collaborate effectively in a programming environment by working on team projects.

COURSE OUTCOMES:

On successful completion of this course; the student will be able to

CO#	Course Outcomes	POs	PSOs
CO1	Apply arrays, pointers, and structures concepts to solve real world problems	1 to 5,9,10,12	1
CO2	Demonstrate use different types of Linked Lists to solve real world problems	1 to 5, 9,10,12	1,2
CO3	Illustrate use apply stacks to solve real world problems.	1 to 5, 9,10,12	1,2
CO4	Demonstrate use queues to solve real world problems.	1 to 5, 9,10,12	1,2
CO5	Develop solutions for real world problems using trees.	1 to 5, 9,10,12	1,2,3
CO6	Apply critical thinking and problem-solving skills to solve complex problems involving data structures.	1 to 6, 9,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√	√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2				3	3		3	3		
CO2	3	2	3	3	2				3	3		3	3	3	
CO3	3	1	2	3	1				3	3		3	3	3	
CO4	3	1	3	3	2				3	3		3	3	3	
CO5	3	3	3	3	1				3	3		3	3	3	3
CO6			3	2	3				2			3	3	3	3

Note:1-Low,2-Medium,3-High

Sl No.	Title of the Experiment
	Part A
1.	**Pointers and Arrays:** You are working on a genetics research project and have been tasked with creating a C program to analyze genetic sequences. Genetic sequences are represented as strings of characters **(A: Adenine, T: Thymine, C: Cytosine,** and **G: Guanine)**, where each character represents a nucleotide in the DNA sequence. You need to develop a C program that performs basic analysis on genetic sequences provided by the user. The program will use dynamic memory allocation to store the genetic sequences and arrays to store the analysis results. The program will have the following functionalities: 1. **Input Genetic Sequences:** The program should prompt the user to input a number of genetic sequences. Each sequence should be stored dynamically in memory. 2. **Analysis Functions**: a. **Count Nucleotides**: Write a function that takes a genetic sequence as input and counts the occurrences of each nucleotide (A, C, G, and T) in that sequence. Store the counts in an array. b. **Calculate GC Content**: Write a function that calculates the GC content (the percentage of G and C nucleotides) of a genetic sequence. Store the GC content in an array. The GC content of a DNA sequence is calculated using the following formula: $$GC\ Content = \frac{Number\ of\ G\ and\ C\ nucleotides}{Total\ number\ of\ nucleotides} \times \mathbf{100}$$ 3. **Display Results**: After analyzing all the input sequences, display the analysis results for each sequence. Display the counts of each nucleotide and the calculated GC content. **Requirements**: • Use dynamic memory allocation to store genetic sequences. • Use arrays to store the analysis results (nucleotide counts and GC content) for each sequence. • Implement separate functions for counting nucleotides and calculating GC content. • Use appropriate data types and structures to store the information. **Sample Output**: Genetic Sequence Analyzer Enter the number of genetic sequences: 3 Enter genetic sequence 1: ATCGATTAGCGTCA Enter genetic sequence 2: GCGCGCGTGCAT Enter genetic sequence 3: TACGTACGTACGTACG Analysis Results: Sequence 1: A: 3 C: 3 G: 3 T: 3 GC Content: 33.33% Sequence 2: A: 2 C: 5 G: 5 T: 1 GC Content: 70.00% Sequence 3:

A: 4
C: 4
G: 4
T: 4
GC Content: 50.00%

Note:
In this experiment, you're practicing dynamic memory allocation and array usage. The scenario involves real-world genetics data analysis, making it more engaging and practical.

2. **Pointers and Structures:**

You are tasked with simulating the behavior of particles in a 2D space using C programming. Each particle is represented by its position (`**x**` and `**y**` coordinates as **floats**) and velocity (`**vx**` and `**vy**` components as **floats**). Your goal is to write a program that does the following:

1. Define a structure named `**Particle**` with attributes for position and velocity components.
2. Declare an array of `Particle` structures to store information for a maximum of 4 particles.
3. Populate the array with sample data for 3 particles, including their positions and velocities.
4. Write a function `updateParticle` that takes a pointer to a `Particle` structure as its argument and updates the particle's position based on its velocity. You can assume a constant time step for simplicity.
5. Write a function `printParticle` that takes a pointer to a `Particle` structure as its argument and displays the particle's position and velocity in a formatted manner.
6. In the `main` function, simulate the movement of particles by repeatedly calling the `updateParticle` function for each particle and then calling the `printParticle` function to display their updated information.

Provide the C code to implement the above scenario.
Note:
In this experiment, you're practicing pointers and structure usage. The scenario involves particle simulation in physics.

3. **Dynamic Memory Allocation, Arrays, and Structures: Tic-Tac-Toe Game**

In this programming experiment, you will implement a Tic-Tac-Toe game in C that utilizes dynamic memory allocation, arrays, and structures. The game will be played between two players, **'X'** and **'O'**, on a 3x3 grid. The program will dynamically allocate memory for the grid and use structures to represent the players and their moves.

1. Create a structure named Player with the following attributes:
   a. **char symbol:** To store the player's symbol (**'X'** or **'O'**).
   b. **int score**: To store the player's score (**1** for win, **0** for loss).
2. Implement a function named **initializeGrid** that dynamically allocates memory for a 3x3 grid. Initialize the grid with empty spaces (' ').
3. Implement a function named **printGrid** that takes the dynamically allocated grid as input and prints the current state of the Tic-Tac-Toe grid.
4. Implement a function named **checkWin** that checks if a player has won the game. It should take the grid and the current player's symbol as input and return 1 if the player has won, 0 otherwise.
5. Implement the main function:
   a. Initialize two instances of the Player structure, one for **'X'** and one for **'O'**.
   b. Use a loop to alternate between players and allow them to make moves.
   c. For each move, prompt the current player to enter their row and column choices.
   d. Validate the inputs to ensure they are within the valid range and the chosen cell is not already occupied.
   e. After each move, update the grid and print its current state.
   f. Check if the current player has won using the **checkWin** function.
   g. If a player wins, update their score and display the winner.
   h. If the grid is full and no one has won, display a tie message.
6. Properly deallocate the dynamically allocated memory for the grid at the end of the program.
7. Use proper error handling and input validation to handle incorrect user inputs gracefully.

	Note: This exercise focuses on dynamic memory allocation, arrays and structures.
4.	**Doubly Linked List:** A linked list is a linear data structure used in computer science and programming for storing and organizing a collection of elements. A linked list can be visualized as a chain of nodes, where each node points to the next node, creating a sequence. Create a C program on a doubly linked list that has a header node which maintains additional information of the list like – Number of nodes. Perform insertion at beginning, at end, at a position in the list, perform deletion at beginning, at end and of an item from the list, also include a display operation to display the contents of the list. Your program must be a menu driven program that provides choices to perform various operations. The node should contain the SRN, Name, branch and semester information of students in a college. **Note**: In this exercise, you will practice implementing a doubly linked list.
5.	**Implementing a Stack using Linked List:** You are required to implement all the basic stack operations i.e., push, pop, peek, isEmpty, and display. The following are the rubrics to be followed while preparing the code. 1. **Data Structures**: a. Define a structure **Node** to represent each element of the linked list. It should contain two fields: a data field to store the value, and a pointer to the next node. b. Define a structure **Stack** to represent the stack. It should contain a pointer to the top node of the linked list. 2. **Initialization**: a. Implement a function **void initialize(Stack *stack)** to initialize the stack. This function should set the top pointer to **NULL**. 3. **Push Operation**: a. Implement a function **void push(Stack *stack, int value)** to push an element onto the stack. b. Create a new node with the provided value and link it to the top of the stack. 4. **Pop Operation**: a. Implement a function **int pop(Stack *stack)** to pop an element from the stack. b. Return the value of the top node, update the top pointer, and free the memory of the popped node. 5. **Peek Operation**: a. Implement a function **int peek(Stack *stack)** to retrieve the value of the top element without removing it. b. Return the value of the top node without modifying the stack. 6. **isEmpty Operation**: a. Implement a function **int isEmpty(Stack *stack)** to check if the stack is empty. b. Return 1 if the stack is empty, and 0 otherwise. 7. **Display Operation**: a. Implement a function **void display(Stack *stack)** to display the elements of the stack from top to bottom. b. Traverse through the linked list and print each element's value. 8. **Testing**: a. Create a menu driven main function to test your stack implementation. b. Perform a sequence of push, pop, and peek operations to demonstrate the functionality of the stack. c. Test edge cases, such as popping from an empty stack and peeking into an empty stack, to ensure proper error handling. Implement error handling for edge cases, such as stack overflow and underflow. For example, if the stack is full and a push operation is attempted, or if a pop operation is attempted on an empty stack, display appropriate error messages. **Note**: In this exercise, you will practice implementing a stack data structure using a linked list.
6.	**Circular Queue Implementation with Linked Storage:** You have been tasked with implementing a circular queue data structure using linked storage in C language. The queue should include a header node that stores the number of nodes in the queue, as well as the largest and smallest values currently present in the queue. Implement the following operations for this circular queue: 1. **Initialize Queue**: Write a function to initialize an empty circular queue with a header node. The header node should have its count initialized to 0, and largest and smallest initialized to appropriate values.

	2. **Enqueue**: Write a function to enqueue an integer value into the circular queue. Update the header node's count, largest, and smallest accordingly. 3. **Dequeue**: Write a function to dequeue an element from the circular queue. Update the header node's count, largest, and smallest appropriately. 4. **Get Largest Value**: Write a function to retrieve the largest value from the circular queue. 5. **Get Smallest Value**: Write a function to retrieve the smallest value from the circular queue. 6. **Display Queue**: Write a function to display the elements of the circular queue, starting from the front. **Note**: In this exercise, you will practice implementing a queue data structure using a linked list.
7.	**Infix to Postfix Conversion using Dynamic Stack:** Write a C program to convert an infix expression containing the operators +, -, *, /, %, and ^, along with parentheses, into its postfix form. Your program should use a dynamic flexible array to implement the stack for the conversion process. The program should also be case-insensitive, meaning that it should recognize operators and operands regardless of their case (upper or lower). Your program should perform the following steps: 1. Read an infix expression from the user. 2. Convert the infix expression to postfix using the dynamic stack. 3. Display the resulting postfix expression. Remember to handle operator precedence and associativity correctly during the conversion process.
8.	**Evaluating Postfix Expressions using Linked List-based Stack:** Write a C program to evaluate a postfix expression using a linked list to implement the stack. The program should validate inputs to ensure that only numbers and valid operators are accepted. Your program should perform the following steps: 1. Define a structure for a linked list node that holds an integer value and a pointer to the next node. 2. Implement functions to perform stack operations (push, pop, isEmpty, etc.) using the linked list. 3. Implement a function to evaluate a postfix expression. The function should accept a string containing the postfix expression and return the result of the evaluation. 4. The program should validate the input expression to ensure that only numbers and valid operators (+, -, *, /, %) are present. Any other characters should be considered invalid input. 5. Display appropriate error messages if the input expression is invalid or if there's a problem during evaluation.
9.	**Round Robin Scheduling Simulation – Queues:** You have been tasked with implementing a round robin scheduling simulation using a dynamically allocated array-based queue in C. Your goal is to help manage a set of processes and simulate their execution based on the round robin scheduling algorithm, assuming time of arrival is same for all processes. Write a C program that accomplishes the following tasks: 1. Prompt the user to enter the number of processes. 2. For each process, prompt the user to enter the burst time. 3. Prompt the user to enter the time quantum for the round robin scheduling. 4. Implement the round robin scheduling algorithm using a dynamically allocated array-based queue. 5. Display a Gantt chart that shows the execution order of processes along with their respective start and end times. 6. Ensure that the queue is properly managed for task scheduling. 7. Free any dynamically allocated memory before the program exits.
10.	**Complete Binary Tree:**

	You are tasked with implementing a program that creates a complete binary tree from user input and offers different traversal options. Complete binary trees are special binary trees where all levels are completely filled except possibly the last level, and nodes are added from left to right. Your program should perform the following steps: 1. Take input from the user for the number of elements \`n\` and then \`n\` elements to create a complete binary tree. 2. Implement a function to insert elements into the complete binary tree in level order. 3. Implement functions to perform inorder, preorder, and postorder traversals of the created binary tree. 4. Provide a menu-driven main function that allows the user to choose from the following options: a. Inorder Traversal b. Preorder Traversal c. Postorder Traversal d. Exit Your implementation should create the complete binary tree and allow the user to select a traversal method from the menu. Each traversal method should display the corresponding order of node values. Write a complete C program to achieve the above functionality. You are free to use any standard C libraries and programming constructs.
11.	**Binary Tree Routing Table** Create a C program to demonstrate the use of binary search tree (BST) in implementing a basic routing table for a network. Binary search trees are a type of binary tree where each node has at most two children, and the values in the left subtree are smaller than the node's value, while the values in the right subtree are greater. This property allows for efficient searching and insertion. The program should output appropriate nextHop or "Route not found" message based on destination IP address. The program should do the following tasks: **Binary Search Tree (BST):** In a binary search tree routes must be organized based on the destination IP addresses. The left subtree of a node contains routes with smaller destination IP addresses, and the right subtree contains routes with larger destination IP addresses. **Route Insertion Criteria:** Create a function insert to insert a new route into the binary search tree. • If the tree is empty (i.e., root is NULL), a new node is created with the route and returned. • If the tree is not empty, the function compares the destination IP address of the new route with the destination IP address of the current node. • If the new route's destination IP is less than the current node's destination IP, the insertion continues in the left subtree recursively. • If the new route's destination IP is greater than or equal to the current node's destination IP, the insertion continues in the right subtree recursively. • The function returns the modified subtree after inserting the new route. This structure ensures that when performing a routing lookup, the program can efficiently traverse the tree to find the appropriate next hop based on the destination IP address. **Look up**: Create lookup function for performing a routing lookup in the binary search tree (BST) to find the appropriate next hop for a given destination IP address. **Delete Node:** Create a function **deleteNode** to delete a node with a specific destination IP address from the binary tree routing table.

12.	**Implementing a Symbol Table using Binary Search Tree (BST)** In this programming exercise, you will have the opportunity to implement a symbol table using a Binary Search Tree (BST). A symbol table is a fundamental data structure used in various applications to store key-value pairs. In this case, you will be creating a symbol table that stores words and their corresponding frequencies. Your task is to implement a C program that demonstrates the use of a Binary Search Tree as a symbol table. The program should allow users to input words, which will be inserted into the BST. Each word's frequency will be tracked. After inserting words, the program should display the contents of the symbol table and prompt the user to enter a word for searching. If the word is found in the symbol table, its frequency should be displayed; otherwise, a message indicating that the word is not in the table should be shown.
	Part B (Projects)
	Students have to do two projects, one project testing the skills of structures, arrays, pointers with linked lists before IA1. The second project that test skills of data structure application on stacks and queues along with binary search trees would be submitted before IA2. The rubrics shall be given in the laboratory.

TEXTBOOKS:

5. Richard Reese, Understanding and Using C Pointers, First Edition, O'Reilly, 2013.
6. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
7. Seymour Lipschutz, Data Structures With C, Schaum's Outlines, McGraw Hill Education, 2017.
8. Data Structures using C, E Balagurusamy ; McGraw-Hill Education (India), 2013

REFERENCE BOOKS:

3. Richard Gilberg, Behrouz Forouzan, "DataStructures: A Pseudocode Approach with C", Cengage Learning,2004.
4. DebasisSamanta, "Classic DataStructures", second edition, PHI Learning Private Limited,2011.

Course Title	**Digital Logic and Design Lab**				**Course Type**		**HC**	
Course Code	B22EH0302	**Credits**	**2**		**Class**		**III Semester**	
Course Structure	**TLP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Theory	-	-	-				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	1	2	2		**28**	**25**	**25**

COURSE OBJECTIVES

The objectives of this course are to:

1. Design, build and test Combinational Digital logic circuits
2. Design, build and test Sequential Digital logic circuits
3. Simulate Combinational logic circuits using HDL.
4. Simulate Sequential logic circuits using HDL

COURSE OUTCOMES

On successful completion of this course; student shall be able to:

CO#	Course Outcomes	Pos	PSOs
CO1	Design combinational Digital logic circuits for the given specification and test the design.	1,2,3,4,9,10,12	1,2,3
CO2	Design sequential Digital logic circuits for the given specification and test the design.	1,2,3,4,9,10,12	1,2,3
CO3	Use EVM technique to simplify the Boolean expression and implement the simplified expression using Multiplexers	1,2,3,4,9,10,12	1,2,3
CO4	Demonstrate the Xilinx tool usage for simulating Digital logic circuits described using HDL	1,2,3,4,9,10,12	1,2,3
CO5	Make use ofXilinx tool to Simulate combinational logic circuits	1,2,3,4,9,10,12	1,2,3
CO6	Make use of Xilinx tool to Simulate sequential logic circuits described using VHDL and verify the behavior	1,2,3,4,9,10,12	1,2,3

Course Articulation Matrix:

	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	3					3	3		2	3	1	2
CO 2	3	3	3	3					3	3		2	3	1	2
CO 3	3	3	3	3					3	3		3	3	1	3
CO 4	2	3	3	3	3				3	3		3	3	1	3
CO5	2	3	3	3	3				3	3		3	3	1	3
CO6	2	3	3	3	3				3	3		3	3	1	3

SL.NO	LAB EXPERIMENTS	
1.	a.	Realization of Basic gates using Universal Gates.
	b.	Design and develop VHDL code to realize Basic gates using Universal gates.
2.	a.	Realization of Half adder and Full adder using logic gates.
	b.	Design and develop VHDL code to realize Half adder and Full adder.
3.	a.	Realization of Full Subtractor using 3:8 decoder IC 74138.
	b.	Realization of Half Subtractor using basic gates.

4.	a.	en a 4-variable logic expression, simplify it using Entered Variable Map and realize the simplified logic expression using 8:1 multiplexer IC.
	b.	Design and develop the VHDL code for an 8:1 multiplexer. Simulate and verify it's working.
5.	a.	ılization of Master Slave JK flip flop truth table using IC 7476 and verify Delay and toggle flip flop using MSJK flip flop IC.
	b.	Design and develop VHDL code for D and T Flip-Flop with positive-edge triggering. Simulate and verify it's working.
6.		ṣign and implement a mod-n (n<8) synchronous up counter using J-K Flip-Flop ICs and demonstrate its working.
7.	a.	ṣign and implement a ring counter using 4-bit shift register and demonstrate its working.
	b.	Design and develop VHDL code for Johnson counter. Simulate and verify it's working.
8.	a.	ṣign and implement an asynchronous counter using decade counter IC 7490 to count up from 0 to n (n<=9) and demonstrate its working.
	b.	Design and develop VHDL code for mod-8 up counter, Simulate and verify it's working.
9.		Design and develop VHDL code for 1-bit and 2-bit magnitude comparator, Simulate and verify it's working.
10.		Design and develop VHDL code for 8 to 3 Encoder and 1:4 De-multiplexer, Simulate and verify it's working.

TEXT BOOKS:

1. VHDL: Programming by Example, Douglas L. Perry, Fourth Edition.
2. Carl Hamacher ,ZvonkoVranesic, SafwatZaky, NaraigManjikian, "Computer Organization and Embedded Systems", Sixth Edition, McgraHIll

IV SEMESTER

IV SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE /MC/ SDC	Credit Pattern L	T	P	Total Credit	Contact Hours/ Week	Examination CIE Marks	SEE Marks	Total Marks	Course category (As per AICTE)
1	B22EH0401	Foundations of Artificial Intelligence and Machine learning	HC	2	0	0	3	2	50	50	100	HSMC
2	B22EE0310	Universal Human Values	FC	2	0	0	2	1	25	25	50	PCC
3	B22EN0308	Technical Documentation	MC	1	0	0	1	2				HSMC
4	B22MEM301	Indian Constitution	HC	2	0	0	0	3	50	50	100	PCC
5	B22EF0401	Design and Analysis of Algorithms	HC	3	0	0	3	3	50	50	100	PCC
6	B22EF0402	Database Management Systems	HC	3	0	0	3	3	50	50	100	PCC
7	B22EF0403	Computer Organization and Architecture	HC	3	0	0	3	3	50	50	100	PCC
8	B22EFS41X	Professional Elective 1	PE	3	0	0	3	3	50	50	100	PEC
9	B22EH0402	Foundations of Artificial Intelligence and Machine Learning Lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EF0404	Algorithms Lab	HC	0	0	1	1	2	25	25	50	PCC
11	B22EF0405	Database Management Systems Lab	HC	0	0	1	1	2	25	25	50	PCC
12	B22EH0403	Skill Development course 2	SDC	0	0	2	2	4	50	50	100	SDC
TOTAL				20	0	5	23	30	450	450	900	
TOTAL SEMESTER CREDITS				23								
TOTAL CUMULATIVE CREDITS				88								
TOTAL CONTACT HOURS				30								
TOTAL MARKS				900								

Course Title	Foundations of Artificial Intelligence and Machine Learning				Course Type		HC	
Course Code	B22EH0401	Credits	3		Class		Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW:

The course "Foundations of Artificial Intelligence and Machine Learning" provides an in-depth introduction to the fundamental concepts, theories, and techniques of artificial intelligence (AI) and machine learning (ML). This course aims to equip students with a solid foundation in AI and ML and empower them to apply these principles to real-world problems. Throughout the course, students will gain a comprehensive understanding of the key components of AI and ML, including data preprocessing, feature engineering, model selection, and evaluation. They will learn about different types of machine learning algorithms, such as supervised learning, unsupervised learning, and reinforcement learning, and explore their applications across various domains. The course will start by laying the groundwork with an exploration of the basic principles and theories behind AI and ML. Students will examine the mathematical foundations and concepts underlying machine learning algorithms, enabling them to grasp the fundamental mechanisms behind these models.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Gain a solid understanding of the fundamental principles and theories of AI and ML.
2. Develop proficiency in applying different machine learning algorithms to real-world datasets.
3. Acquire the skills to preprocess and engineer data effectively for machine learning tasks.
4. Evaluate and compare the performance of different machine learning models using appropriate metrics.
5. Explore the ethical implications and considerations inherent to AI and ML systems.
6. Apply critical thinking and problem-solving skills to design and develop effective machine learning solutions.

COURSEOUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Recall the fundamental concepts and terminology of artificial intelligence and machine learning.	1 to 5,9 10,12	1,2
CO2	Explain the principles and theories behind artificial intelligence and machine learning.	1 to 5,9.10,12	1,2
CO3	Identify the different types of machine learning algorithms and their applications.	1 to 5,9,10,12	1,2,3

CO4	Demonstrate an understanding of the mathematical foundations of machine learning algorithms.	1to 5,9,10,12	1,2
CO5	Apply machine learning algorithms to real-world datasets for solving classification and regression problems.	1to 5,9,10,12	1,3
CO6	Evaluate the performance of machine learning models using appropriate metrics and techniques.	1to 5,9,10,12	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3		√				
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2				3	3		1	3	3	3
CO2	3	3	2	3	1				3	3		1	3	3	3
CO3	3	3	2	3	3				3	3		1	3	3	3
CO4	3	3	2	3	1				3	3		1	3	3	3
CO5	3	2	3	3	3				3	3		1	3	3	3
CO6	3	3	2	3	3				3	3		1		3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

Unit-1
Introduction: What Is AI?, The Foundations of Artificial Intelligence, The History of Artificial Intelligence,
The State of the Art. **Intelligent Agents**: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents. **Solving Problems by Searching**: Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed search strategies.

Unit-2
Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments. **Constraint**

Satisfaction Problems: Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.

Unit-3

Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias

Decision tree Learning : Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.

Unit-4

Artificial neural network : Introduction, Neural Network representation, Appropriate problems, Perceptrons, Backpropagation algorithm.

Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm, k-nearest neighbor learning, locally weighted regression, Radial basis functions.

TEXTBOOKS

1. Stuart Russell and Peter Norvig, Artificial Intelligence, Third Edition 2010, Pearson Education, Inc.
2. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.

REFERENCE BOOKS:

1. Rich, E., Knight, K., & Nair, S. (2009). Artificial Intelligence. Tata McGraw Hill.
2. Learning, M. (1997). Tom Mitchell. Publisher: McGraw Hill.

SWAYAM NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_cs56/preview
2. https://onlinecourses.nptel.ac.in/noc23_cs18/preview

GitHub Links:

https://github.com/topics/artificial-intelligence

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</table>

COURSE OVERVIEW

COURSE OBJECTIVE

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the significance of value inputs in a classroom and start applying them in their life and profession.	PO6,PO8	1
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.	PO7,PO8	
CO3	Understand the role of a human being in ensuring harmony in society and nature.	PO6,PO8	
CO4	Demonstrate the role of human being in the abetment of pollution.	PO7,PO8	1
CO5	Describe appropriate technologies for the safety and security of the society as responsible human being.	PO7,PO8	1
CO6	Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.	PO8	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyse (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3		√				
CO4			√			
CO5		√				
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						1		3					1	
CO2							1	2						
CO3						1		2						
CO4							1	2					1	
CO5							1	2					1	
CO6								3						

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship, basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happinessand Prosperity correctly, Method to fulfil human aspirations: understanding and living in harmony at various levels, Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs ofSelf ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seeker and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.

Unit - 2

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co- existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Unit - 3

Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Unit - 4

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize theprofessional competence for augmenting universal human order b. Ability to identify the scope and characteristics ofpeople friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management modelsand production systems. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations.

TEXT BOOKS:

1. R R Gaur, R Sangal, G P Bagaria, Human Values and Professional Ethics, Excel Books, New Delhi, 2010
2. A.N Tripathy, Human Values, New Age Intl. Publishers, New Delhi, 2004.
3. R.R. Gaur, R. Sangal and G.P. Bagaria, A Foundation Course in Human Values and Professional Ethics, Excel Books, New Delhi, 2010
4. Bertrand Russell, Human Society in Ethics & Politics, Routledge Publishers, London, 1992

REFERENCE BOOKS:

1. Corliss Lamont, Philosophy of Humanism, Humanist Press, London, 1997
2. I.C. Sharma, Ethical Philosophy of India Nagin & co Julundhar, 1970
3. Mohandas Karamchand Gandhi, The Story of My Experiments with Truth, Navajivan Mudranalaya, Ahmadabad, 1993

<table>
<tr><td>Course Title</td><td colspan="4">Technical Documentation</td><td colspan="2">Course Type</td><td colspan="2">FC</td></tr>
<tr><td>Course Code</td><td>B22EN0308</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment Weightage</td></tr>
<tr><td>Lecture</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>1</td><td>1</td><td>1</td><td>14</td><td>-</td><td>50%</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW:

Technical writing is all about strategically placing facts and figures in a sensible and user-understandable way. A structured approach encourages creating a better output, all the while considering available resources and objectives. This course focus on various factors to improve the skills of Technical documentation.

COURSE OBJECTIVES:

The objectives of this course are to:
1. Acquire language skills
2. Develop linguistic and communicative competencies
3. Study academic subjects more effectively using the theoretical and practical components of English syllabus, and hence will develop study skills and communication skills in formal and informal situations.

COURSE OUTCOMES (COs):

On successful completion of this course students should learn

CO#	Course Outcomes	POs	PSOs
CO1	Produce effective engineering documents that enable readers to access relevant information.	6,8,9,10, 12	**1**
CO2	Learn to avoid communication problems that distract the readers, causing confusions, distrust, or misunderstanding.	6 8,9,10,12	**1**
CO3	Practice various verbal reasoning and grammar practice.	6,8,9,10,12	**1**
CO4	Search engineering information, both in traditional ways and online.	6,8,9,10,12	1
CO5	Write research/design reports with special emphasis on content and style.	6,8,9,10,12	1
CO6	Improve the art of presentations in team	6,8,9,10, 12	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√					
CO2	√					
CO3		√				
CO4		√				
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						1		1	2	2		2	1		
CO2						1		1	2	2		2	1		
CO3						1		1	2	2		2	1		

CO4						1		1	2	2		2	1		
CO5						1		1	2	2		2	1		
CO6						1		1	2	2		2	1		

Note:1-Low,2-Medium,3-High **COURSE**

CONTENTS:

UNIT – 1

Information Design and Development- Different kinds of technical documents, Information development life cycle, factors affecting information and document design, Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style.

UNIT-2

Advanced Technical Communication: Introduction to advanced technical communication, Usability, Managing technical communication projects, time estimation, Single sourcing, Localization, Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

TEXT BOOKS:

1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843)
3. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
4.Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
5.Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
6.Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002. 7. Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN 0402213).

<table>
<tr><td>Course Title</td><td colspan="4">Indian Constitution</td><td colspan="2">Course Type</td><td colspan="2">MC</td></tr>
<tr><td>Course Code</td><td>B22MEM301</td><td>Credits</td><td colspan="2">0</td><td colspan="2">Class</td><td colspan="2">III/IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>0</td><td>2</td><td>2</td><td>28</td><td>0</td><td>50 %</td><td>50 %</td></tr>
</table>

COURSE OVERVIEW

The Constitution of India lays down in defining fundamental political principles, establishes the structure, procedures, powers and duties of government institutions and sets out fundamental rights, directive principles and duties of citizen. It helps to know and understand state executive and elections system of India.

COURSE OBJECTIVES

The objectives of this course are to:

1. To know about the basic structure of Indian Constitution.
2. To know the Fundamental Rights (FR's), DPSP's and Fundamental Duties (FD's) of our constitution.
3. To know about our Union Government, political structure & codes, procedures.
4. To know the State Executive & Elections system of India.
5. To learn the Amendments and Emergency Provisions, other important provisions given by the constitution

COURSE OUTCOMES (Cos)

After the completion of the course, the student will be able to:

CO	Course Outcomes	Pos	PSOs
CO1	Analyze the basic structure of Indian Constitution	6,8,9, 12	
CO2	Remember their Fundamental Rights, DPSP's and Fundamental Duties (FD's) of our constitution	6,8,9, 12	
CO3	Know about Indian Union Government, political structure & codes, procedures.	6,8,9, 12	
CO4	Understand our State Executive & Elections system of India	6,8,9, 12	
CO5	Understand the Amendments and Emergency Provisions, other important provisions given by the constitution	6,8,9, 12	

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1				**√**		
CO2		**√**				
CO3		**√**				
CO4		**√**				
CO5		**√**				

COURSE ARTICULATION MATRIX

CO / Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						**2**		**1**	**1**			**1**			
CO2						**2**		**1**	**1**			**1**			
CO3						**2**		**1**	**1**			**1**			
CO4						**2**		**1**	**1**			**1**			
CO5						**2**		**1**	**1**			**1**			
Average						2		1	1			1			

Note: **1-Low, 2-Medium, 3-High**

COURSE CONTENT

Unit – 1

Indian Constitution: Necessity of the constitution, societies before and after the constitution adoption, introduction to the Indian constitution, making of the constitution, role of the constituent assembly.

Unit – 2

Salient features of India Constitution: Preamble of Indian constitution and key concepts of the preamble, fundamental rights and its restriction and limitations in different complex situations.

Unit – 3

DPSP's and Fundamental Duties: Directive Principles of State Policy (DPSP's) and its present relevance in Indian society, fundamental duties and its scope and significance in nation, union executive: parliamentary system, union executive – president, prime minister, union cabinet.

Unit – 4

Executive and Elections system of India: Parliament - LS and RS, parliamentary committees, important parliamentary terminologies, judicial system of India, supreme court of India and other courts, judicial reviews and judicial activism, state Executive and Governer, CM, state cabinet, legislature - VS & VP, election commission, elections and electoral process, amendment to constitution, and important constitutional amendments till today, emergency provisions.

TEXT BOOKS

1. Kapoor, S.K., "Human rights under International Law and Indian Law", Prentice Hall of India, New Delhi, 2002.
2. Basu, D.D., "Indian Constitution", Oxford University Press, New Delhi, 2002.

REFERENCES BOOKS

1. M V Pylee, "An Introduction to Constitution of India", S Chand & Company, 5th Edition.
2. Durga Das Basu, "Introduction to constitution of India", LexisNexis, 23rd Edition.

Course Title	**Design and Analysis of Algorithms**				**Course Type**	**HC**	
Course Code	**B22EF0401**	**Credits**	**3**		**Class**	**IV Semester**	
Course Structure	**LTP**	**Credits**	**Contact**	**Work**	**Total Number of Classes**	**Assessment in**	
	Lecture	3	3	3			
	Tutorial	-	-	-	Theory	CIE	SEE
	Practical	-	-	-			
	Total	3	3	3	42	50%	50%

COURSE OVERVIEW:

It is a conceptual course which gives insight to the students about different algorithm design techniques. Understanding the fundamental concepts of writing algorithms for the given problem using appropriate algorithmic design technique and analyzing for its time complexity makes students to develop problem solving skill sets and coding methodology.

This course introduces techniques for the design and analysis of efficient algorithms and methods of applications. Deals with analyzing Time and Space complexity of algorithms and to evaluate trade-offs between different algorithms.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Develop a solid understanding of fundamental concepts in algorithm design, analysis, and data structures.
2. Enhance problem-solving skill sets and strategies for designing efficient algorithms.
3. Learn techniques for analyzing the efficiency of algorithms, including Time and Space complexity analysis.
4. Evaluate the learned concepts and techniques to solve a variety of complex problems using different algorithms.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand of fundamental algorithmic concepts	1, 2, 3, 5, 9,12	1,2,3
CO2	Design efficient algorithms and solve a variety of problems	1, 2, 3, 5, 9,12	1,2
CO3	Develop the skills to analyze the time complexity and space complexity of algorithms.	1, 2, 3, 5, 6, 9, 12	1,2
CO4	Analyze different algorithmic techniques and data structures to solve the problems efficiently.	1, 2, 3, 5, 6, 9, 12	1,2,3
CO5	Apply the knowledge and skills to solve problems that require algorithmic solutions	1, 2, 3, 5, 6, 9,12	1,2
CO6	Evaluate the algorithms for real time complex problems.	1, 2, 3,4, 5, 6, 9,12	1,2,3

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
CO1		√				
CO2			√	√		
CO3			√	√		
CO4				√		
CO5			√		√	
CO6			√	√	√	

COURSE ARTICULATION MATRIX

Course Outcomes	Program Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO 1	**3**	**2**			**1**								**3**	**3**	
CO 2		**3**			**2**							**2**	**3**	**3**	
CO 3		**2**	**3**		**3**							**2**	**3**	**3**	**3**
CO 4		**2**	**2**		**2**							**2**	**3**	**3**	
CO 5			**3**		**3**				**2**			**2**	**3**		**3**
CO 6			**3**	**2**	**2**				**2**			**3**		**3**	**3**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction: Notion of algorithm, Important Problem types, Fundamentals of data structures, Asymptotic Notations and its properties, Basic Efficiency classes, Analysis framework, Mathematical analysis for Recursive and Non-recursive algorithms.

UNIT – 2

Algorithm design techniques-Brute force : sequential search, Uniqueness of Array, Exhaustive search Travelling Salesman, Knapsack Problem and String matching.

Hashing: Hash Table organizations, Hashing Functions, Static and Dynamic Hashing.

UNIT – 3

Dynamic programming and greedy technique: General Method of dynamic programming, Fibonacci numbers, warshall's, floyds,0/1 Knapsack, Greedy technique General method, Minimum spanning tree, Dijkstra's Algorithm.

UNIT – 4

Backtracking , Coping with the limitations of algorithm :n-Queens problem, Subset-sum problem, basic concepts of deterministic and non-deterministic algorithms, P, NP, NP-Complete and NP-Hard problems

Text Books:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd edition, Pearson Education, 2017.

Reference Books:

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd edition, PHI Learning Private Limited, 2017

2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson.

3. Donald E. Knuth, "The Art of Computer Programming", Volumes 1and 3 Pearson.

Web Based Resources and E-books:

1. NPTEL Course on "Design and Analysis of Algorithms", Prof. Abhiram G Ranade, Prof. Ajit A Diwan and Prof. Sundar Vishwanathan, https://nptel.ac.in/courses/106101060

2. "Introduction to Design and Analysis of Algorithms" by Anany Levitin, 2nd edition

http://160592857366.free.fr/joe/ebooks/ShareData/Anany%20Levitin%20English

3.https://www.researchgate.net/publication/276847633_A_Review_Report_on_Divide_and_Conquer_Sorting_

Algorithm

4. https://www.ijsrp.org/research-paper-0813/ijsrp-p2014.pdf

5. https://iopscience.iop.org/article/10.1088/1742-6596/1566/1/012038/pdf

Practice

Here are some key activities involved in the design and analysis of algorithms:

Problem Understanding: The first step is to clearly understand the problem at hand. This involves identifying the input, output, constraints, and any specific requirements.

Algorithm Design: Once the problem is understood, the next step is to design an algorithm to solve it. This involves creating a step-by-step procedure or a set of rules that outlines how the problem can be solved.

Algorithm Analysis: After designing the algorithm, it is essential to analyze its efficiency and performance. This analysis includes evaluating the algorithm's time complexity (how the running time grows as the input size increases) and space complexity (how much memory the algorithm requires).

Algorithm Optimization: Based on the analysis, the algorithm can be optimized to improve its efficiency. This may involve making algorithmic modifications, utilizing data structures that are better suited for the problem, or applying known optimization techniques.

Algorithm Correctness: Ensuring the algorithm is correct is crucial. This involves proving its correctness using formal methods like mathematical proofs or conducting extensive testing to verify that the algorithm produces the correct output for different input scenarios.

Algorithm Implementation: Once the algorithm design is finalized and its correctness is established, the next step is to implement the algorithm in a programming language. This involves translating the algorithm into code and addressing any specific programming language considerations.

Experimental Analysis: To validate the algorithm's performance in practice, experimental analysis can be conducted. This involves running the algorithm on various inputs and measuring its running time, memory usage, and other relevant metrics. The results can be compared with the theoretical analysis to verify the algorithm's efficiency.

These activities are iterative and may involve revisiting earlier stages as the design and analysis process progresses. The goal is to create efficient and reliable algorithms that can effectively solve specific problems.

Course Title	**Database Management System**				**Course Type**	**HC**	
Course Code	B22EF0402	**Credits**	**3**		**Class**	**IV Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Theory	3	3	3			
	Practice	-	-	-	Theory	CIE	SEE
	-	-	-	-			
	Total	**3**	**3**	**3**	**42**	**50**	**50**

COURSE OVERVIEW:

This course is intended to provide an understanding of the current theory and practice of database management systems. The course provides a solid technical overview of database management systems, using a current database product as a case study. In addition to technical concerns, more issues that are general are emphasized. These include data independence, integrity, security, recovery, performance, database design principles, and database administration. This course is designed to investigate how database management system techniques are used to design, develop, implement, and maintain modern database applications in organizations.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the basic concepts about the conceptual data models and ER diagrams.
2. Make use of basic concepts to build the relational models and relational algebra.
3. Apply SQL commands to create and manipulate database.

4. Analyze database design concepts using normalization techniques.

COURSEOUTCOMES(COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Construct the conceptual entity relationship diagrams for the real - world applications.	1 to 5, 9,10,12	1,2,3
CO2	Make use of the concepts of relational algebra to solve queries over database.	1 to 5,9,10,12	1,2
CO3	Relate conceptual model to relational model and formulate relational algebra queries	1 to 5, 9,10,12	1,2
CO4	Create the database for given real world application and solve queries over it using SQL commands.	1 to 5, 9,10,12	1,2,3
CO5	Organize database using design guidelines and normalization technique.	1 to 5, 9,10,12	1,2
CO6	Design the database model for real-world applications	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

	Bloom's Level					
CO#	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4						√
CO5					√	
CO6						√

COURSE ARTICULATION MATRIX

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO 1	3	3	3	2	3				3	3		3	3	3	
CO 2	3	3	2	2	1				3	3		3	3	3	
CO 3	3	3	2	2	1				3	3		3	3	3	3
CO 4	3	3	3	3	3				3	3		3	3	3	
CO 5	3	3	1	3	1				3	3		3	3		3
CO 6	3	3	3	3	3				3	3		3		3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT – 1

Introduction to databases and Conceptual Modelling: Introduction, characteristics of the database approach, data models, schemas, instances, database languages and interfaces, Using high-level conceptual data models for database design, a sample database application, entity types, attributes, keys, relationship types, weak entity types, ER diagrams, naming conventions, design issues.

UNIT – 2

Relational Data Model and Relational algebra: Relational model concepts, relational model constraints and relational database schemas, update operations, transactions, dealing with constraint violations, unary relational operations, select and project, relational algebra operations from set theory, binary relational operations, join and division, additional relational operations, examples of queries in relational algebra

UNIT – 3

SQL: SQL data definition and data types, specifying constraints in SQL, basic retrieval queries in SQL, insert, delete, update statements in SQL, additional features of SQL, schema change statements in SQL, retrieving data using the SQL Select Statement, Restricting and sorting data, Using Single row functions, Joins, More complex SQL retrieval queries, views in SQL.

UNIT – 4

Database Design Theory and Normalization: Informal design guidelines for relation schemas, Functional dependencies, Normal forms based on primary keys, General definitions of second and third normal forms, Other Normal forms.

TEXTBOOKS:

1. Elmasri and Navathe, "Fundamentals of Database Systems", 5th Edition, Pearson Education, 2007.
2. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", 3rd Edition, McGraw Hill, 2003
3. Phill Pratt, "Concepts of Database Management, Cengage Learning", 8th Edition, 2014.
4. Jeffrey A Hoffer, "Modern Database Management, Pearson", 12th Edition, 2015.

REFERENCEBOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan: "Database System Concepts", 6th Edition, McGraw Hill, 2010.
2. C J Date, "Database Design and Relational Theory: Normal Forms and All that Jazz", O 'Reilly, April 2012.
3. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi
4. IEEE Transactions on Knowledge and Data Engineering
5. Elsevier Data and Knowledge Engineering
6. ACM Transactions on Database Systems

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/5464387
2. https://blogs.oracle.com/javamagazine/
3. https://airccse.org/journal/ijdms/index.html
4. https://www.imedpub.com/scholarly/database-management-journals-articles-ppts-list.php
5. http://www.odbms.org/odmg-standard/reading-room/magazines/
6. https://www.igi-global.com/journal/journal-database-management/1072

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_cs51/preview
2. https://www.mooc-list.com/tags/database-management
3. https://onlinecourses.swayam2.ac.in/cec21_cs11/preview
4. https://www.udemy.com/topic/database-management/

Course Title	Computer Organization and Architecture	Course Type	HC

Course Code	B22EF0403	Credits	3			Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load		Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3					
	Tutorial	-	-	-		Theory	Practical	CIE	SEE
	Practical	-	-	-					
	Total	**3**	**3**	**3**		**42**	**0**	**50%**	**50%**

COURSE OVERVIEW:

The course is designed to make the students capable of comprehending the fundamental design of a digital computer. Understanding the hardware that powers the code and how it interacts with the existing memory and I/O structure during execution at the physical level requires study of computer organisation and architecture. It aids students in grasping the principles of computer system design so they may expand on the capabilities of computer organisation to identify and address issues with computer architecture.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the basics of computer organisation & architecture.
2. Learn the mechanism of computer arithmetic.
3. Recognize the different memory hierarchy.
4. Study the different I/O mechanism.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Recognize and explain the significance of a digital computer's fundamental parts, I/O organisation, and memory architecture.	1,2,3,9,12	1
CO2	Describe how arithmetic algorithms are implemented in a digital computer.	1,2,3.9,12	1
CO3	Explain the types of memory systems and mapping functions used in memory systems	1,2,39,12	1
CO4	Understand the different input output mechanism and interfacing circuits.	1,2,3,9,12	1
CO5	Discuss different communication techniques used in computer architecture.	1,2,3,9,12	1
CO6	Demonstrate the control signals required for the execution of a given instruction	1,2,3,9,12	1

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2						3			2	3		
CO2	3	3	2						3			2	3		
CO3	3	3	2						3			2	3		
CO4	3	3	3						3			2	3		
CO5	3	2	2						3			2	3		
CO6	3	2	2						3			2	3		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Basic Structure of Computers & Basic Processing: Computer Types, Functional Units, Input Unit, Memory Unit, Arithmetic and Logic Unit, Output Unit, Control Unit, Basic Operational Concepts.

Some Fundamental Concepts, Instruction Execution, Load Instructions, Arithmetic and Logic Instructions, Store Instructions.

UNIT – 2

Computer Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Carry-Lookahead Addition, Multiplication of Unsigned Numbers, Array Multiplier, Sequential Circuit Multiplier, Multiplication of Signed Numbers, The Booth Algorithm, Fast Multiplication, Bit-Pair Recoding of Multipliers, Carry-Save Addition of Summands, Integer Division, Floating-Point Numbers and Operations Arithmetic Operations on Floating-Point Numbers.

UNIT – 3

Memory: Basic Concepts, Semiconductor RAM Memories, Internal Organization of Memory Chips, Static Memories, Dynamic RAMs, Synchronous DRAMs, Structure of Larger Memories, Read-only Memories, ROM, PROM, EPROM, EEPROM, Flash Memory, Direct Memory Access, Memory Hierarchy, Cache Memories, Mapping Functions, Replacement Algorithms, Virtual Memory, Address Translation.

UNIT – 4

I/O : Accessing I/O Devices, I/O Device Interface, Program-Controlled I/O, Interrupts, Bus Structure, Bus Operation, Synchronous Bus, Asynchronous Bus, Arbitration, Interface Circuits, Parallel Interface, Serial Interface, Interconnection Standards Universal Serial Bus (USB), PCI Bus, PCI Express.

Self Learning Components: Pipelining: Basic Concept—The Ideal Case, Pipeline Organization, Pipelining Issues, Data Dependencies, Memory Delays, Branch Delays.

Basic introduction to multi core processors

Text Book:

1. Carl Hamacher, Computer Organization and Embedded Systems, Sixth Edition, Tata MC Graw Hill.

REFERENCE BOOKS:

1. David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware / Software Interface ARM Edition, 4th Edition, Elsevier.
2. William Stallings: Computer Organization & Architecture, 7th Edition, PHI.
3. Vincent P. Heuring& Harry F. Jordan: Computer Systems Design and Architecture, 2nd Edition, Pearson Education.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=40
2. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=2
3. https://dl.acm.org/journal/tocs
4. https://www.sciencedirect.com/journal/future-generation-computer-systems

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc20_cs25/preview
2. https://onlinecourses.nptel.ac.in/noc20_cs64/preview

Professional Elective 1

<table>
<tr><th>Course Title</th><th colspan="4">Data Mining and Warehousing</th><th colspan="2">Course Type</th><th colspan="2">PE</th></tr>
<tr><td>Course Code</td><td>B22EHS411</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>0</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>0</td><td>50%</td><td>50%</td></tr>
</table>

COURSE DESCRIPTION

Data warehousing and data mining are two major areas of exploration for knowledge discovery in databases. Data mining is for relatively unstructured data for which more sophisticated techniques are needed. The course aims to cover powerful data mining techniques including clustering, association rules. It then teaches high volume data processing mechanisms by building warehouse schemas such as snowflake, and star.

COURSE OBJECTIVES

The objectives of this course are to:

1. Describe the basic concepts of Data Warehouse and Data Mining techniques.
2. Illustrate the processing of raw data to make it suitable for various data mining algorithms.
3. Explain the measurement of interesting patterns in different databases
4. Discuss the techniques of clustering, classification, association finding, feature selection and visualization to realworld data.

COURSE OUTCOMES (COs)

On successful completion of this course; the student will be able to:

CO1	Outline the basic concepts of Data Warehouse and Data Mining techniques.
CO2	Make use of preprocessing techniques to process raw data to make it suitable for various data miningalgorithms.
CO3	Solve classification problems using by identifying suitable machine learning algorithm.
CO4	Apply the techniques of clustering to cluster real world data.

BLOOM'S LEVEL OF THE COURSE OUTCOMES

Course Outcomes	**Program Outcomes**														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**

CO 1	2	2	2	2	2	-	-	-	-	-	-	-	3	-	-
CO 2	2	2	2	2	2	1	-	-	-	-	-	1	-	3	-
CO 3	2	2	2	2	2	1	-	-	-	-	-	1	3	3	-
CO 4	2	2	2	2	2	1	-	-	-	-	-	1	-	-	-
CO 5	2	2	2	2	2	1	-	-	-	-	-	1	-	-	-
CO 6	2	2	2	2	2	1	-	-	-	-	-	1	-	-	-

Note: 1-Low, 2-Medium, 3-High

UNIT-1

Data Warehousing: Introduction, Operational Data Stores (ODS), Extraction Transformation Loading (ETL), Data Warehouses, Design Issues, Guidelines for Data Warehouse Implementation, Data Warehouse Metadata, Online Analytical Processing (OLAP): Introduction, Characteristics of OLAP systems, Multidimensional view and Data cube.

UNIT-2

Data Mining: What is Data Mining? Motivating Challenges, The origins of data mining, Data Mining Tasks, Types of Data, Data Quality Data Pre-processing, Measures of Similarity and Dissimilarity, Data Mining Applications, Visualization

UNIT-3

Association Analysis: Basic Concepts and Algorithms, Frequent Itemset Generation, Rule Generation, Compact Representation of Frequent Item sets, Alternative methods for generating Frequent Item sets, FP GROWTH Algorithm, Evaluation of Association Patterns.

UNIT-4

Clustering: Clustering Techniques: Overview, features of cluster analysis, Types of Data and Computing Distance, Types of Cluster Analysis Methods, Partitional Methods, Hierarchical Methods, Density Based Methods, Quality and Validity of Cluster Analysis.

TEXT BOOKS

1. A Pang-Ning Tan, Michael Steinbach and Vipin Kumar, “Introduction to Data Mining”, Pearson Education, 2007.
2. Jiawei Han and Micheline amber, “Data Mining Concepts and Techniques” Second Edition, Elsevier, Reprinted2008.

REFERENCE BOOKS

1. K.P. Soman, ShyamDiwakar and V. Ajay, “Insight into Data mining Theory and Practice”, Easter Economy Edition,Prentice Hall of India, 2006.
2. K. Gupta, “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India 2006.
3. Data Mining and Knowledge Science – Springer.
4. Inderscience, The International Journal of Data mining, Modelling and Management-
5. IEEE, IEEE Transactions on Knowledge and Data Engineering.

<table>
<tr><th>Course Title</th><th colspan="3">System Software</th><th colspan="2">Course Type</th><th colspan="2">PE</th></tr>
<tr><td>Course Code</td><td>B22EHS413</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="4">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
</table>

	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

The course deals with various system softwaresuch as assemblers, loaders, linkers and compilers which support the operation of a computer. It helps the user to focus on an application, without needing to know the details of how the machine works internally. System applications are used to translate into machine language program. The course also deals with lexical and syntactical analysis that deals with construction of parsing. This course is essential for all computer science students who are aspiring to become computer architects

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Impart the knowledge about the architecture of SIC and SIC/XE.
2. Illustrate the use of different addressing modes in generating machine code.
3. Discuss functions of different types of loaders and linkers, structure of compilers
4. Design and develop simple programs using lex and yacc.

COURSE OUTCOMES(COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Summarize the Architecture of SIC and SIC/XE.	1 to 5,9,10,12	1,3
CO2	Apply addressing modes of SIC/XE in developing Assembly programs.	1 to 5, 9,10,12	1,3
CO3	Implement Absolute loader and relocating loader	1 to 5, 9,10,12	2, 3
CO4	To understand the working of compilers	1 to 5, 9,10,12	2
CO5	Identify and generate of tokens using lexical analysis	1 to 5, 9,10,12	1,3
CO6	Define the rules of grammar using syntactic analysis.	1 to 5, 9,10,12	1,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3		√				
CO4		√				
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1				3	3		2	3		3

CO2	3	3	2	2	1				3	3		2	3		3
CO3	3	3	1	1	1				3	3		2		3	3
CO4	3	3	3	1	2				3	3		2		3	
CO5	3	1	2	1	3				3	3		2	3		3
CO6	3	1	2	1	3				3	3		2	3		3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

UNIT – 1

Introduction: System software and machine architecture, The simplified instructional computer (SIC): SIC Machine Architecture, SIC/XE Machine Architecture, SIC and SIC/XE programming examples.

UNIT – 2

Assemblers: BasicAssembler functions: A Simple SIC Assembler, Assembler Algorithm and Data Structures, Machine Dependent Assembler features: Instruction formats & addressing modes, program relocation, Machine Independent Assembler features: Literals, symbol defining statements, expressions, program blocks, control sections and program linking.

UNIT – 3

Loaders: Basic Loader functions: Absolute Loaders, Bootstrap loaders, Machine Dependent loader features: Relocation, program linking, algorithms and data structures for a Linking loader.

Compilers: The structure of a compiler: Grammars, lexical analysis, syntactical analysis & code generation, code optimization, symbol table management, grouping of phases into passes, compiler construction tools, Basic Compiler functions, Applications of compiler technology.

UNIT – 4

Lex and Yacc: The Simplest Lex Program, Grammars, Parser-Lexer Communication, A YACC Parser, The Rules Section, Running LEX and YACC, LEX and Hand- Written Lexers, A Word Counting Program, Using YACC – Grammars, Recursive Rules, Shift/Reduce Parsing, What YACC Cannot Parse, A YACC Parser - The Definition Section, The Rules Section, The LEXER, Compiling and Running a Simple Parser.

TEXTBOOKS:

1. System Software by Leland. L. Beck, D Manjula, 3rd edition, 2012.
2. Doug Brown, John Levine, Tony Mason, lex&yacc, O'Reilly Media, October 2012.

REFERENCEBOOKS:

1. System programming and Compiler Design, K C Louden, Cengage Learning.
2. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman , Compilers-Principles, Techniques and Tools, Pearson, 2nd edition, 2007.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/4724385
2. https://ieeexplore.ieee.org/document/1515775
3. https://ieeexplore.ieee.org/document/537096
4. https://ieeexplore.ieee.org/document/642815
5. https://ieeexplore.ieee.org/document/5942077
6. https://ieeexplore.ieee.org/document/1183668

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_cs07/preview
2. https://onlinecourses.nptel.ac.in/noc21_cs81/preview

3. https://nptel.ac.in/courses/128106013

SELF-LEARNINGEXERCISES:

1. Multi-pass assemblers
2. Macro processors
3. Text Editors
4. Interactive Debugging Systems
5. Operating System

<table>
<tr><td>Course Title</td><td colspan="4">System Modeling and Simulation</td><td colspan="2">Course Type</td><td colspan="2">PE</td></tr>
<tr><td>Course Code</td><td>B22EHS414</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
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<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

Simulation modeling and simulation is the process of creating and able to understand the working principle of a model. In this course, students learn the different statistical techniques and simulation software model.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1.Understand and explain the different simulation techniques.
2.Define the basics of simulation modeling and simulate the real-world situations.
3.Describe the models for the purpose of optimization using simulation software.
4.Analyze the current queueing system through a simulation framework.

COURSE OUTCOMES (COs)

After the completion of the course, the students will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Illustrate the fundamentals of discrete-time and continuous-time simulations.	1,12	1,2,3
CO2	Apply the techniques to model a complex system using discrete event simulation.	1,2,5,12	1,2,3
CO3	Express proficiency in generating random numbers using different techniques.	1,2,3,12	1,2,3
CO4	Analyze the distribution of data using various statistical models.	1,2,5,12	1,2,3
CO5	Apply various simulation techniques / models for real world applications.	1,2,3,4,5,12	1,2,3
CO6	Evaluate the performance of real-world queuing systems.	1,2,3,4,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level

CO#	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4				√		
CO5			√			
CO6				√	√	

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											3	3	3	3
CO2	3	3			3							3	3	3	3
CO3	3	3	3		3							3	3	3	3
CO4	3	3			3							3	3	3	3
CO5	3	3	3	3	2							3	3	3	3
CO6	3	2	2	3								3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

INTRODUCTION: When simulation is the appropriate tool and when it is not appropriate; Advantages anddisadvantages of Simulation; Areas of application; Systems and system environment; Components of asystem; Discrete and continuous systems; Model of a system; Types of Models; Discrete-Event System Simulation, Steps in a Simulation Study.

The basics of spread sheet simulation, the random generators used in the examples, simulation example: Simulation of queuing systems in spread sheet, simulating a single service queue.

UNIT – 2

General Principles, Simulation Software : Concepts in Discrete-Event Simulation, The Event-Scheduling / Time-Advance Algorithm, World Views, Manual simulation Using Event Scheduling, List processing-Basic properties and Operations performed on list, Using arraysfor List processing, Using Dynamic Allocation and Linked Lists, Simulation in Java-Single server Queue simulation in java.

Random Number Generation: Properties of random numbers; Generation of pseudo-random numbers; Techniques for generating random numbers; Tests for Random N for numbers.

UNIT – 3

Statistical Models in Simulation: Review of terminology and concepts, Useful statistical models, Discrete Distributions, Continuous Distributions, Poisson Process, Empirical distributions

UNIT – 4

Queuing Models: Characteristics of queuing Systems, Queuing notation, Long-run measures of performance of queuing Systems, The Conservation Equation, Server Utilization, Steady-state behavior of infinite-population Markovian models, Steady-state behavior of finite-population models, Networks of queues,Rough-cut modeling: An illustration.

Case study: AnyLogic Simulation software: Study of simple queue system, Behavior of queuing system, Bus stop simulation.

TEXT BOOKS:

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, “Discrete-Event System Simulation”, 5th, Pearson Education, 2007.

REFERENCE BOOKS:

1 Seila-Ceric-Tadikamalla, “Applied Simulation Modelling”, Cengage Learning,2004.
2 Averill M. Law, “Simulation Modeling and Analysis”, 4thEdition, Tata McGraw-Hill, 2007.ISBN: 9780070667334
3. Lawrence M. Leemis, Stephen K. Park, “Discrete – Event Simulation: A First Course”,Pearson Education, 2006.ISBN: 978-0131429178

Case study Weblinks:

Simple queue system:
https://cloud.anylogic.com/model/1c626205-7dfa-48ae-8f57-52cd89183afc?mode=SETTINGS
Behavior of queuing system:
https://cloud.anylogic.com/model/dba4abd8-4b7b-41a6-b62a-bef250dc1754?mode=SETTINGS
Bus stop simulation:
https://cloud.anylogic.com/model/2b573f5a-6397-4f40-bcff-e7b710b5b042?mode=SETTINGS

JOURNALS/MAGAZINES:

1. https://www.cs.utexas.edu/users/browne/cs380ns2003/Papers/SimpleQueuingModelspdf.pdf
2. https://www.researchgate.net/publication/303965218_Numerical_Simulation_Approaches
3. https://irh.inf.unideb.hu/~jsztrik/education/16/Queueing_Problems_Solutions_2021_Sztrik.pdf
4. https://www.sciencedirect.com/science/article/abs/pii/S1364032117307761s

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_ma17/preview
2. https://nptel.ac.in/courses/117103017

SELF-LEARNING EXERCISES:

Simulation games in the education system.
1. https://homepage.divms.uiowa.edu/~mbognar/applets/pois.html

Course Title	**Introduction to Python Programming**				**Course Type**		**OE/SC**	
Course Code	**B22EHS415**	**Credits**	**3**		**Class**		**1V Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	**3**	**3**	**3**				
	Tutorial	**-**	**-**	**-**	**Theory**	**Practical**	**CIE**	**SEE**
	Practical	**-**	**-**	**-**				
	Total	**3**	**3**	**3**	**42**	**-**	**50%**	**50%**

COURSE OVERVIEW:

This course presents advanced topics in Python for professional programming. It covers theory only where it will enhance programming ability. The course gives a detailed overview of advanced python programming topics like, define classes, files and exception handling, pattern matching using regular expression, query databases and code graphical interfaces for applications.

COURSE OBJECTIVE (S):
The objectives of this course are to:

1.Describe the semantics of Python programming language.
2.Illustrate the process of structuring the data using lists, dictionaries, tuples, strings and sets.
3.Illustrate the Object-oriented Programming concepts in Python.
4.Demonstrate the basic database design for storing data as part of a multi-step data gathering, analysis, and processing.

COURSE OUTCOMES (COs):
After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Interpret the basic principles of Python programming language	1,2,3,4,5	1,2
CO2	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python	1,2,3,4,5	1,2
CO3	Appraise Exception handling mechanism in real world scenario.	1,2,3,4,5	1,2
CO4	Identify the commonly used operations involving file systems.	1,2,3,4,5	1,2
CO5	Demonstrate the commonly used regular expressions.	1,2,3,4,5	1,2
CO6	Develop database and GUI applications	1,2,3,4,5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3					√	
CO4	√					
CO5			√			
CO6						√

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3								3	2	
CO2	2	2	2	1	3								3	2	
CO3	3	3	2	2	3								3	2	
CO4	2	1	1	3									3	2	
CO5	3	3	2	2	3								3	2	
CO6	3	2	2	2	2								3	2	

Note: 1-Low,2-Medium,3-High

COURSE CONTENT

UNIT – 1

Introduction to Python: Use IDLE to develop programs, Basic coding skills, working with data types and variables, working with numeric data, working with string data, Python functions, Boolean expressions, selection structure, iteration structure, working with lists, work with a list of lists, work with tuples, work with dates and times, get started with dictionaries

UNIT – 2

Classes in Python: OOPS Concepts, Classes and objects, Classes in Python, Constructors, Data hiding, Creating Classes, Instance Methods, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Custom Exception Classes, Iterators, generators and decorators.

UNIT – 3

I/O and Error Handling in Python: Introduction, Data Streams, Creating Your Own Data Streams, Access Modes, Writing Data to a File, Reading Data From a File, Additional File Methods, Handling IO Exceptions, Errors, Run Time Errors, The Exception Model, Exception Hierarchy, Handling Multiple Exceptions, Working with Directories.

UNIT – 4

An Introduction to relational databases: SQL statements for data manipulation, Using SQLite Manager to work with a database, Using Python to work with a database, Creating a GUI that handles an event, working with components.

Text book/s:

1. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016.
2. Halterman, Richard L. "Learning to program with Python" Python Software Foundation 283 (2011).
3. Mark Lutz, Programming Python, O`Reilly, 4th Edition, 2010.

Reference Books:

1. Pilgrim, Mark, and Simon Willison. Dive into python 3. Vol.2. New York, NY, USA: Apress, 2009.
2. Martelli, Alex, Anna Ravenscroft, and David Ascher, Python cookbook, "O'Reilly Media, Inc.", 2005.
3. Sneeringer, Luke, Professional Python, John Wiley & Sons, 2015.
4. Cassell, Laura, and Alan Gauld, Python projects, John Wiley & Sons, 2014.
5. Vaingast, Shai, Beginning Python visualization: crafting visual transformation scripts, Apress, 2014.

Online Resources:

1. https://www.w3schools.com/python
2. https://docs.python.org/3/tutorial/index.html
3. https://www.python-course.eu/advanced_topics.php

Course Title	**Foundations of Artificial Intelligence and Machine Learning Lab**				**Course Type**		**HC**	
Course Code	**B22EH0402**	**Credits**	**1**		**Class**		**Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Leture	-	-	-				
	Theory	-	-	-	Theory	Practical	CIE	SEE
	Practice	1	2	2				
	Total	**1**	**2**	**2**	**-**	**28**	**25%**	**25%**

Course Overview

The course on Artificial Intelligence and Machine Learning (AIML) is designed to introduce students to the fundamentals of AI and the principles and techniques of machine learning. The course will cover a wide range of topics, from the basics of AI and its applications to the various algorithms and methodologies used in machine learning. Students will gain a comprehensive understanding of how AI and ML work and their potential impact on various industries.

Course objectives

1. Introduce students to the concepts and principles of Artificial Intelligence (AI).
2. Explain the various subfields of AI, such as machine learning, natural language processing, computer vision, and robotics.
3. Familiarize students with the history and evolution of AI and its impact on society.
4. Provide an overview of the major algorithms and techniques used in machine learning.
5. Help students understand the different types of machine learning (supervised, unsupervised, and reinforcement learning) and their applications.
6. Enable students to gain practical experience by implementing AI and machine learning models on real-world datasets using popular machine learning libraries and tools for AI development.

Course Outcomes

After studying this course, students will be able to:

CO#	Course Outcomes	Pos	PSOs
CO1	Implement and demonstrate the searching and concept learning algorithms (A* and AO*, Candidate-Elimination)	1,2,3,4,5,9 10,12	1,2
CO2	Demonstrate the working of the decision tree and apply this knowledge to classify a new sample. (ID3)	1,2,3,4,5,9 10,12	1,2
CO3	Build an Artificial Neural Network by implementing the Back propagation algorithm.	1,2,3,4,5,9 10,12	1,2,3
CO4	Apply the naïve Bayesian classification methods and build Bayesian network.	1,2,3,4,5,9 10,12	1,2
CO5	Implement EM algorithm, k-means and compare their results.	1,2,3,4,5,9 10,12	1,3
CO6	Investigate instance based and regression algorithms.	1,2,3,4,5,9 10,12	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	√	√		
CO2		√	√	√		
CO3		√	√	√		
CO4		√	√	√		
CO5		√	√	√		
CO6		√	√	√		

COURSE ARTICULATION MATRIX

CO / PO & PSO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO1 2	PSO 1	PSO 2	PSO 3
CO-1	3	3	2	2	2				3	3		1	3	3	3
CO-2	3	3	2	3	1				3	3		1		3	3
CO-3	3	3	2	3	3				3	3		1	3		3

CO-4	3	3	2	3	1				3	3		1	3	3	
CO-5	3	2	3	3	3				3	3		1	3	3	3
CO-6	3	3	2	3	3				3	3		1		3	3

Note:1-Low,2-Medium,3-High

List of Programs

Sl. No	**Name of Experiment**	**CO**	**PO**	**PSO**
1	plement and evaluate AI and ML algorithms in Python programming language Implement A* Search algorithm.	CO1	1,2,34,5,9,10,12	1,2
2	Implement AO* Search algorithm	CO1	1,2,34,5,9,10,12	1,2
3	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Find-S algorithm to output a hypotheses consistent with the training examples.	CO1	1,2,34,5,9,10,12	1,2,3
4	Write a program to demonstrate the working of the decision tree basedID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	CO2	1,2,34,5,9,10,12	1,2
5	Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.	CO3	1,2,34,5,9,10,12	1,3
6	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	CO4	1,2,34,5,9,10,12	1,2,3
7	Apply k-Means algorithm to cluster a set data stored in .CSV file and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.	CO5	1,2,34,5,9,10,12	1,2,3
8	Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. You can use Java/Python ML library classes can be used for this problem.	CO6	1,2,34,5,9,10,12	1,2,3
9	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set foryour experiment and draw graphs	CO6	1,2,34,5,9,10,12	1,2,3
10	Write a program to construct a Bayesian network considering a medical data. Use this model to demonstrate the diagnosis of heart patients using std heart disease data set. You can use Java/Python ML library classes can be used for this problem.	CO6	1,2,34,5,9,10,12	1,2,3

<table>
<tr><td>Course Title</td><td colspan="4">Algorithms lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EF0404</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="4">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>1</td><td>2</td><td>2</td></tr>
</table>

	Total	**1**	**2**	**2**	**-**	**28**	**25%**	**25%**

COURSE OVERVIEW:

The Design and Analysis of Algorithms Lab is a practical course that complements the theoretical concepts covered in this course. It focuses on hands-on implementation, experimentation, and analysis of algorithms, with an emphasis on problem-solving and performance evaluation. It reinforces the theoretical concepts covered in the accompanying course and equips students with the skill sets necessary to solve complex problems efficiently. This course gives an exposure to improve the coding skill sets of the students.

COURSE OBJECTIVE (S):

The objectives of this course are to

1. Demonstrate performance of algorithms with respect to time and space complexity.
2. Explain Graph and Tree traversals techniques.
3. Understand the concepts of greedy method and dynamic programming for different applications.
4. Illustrate the methods of Backtracking, Branch and bound techniques.
5. Familiarize the concepts of deterministic and non-deterministic algorithms.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Implement sorting and searching techniques using different algorithmic techniques.	1, 2, 3, 5, 9,12	1,3
CO2	Implement Tree Traversal method and Greedy Algorithms	1, 2, 3, 5, 9,12	1,3
CO3	Develop the skill set to solve problems using Dynamic Programming concepts.	1, 2, 3, 5, 6, 9, 12	2,3
CO4	Illustrate Backtracking, Branch and Bound concept to solve various problems	1, 2, 3, 5, 6, 9, 12	1,2
CO5	Demonstrate Time and Space complexities of various algorithms	1, 2, 3, 5, 6, 9, 12	1,2
CO6	Analyze and evaluate different performance analysis methods for non-deterministic algorithms	1, 2, 3,4, 5, 6, 9, 12	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2		√	√			
CO3			√			
CO4			√			
CO5				√		
CO6				√	√	

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3		2							1	3	3	
CO2		3			2							2	3	3	
CO3	2	2	3									2	3	3	3
CO4	2	2	2		2							2	3	3	
CO5	3	2			2				2			2	3		3
CO6			3	2	3				2			3		3	3

Note: 1-Low, 2-Medium, 3-High

SL. NO.	Title of the Experiment
	PART-A
1	t a given set of elements using the Quicksort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
2	)btain the Topological ordering of vertices in a given digraph. Compute the transitive closure of a given directed graph using Warshall's algorithm
3	Implement 0/1 Knapsack problem using Dynamic Programming.
4	From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
5	Find the Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.
6	Find Minimum Cost Spanning Tree of a given undirected graph using Prim’s algorithm.
7	plement any scheme to find the optimal solution for the Traveling Salesperson problem and then solve the same problem instance using any approximation algorithm and determine the error in the approximation.
8	a given graph Print all the nodes reachable from a given starting node in a digraph using BFS method. Check whether a given graph is connected or not using DFS method.
9	plement N Queen's problem using Back Tracking
10	plement All-Pairs Shortest Paths Problem using Floyd's algorithm
	PART-B(Mini Project)
1	Mini Projects on Sorting Algorithm Efficiency Comparison.
2	Mini Projects on Dynamic Programming
3	Mini Projects on Mini Projects on Pathfinding
4	Mini Projects on Graph Traversal Techniques
5	Mini Projects on Traveling Salesman Problem

Reference Books:

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, 3rd edition, PHI Learning Private Limited, 2017

2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson.

3. Donald E. Knuth, “The Art of Computer Programming”, Volumes 1and 3 Pearson.

Web Based Resources and E-books:

1. NPTEL Course on “Design and Analysis of Algorithms”, Prof. Abhiram G Ranade, Prof. Ajit A Diwan and Prof. Sundar Vishwanathan, https://nptel.ac.in/courses/106101060

2. “Introduction to Design and Analysis of Algorithms” by Anany Levitin, 2nd edition

http://160592857366.free.fr/joe/ebooks/ShareData/Anany%20Levitin%20English

3.https://www.researchgate.net/publication/276847633_A_Review_Report_on_Divide_and_Conquer_Sorting_Algorithm

4. https://www.ijsrp.org/research-paper-0813/ijsrp-p2014.pdf

5. https://iopscience.iop.org/article/10.1088/1742-6596/1566/1/012038/pdf

<table>
<tr><td>Course Title</td><td colspan="4">Database Management System Lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EF0405</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>Total</td><td>1</td><td>2</td><td>2</td><td>-</td><td>28</td><td>25%</td><td>25%</td></tr>
</table>

COURSE OVERVIEW:

This course introduces the core principles and techniques required in the design and Implementation of database systems. This introductory application-oriented course covers therelational database systems RDBMS - the predominant system for business scientific and Engineering applications at present. It includes Entity-Relational model, Normalization, Relationalmodel, Relational algebra, and data access queries as well as an introduction to SQL. It also coversessential DBMS concepts such as: Transaction Processing, Concurrency Control and Recovery. Italso provides students with theoretical knowledge and practical skills in the use of databases anddatabase management systems in information technology applications.

COURSE OBJECTIVE (S):
Students will have the ability to:

1. Keep on a level with of current developments to continue their own professional Development.
2. To engage themselves in lifelong learning of Database management systems, Theories and technologies this enables them to purse higher studies.
3. To interact professionally with colleagues or clients located abroad and the ability to overcome challenges that arises from geographic distance, cultural differences, and multiple languages in the context of computing.
4. Develop team spirit, effective work habits, and professional attitude in written and oral forms, towards the development of database applications.

COURSE OUTCOMES
After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the basic concepts of Database Systems and Applications.	1 to 5,9,10,12	1,3
CO2	Use the basics of MySQL and construct queries using MySQL in database creation and interaction.	1 to 5, 9,10,12	1,3
CO3	Design a commercial relational database system (Oracle, MySQL) by writing MySQL using thesystem.	1 to 5,9,10,12	2,3
CO4	Analyze and Select storage and recovery techniques of database system.	1 to 5,9,10,12	1,2
CO5	Construct the physical and logical database designs, database modeling, relational, hierarchical, and network models.	1 to 5, 9,10,12	1,2
CO6	Relate conceptual model to relational model and formulate relational algebra queries.	1 to 5, 9,10,12	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2				2	3		2	3	3	
CO2	3	3	2	3	1				2	3		2	3	3	
CO3	3	3	2	3	3				2	3		2	3	3	3
CO4	3	3	2	3	1				2	3		2	3	3	
CO5	3	2	3	3	3				3	3		3	3		3
CO6	3	3	2	3	3				3	3		3		3	3

Note: 1-Low, 2-Medium, 3-High

PART-A: MySQL Programming

1. Design, develop, and implement the specified queries for the following problems using Oracle, MySQL,SQL Server, or any other DBMS under LINUX/Windows environment.
2. Create Schema and insert at least 5 records for each table.
3. Add appropriate database constraints.

PART-B: Mini Project

1. Use Java, C#, PHP, Python, or any other similar front-end tool.
2. All applications must be demonstrated on desktop/laptop as a stand-alone or web based application (Mobile apps on Android/IOS are not permitted.)

SL.NO.	Title of the Experiment
	PART-A
1	Implementation of DDL, DML, DCL and TCL commands of SQL with suitable examples.
2	Study & Implementation of different types of constraints with suitable examples.
3	Implementation of different types of function, operators, Joins with suitable examples.
4	Study and Implementation of • Group By & having clause • Order by clause • Indexing • Views • Sub queries
5	Identifying entities, attributes, keys and relationshipsbetween entities, cardinalities, generalization, specialization etc. using Conceptual Designing (Ex:- ER Diagrams).
6	**Consider the following schema for a Flight Database and draw an ER Diagram.** FLIGHT(Flight no: integer, Flight from: string, Flight to: string, distance: integer, departs: time, arrives: time, price: real) AIRCRAFT (aid: integer, aname:string, cruisingrange:integer) CERTIFIED (eid:integer, aid:integer) EMPLOYEES (eid:integer, ename:string, salary: integer) **ite SQL queries to** 1. Find the names of aircraft such that all pilots certified to operate them have salaries more than Rs 80,000. 2. For each pilot who is certified for more than three aircrafts, find the eid and the maximum cruising range of the aircraft for which he/she is certified. 3. Find the names of all pilots whose salary is less than the price of the cheapest route from Bangalore to Frankfurt. 4. For all aircrafts with cruising range over 1000 kms, find the name of the aircraft and the average salary of all pilots certified for this aircraft. 5. Find the names of pilots certified for some Boeing aircraft. 6. Find the aid's of all aircraft whose cruising range is greater than the minimum distancefrom the routes from Bangalore to Delhi**.**
7	**nsider the schema for College Database and draw and ER Diagram.** UDENT (USN, SName, Address, Phone, Gender) MSEC (SSID, Sem, Sec) ASS (USN, SSID) BJECT (Subcode, Title, Sem, Credits) MARKS (USN, Subcode, SSID, Test1, Test2, Test3, FinalIA) **ite SQL queries to** List all the student details studying in fourth semester 'C' Section. Compute the total number of male and female students in each semester and in each section. Create a view of Test1 marks of student USN '1BI15CS101' in allsubjects.

	Calculate the FinalIA (average of best two test marks) and update the rresponding table for allstudents. Categorize students based on the followingcriterion: inalIA = 17 to 20 then CAT ='Outstanding' inalIA = 12 to 16 then CAT = 'Average' inalIA< 12 then CAT = 'Weak' e these details only for 8th semester A, B, and C section students.
PART-B(Mini Project)	
	For any problem selected • Make sure that the application should have five or more tables • Indicative areas include; health care, Laboratory Outcomes: The student should be able to: • Create, Update and query on the database. • Demonstrate the working of different concepts of DBMS • Implement, analyze and evaluate the project developed for an application with the front end compatibility.

Course Title	**Skill Development Course - 2**				**Course Type**		**SDC**	
Course Code	**B22EHO403**	Credits	**2**		**Class**		**IV Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	-	-	-				
	Tutorial	-	-	-	**Theory**	**Practical**	**CIE**	**SEE**
	Practical	2	4	4				
	Total	**2**	**4**	**4**	**-**	**56**	**50%**	**50%**

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3

CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3

CO9									3				3	3	3
CO10										3			3	3	3
CO11											3		3	3	3
CO12												3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Skill development-2:

Students will be offered training and certifications on the trending technologies from the industry experts.

The students are evaluated and certified after the training programs.

3rd Year
Detailed Syllabus

V SEMESTER

V SEMESTER

W	Course Code	Title of the Course	HC/FC /SC/ OE/MC /SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22XXO51 X	Open Elective -1 (multidisciplinary)	OE	3	0	0	3	3	50	50	100	POE
2	B22ED0501	Indian Heritage and Culture (MC)	MC	2	0	0	0	2				HSMC
3	B22EF0501	Theory of Computation	HC	3	0	0	3	3	50	50	100	PCC
4	B22EF0502	Big Data Analytics	HC	3	0	0	3	3	50	50	100	PCC
5	B22EF0503	Computer Networks	HC	3	0	0	3	3	50	50	100	PCC
6	B22EH0501	Cloud Computing	HC	3	0	0	3	3	50	50	100	PCC
7	B22EHS51X	Professional Elective 2	SC	3	0	0	3	3	50	50	100	PEC
8	B22EHS52 X	Professional Elective 3	SC	3	0	0	3	3	50	50	100	PEC
9	B22EH050 5	Big Data Analytics Lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EF0506	Computer Networks lab	HC	0	0	1	1	2	25	25	50	PCC
11	B22EH050 2	Cloud Computing Lab	HC	0	0	1	1	2	25	25	50	PCC
12	B22EH050 3	Skill Development course 3	SDC	0	0	2	2	4	50	50	100	SDC
TOTAL				23	0	5	26	33	475	475	950	
TOTAL SEMESTER CREDITS					26							
TOTAL CUMULATIVE CREDITS					114							
TOTAL CONTACT HOURS					33							
TOTAL MARKS					950							

OpenElective 1

(Multidisciplinary)

<table>
<tr><td>Course Title</td><td colspan="3">Introduction to Python Programming</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B22EHO511</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes</td><td colspan="2" rowspan="2">Assessment in</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

This course provides an introduction to programming and the Python language. Students are introduced to core programming concepts like data structures, conditionals, loops, variables, and functions. This course includes an overview of the various tools available for writing and running Python, and gets students coding quickly. In the course we will also discuss Numpy and Pandas along with visualization tools.

COURSE OBJECTIVE (S):

The objectives of this course are to:

a) Explain the fundamentals of python programming language constructs and their applications.

b) Inculcate knowledge of parsing of regular expressions and their usage in various application domains.

c) Gain expertise in Object oriented programming and NumPy package.

d) Discuss the files, Pandas and Data Virtualization concepts.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Write simple computational programs using functions.	1,2,3,4,5,12	1, 2, 3
CO2	Write programs to compute mathematical functions (sin x, e^x and others) using if statements, loops and functions.	1,2,3,4,5,12	1, 2, 3
CO3	Write data processing scripts using string, tuples, sets, dictionaries with appropriate error handling using exceptions.	1,2,3,4,5,12	1, 2, 3
CO4	Write classes to implement given functionality using object-oriented features of python including operator overloading, inheritance, iteration protocol, context management protocol, decorators, and descriptors.	1,2,3,4,5,12	1, 2, 3
CO5	Apply features of object oriented and NumPy package to develop computationally intensive programming to analyze and interpret the data.	1,2,3,4,5,12	1, 2, 3
CO6	Write data processing and visualization scripts using numpy, pandas and matplotlib.	1,2,3,4,5,12	1, 2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
CO1		√				
CO2			√			
CO3			√			
CO4				√		
CO5				√		
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3							3	3	3	3
CO2	3	3	2	3	3							3	3	3	3
CO3	3	2	2	3	3							3	3	3	3
CO4	3	3	3	2	3							3	3	3	3
CO5	3	2	3	3	3							3	3	3	3
CO6	3	3	3	2	3							3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Python Fundamentals: Introduction to Python: History, Applications Your First Python Program, Constants, Variables, Naming conventions, simple data types, Type casting, Assignment statements, expressions, Boolean data type, Trigonometry functions, operators, precedence of operators, libraries, keywords, Python Collections, I/O statements, conditional statements, loops, functions, user defined functions.

UNIT – 2

Exception handling in Python, **Strings:** Unicode, Diving In, Formatting Strings, Format Specifiers, Other Common String Methods, Slicing a String.

Regular Expressions: Case Study: Street Addresses, Case Study: Roman Numerals, Checking for Thousands, Checking for Hundreds, Using the {n,m} Syntax, Checking for Tens and Ones.

UNIT – 3

Object Oriented Programming: Defining Classes, The init_() Method, Instantiating Classes, OOP features: Abstraction. Encapsulation, Single Inheritance, Polymorphism

Files: Reading from Text Files, Writing to text files, Reading and Writing the Binary Files.

UNIT – 4

Numpy: Introduction to numpy, Creating arrays, Indexing Arrays, Array Transposition, Universal Array Function, Array Processing, Array Input and Output

Pandas and Data Visualization: Introduction, Series and Data Frames in pandas, Data Visualization

TEXT BOOKS:

1. Mark Pilgrim, “Dive into Python 3”, Apress special edition, second edition, 20l5.
2. Travis E. Oliphant, “Guide to NumPy”, Trelgol publishers, 2006.

REFERENCE BOOKS:

1. A B Choudhary, “Flowchart and Algorithms Basics” Mercury Learning and Information, 2020.
2. Mark Lutz, “Learning Python”, Oreilly. 2003.
3. John M. Zelle, “PYTHON Programming: An Introduction to Computer Science”, Franklin, Beedle & Associates. 2004.
4. Michael Dawson, “Python Programming for the Absolute Beginners”, 3^{rd} Edition, CENAGE Learning.
5. Wesley J. Chun, “Core Python Programming”, 2^{nd} Edition, Prentice Hall.
6. Steve Holden and David Beazley, “Python Web Programming”, New Riders, 2002. Springer, Kent D. Lee, “Python Programming Fundamentals”, 2^{nd} Edition.
7. John V. Guttag, “Introduction to Computation and Programming using Python”, MIT Press, 2016.

JOURNALS/MAGAZINES:

1. IEEE Transactions on Artificial Intelligence
2. Journal of Machine Learning Research
3. Foundations and Trends in Machine Learning
4. Synthesis Lectures on Artificial Intelligence and Machine Learning
5. ACM Transactions on Intelligent Systems and Technology

SWAYAM/NPTEL/MOOCs:

1. Python for Everybody, Dr. Chuck Online MOOCs, Open Standards, Open Source and OERs
2. Programming, Data Structures and Algorithms using Python, Prof. MadhavanMukund, IIT Madras,

SELF-LEARNING EXERCISES:

1. Data Visualization
2. Basics of Deep Learning

<table>
<tr><td>Course Title</td><td colspan="4">R-Programming</td><td colspan="2">Course Type</td><td colspan="2">OE</td></tr>
<tr><td>Course Code</td><td>B22EHS0512</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
<tr><td rowspan="3">Course</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td>Theory</td><td>Practical</td><td>CIE</td><td>SEE</td></tr>
</table>

Structure	-	-	-	-				
	Total	3	3	3	42	-	50	50

COURSE OVERVIEW:

R is a block-structured programming language used for statistical computations, data analysis and visualization. In this course, students learn the Fundamental concepts of R, data analysis, accessing packages, statistical concepts, object-oriented programming and graphical interpretation.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Understand the fundamentals of R programming.
6. Demonstrate the data handling functions using data frames.
7. Illustrate the linear and mathematical functions to perform statistical operations on data.
8. Compare Graphics features and apply object-oriented concepts for real-world applications.

COURSE OUTCOMES(COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	Pos	PSOs
CO1	Understand the programming fundamentals of R programming.	1,5,12	1-3
CO2	Interpret R script to handle the data frames and perform matrix like operations.	1,2,5,12	1-3
CO3	Implement logical operations, statistical operations, and many more for complex problems.	1,2,3,12	1-3
CO4	Demonstrate the conditional and looping operations to control the flow of data	1	1-3
CO5	Apply object-oriented concepts and demonstrate the mathematical, statistical, and linear operations in R programming.	1,2,5,12	1-3
CO6	Analyze the R graphics features for the given real-world application	1,2,3,4,5,12	1-3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3			√			
CO4			√			
CO5			√			
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3				2							2	3	3	3
CO2	3	3			3							3	3	3	3
CO3	3	3	3									3	3	3	3
CO4	3												3	3	3
CO5	3	3			3							3	3	3	3
CO6	3	3	2	3	3							3	3	3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

UNIT – 1

Introduction to R: Introduction to Functions, some important R Data Structures –Help functions in R, Vectors –Scalars, Vectors, Arrays, and Matrices, Declarations, recycling, Common Vector operations, Using all and any, Vectorised operations, NA and NULL values, Filtering, Vectorised if-then else, Vector Equality, Vector Element names.

UNIT – 2

Matrices, Arrays, Lists and Data Frames: Creating matrices, General Matrix operations, Applying Functions to Matrix Rows and Columns, Adding and deleting rows and columns, Vector/Matrix Distinction, Avoiding Dimension Reduction, Higher Dimensional arrays, lists –Creating lists, General list operations, accessing list components and values, applying functions to lists, recursive lists. Data Frames- Creating Data Frames, Matrix-like operations in frames, Merging Data Frames, Applying functions to Data frames.

UNIT – 3

R Programming structures: Control statements, Arithmetic and Boolean operators and values, Default values for arguments, return values, Functions are objects, Environment and Scope issues, Writing Upstairs, Recursion, Replacement functions, Tools for composing function code, Math and Simulations in R- Math functions, functions for statistical Distributions, Sorting, Linear Algebra operations, Set operations, simulation programming in R.

UNIT – 4

OBJECT-ORIENTED PROGRAMMING: S3 Classes, S4 Classes, managing your objects, Input/Output-Accessing keyboard, and monitor, Reading and writing files, Accessing the internet, String Manipulation, Graphics –Creating Graphs, Customizing Graphs, saving graphs to files, Creating three-dimensional plots.

TEXTBOOKS:

1. Norman Matloff, “The Art of R Programming: A Tour of Statistical Software Design”, No Starch Press, 2011. ISBN-13: 978-1-59327-384-2

REFERENCEBOOKS:

1. Mark Gardener, “Beginning R – The Statistical Programming Language”, Wiley, 2013
2. Robert Knell, “Introductory R: A Beginner's Guide to Data Visualization, Statistical Analysis and programming in R”, Amazon Digital South Asia Services Inc, 2013.
3. Jared P. Lander, “R for Everyone: Advanced Analytics and Graphics”, Addison-Wesley Data & Analytics Series, 2013.

Tutorials for References:

1. https://www.tutorialspoint.com/r/index.htm
2. https://www.javatpoint.com/r-tutorial
3. https://www.w3schools.com/r/

Course Title	**Indian Heritage and Culture**			**Course Type**	**Theory**
Course Code	**B22ED0501**	**Credits**	**2**	**Class**	**V Semester**

Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	0	2	2	Theory	Practical	IA	SEE
	Practice	0	0	0				
	Tutorial	0	0	0				
	Total	0	2	2	28	0	50 %	50 %

COURSE OVERVIEW

India is one of the ancient civilizations of the world which has stood the test of time. In fact what makes Indian culture unique among other ancient civilizations is its ability to accommodate and assimilate external influences and weave them into its own cultural fabric. This composite influence has not only enriched the cultural milieu of India, it has also made it stronger. Indian art, architecture, music, language, philosophy and religion reflect this diversity of influence that has occurred through centuries. This is the beauty of Indian Culture and Heritage. As Indian citizens not only do we need to be proud of this pluralistic and rich cultural heritage but also to study it objectively and assess it critically.

Course Objectives:

- To provide conceptual knowledge of Indian culture.
- To acquire the knowledge of history of ancient India,
- To introduce students to the history related to Indian culture through ages.
- To illustrate the unity and the underlying diversity in the Indian languages.
- To help students understand the religions movements in ancient India.
- To help learners understand the factors which unite the religion and philosophy of India.

Course Outcomes:

On completion of the course students will be able to:

1. Describe the distinctive features of Indian culture; identify the central points and uniqueness of Indian culture.
2. Understand the concept and meaning of culture and establish the relationship between cultures through the ages.
3. Develop an awareness of the variety of languages and literature in India.
4. Examine the relationship between socio-cultural changes in the Indian society and the literature in different Indian languages.
5. Identify the characteristics of various religious movements in ancient India.
6. Examine the contributions of various philosophies.

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	√			
CO2	√	√			√	
CO3		√				
CO4			√		√	
CO5		√				√
CO6				√	√	

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			1			3	3	3	3	3					
CO2			1			3	3	3	3	3					
CO3			1			3	3	3							
CO4			1			3	3		3						
CO5									3	3	3	2			
CO6									2	3	3	2			

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Unit - 1 Culture
Culture: Concept of culture, culture and civilization, culture and heritage, general characteristics of culture, Importance of culture in human life, Characteristics of Indian culture, Culture and civilization, Culture and heritage, General characteristics of culture.
Unit – 2 History and Culture through the Ages
Importance of studying history, ancient India, Vedic culture, popular religious reforms, the Persian invasion and its impact on Indian culture, the Greek (Macedonian) invasion and its impact on Indian culture, Ashoka the great : representing the acme of Indian culture, art, and architecture: Mauryan beginnings, post - Mauryan cultural developments.
Unit – 3 Languages and Literature
Indian languages: the role of Sanskrit, the Vedas, the Upanishads, the Ramayana, and the Mahabharata, puranas, Buddhist and Jain literature in Pali, Prakrit and Sanskrit, other Sanskrit literature, Telegu, Kannada and Malayalam literature, Tamil or Sangma literature, northern Indian languages & literature - Persian and Urdu.
Unit – 4 Religion and Philosophy
Religion, Pre-Vedic and Vedic religion, unorthodox religious movements, theistic religions, folk cults Vaishnava, movement in the south, Shaivism, minor religious movements, Vedic philosophy, Charvaka school, Jain philosophy, philosophy of the buddha.

Textbooks

i. Sundararajan K.R., Hindu Spirituality - Vedas through Vedanta, Cross Road Publications, New York, 1997.
ii. Griffiths Bede, Yoga and the Jesus Prayer Tradition, Asian Trading Corporation, Bangalore, 1992.
iii. Ansh Mishra, Science in Ancient India, Indian Corporation, New Delhi, 1998.
iv. Sen Taylor, Collen. Feasts and Fasts: A History of Food in India. Reaktion Books, New Delhi, 2014.
v. Thapar, Romila, Readings in Early Indian History. Oxford University Press. New Delhi, 2018.

Course Title	**Theory of Computation**				**Course Type**	**HC**
Course Code	**B22EF0501**	**Credits**	**3**		**Class**	**V Semester**
	LTP	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes**	**Assessment in**

Course Structure	Lecture	3	3	3	Per Semester		Weightage	
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

The course introduces some fundamental concepts in automata theory and formal languages which deal with concepts of automata, formal languages, grammar, pushdown automaton, Turing machine. These form basic models of computation; they are also the foundation of many branches of computer science, viz. compilers, software engineering, concurrent systems, etc. The reasons to study Automata Theory and Formal Languages are that Automata Theory provides a simple, elegant view of the complex machine that we call a computer. Automata Theory possesses a high degree of permanence and stability, in contrast with the ever-changing paradigms of computer systems technology, development, and management. Further, parts of the Automata theory have a direct bearing on practice, such as Automata on circuit design, compiler design, and search algorithms; Formal Languages and Grammars on compiler design; and Complexity on cryptography and optimization problems in manufacturing, business, and management.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the concepts of Deterministic and Non-Deterministic Finite Automata.
2. Demonstrate the use of Regular Expressions for constructing DFA and NFA.
3. Illustrate the construction of Context-Free Grammar for a given language.
4. Narrateadvanced computing Machines such as PDA and Turing Machine

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Construct the Finite State Machine by applying the concepts of DFA, NFA and Epsilon-NFA.	1 to 5,11,12	1,2,3
CO2	Express the Regular Expressions for DFA, NFA and Epsilon-NFA.	1 to 5,11,12	1,2,3
CO3	Identify ambiguity in Grammar and Construct CFG for the given language in Normal Forms.	1 to 5,11,12	1,2,3
CO4	Apply the concepts of Push down Automata and Turing machine for a given Language.	1 to 5,11,12	1,2,3
CO5	Classify a problem for different models of Computation.	1 to 5,11,12	1,2,3
CO6	Recognize skills in formal reasoning and reduction of a problem to a formal model.	1 to 5,11,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2		√				
CO3		√				

CO4			√			
CO5		√				
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	3	-	-	-	2	-	3	3	1	3	3
CO2	2	2	3	3	3	-	-	-	2	-	3	3	1	3	3
CO3	2	2	3	3	3	-	-	-	2	-	3	3	1	3	3
CO4	2	2	3	3	3	-	-	-	2	-	3	3	1	3	3
CO5	2	2	3	3	3	-	-	-	2	-	3	3	3	3	3
CO6	2	2	3	3	3	-	-	-	2	-	3	3	2	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Finite Automata (FA): Introduction, Alphabets; Languages; strings; Deterministic Finite Automata (DFA) -Formal definition, simpler notations (state transition diagram, transition table), language of a DFA. Nondeterministic Finite Automata (NFA) - Definition of NFA, language of an NFA, Equivalence of Deterministic and Non-deterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions.

UNIT – 2

Regular Expressions (RE): Minimization of Deterministic Finite Automata, Introduction to Regular Expression, Identities of Regular Expressions, Finite Automata and Regular Expressions- Converting from DFA's to Regular Expressions, Converting Regular Expressions to Automata, Applications of Regular Expressions. Equivalence of finite automata and regular expressions; pumping lemma for regular languages;

UNIT – 3

Regular Grammars, Context Free Grammars and Normal Forms: Definition, regular grammars and FA, FA for regular grammar, Regular grammar for FA. Context Free Grammars; Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings; Ambiguity in CFG's; Normal forms-CNF and GNF.

UNIT – 4

Push Down Automata (PDA): Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA.
Turing Machines (TM): Formal definition and behavior, Languages of a TM, Problems.

TEXTBOOKS:

1. John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages and Computation, 3rd Edition, Pearson Education, 2009.
2. Peter Linz, An Introduction to formal Languages and Automata, 4/ E, Jones and Bartlett Publishers, 2006.

REFERENCE BOOKS:

1. Kamala Krithivasan, Rama R, Introduction to Formal Languages, Automata Theory and Computation, Pearson, 2009.
2. B N Srinivasa Murthy, Formal Languages and Automata Theory, Sanguine Publishers, 2006.

JOURNALS/MAGAZINES:

1. https://theoryofcomputing.org/
2. https://www.springer.com/journal/224/
3. https://www.sciencedirect.com/journal/theoretical-computer-science
4. https://www.worldscientific.com/worldscinet/ijfcs
5. https://lmcs.episciences.org/

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_cs79/preview
2. https://nptel.ac.in/courses/106104028
3. https://www.classcentral.com/course/youtube-computer-science-theory-of-computation-47562
4. https://www.udemy.com/course/theory-of-computation-automata-theory-finite-automata/
5. https://nptel.ac.in/courses/106/103/106103070/
6. https://www.udemy.com/course/theory-of-automata/
7. https://www.edx.org/course/automata-theory
8. https://www.coursera.org/courses?query=theory%20of%20computation

Course Title	**Big Data Analytics**				**Course Type**		**HC**	
Course Code	**B22EF0502**	**Credits**	**3**		**Class**		**V Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

This course introduces the concept of big data and provides a practical foundation level exposure that enables students to participate in big data application development. The course provides grounding in basic and advanced methods to big data technology with Apache Spark fundamentals.

COURSE OBJECTIVE (S):
The objectives of this course are to:

1. Explain the concepts of Big Data and its Business Implications.
2. Illustrate the fundamentals of functional programming for Big-Data Analytics.
3. Exemplifying the features of Apache Spark for Data Analytics.
4. Implement Machine Learning in Spark to solve real business problems.

COURSE OUTCOMES (COs)
After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Outline the concepts of Big Data and its Business Implications.	1 to 5,9,10,12	1
CO2	Apply the concept of functional distributed programming to Big Data Analytics applications.	1 to 5, 9,10,12	1,2, 3
CO3	Understand the fundamentals of Apache Spark and Spark Core.	1 to 5, 9,10,12	1, 3

CO4	Design a Data Analytics Framework using Apache Spark with Python.	1 to 5, 9,10,12	1,2,3
CO5	Implement distributed Machine Learning Applications for big data using Spark.	1 to 5, 9,10,12	1,2,3
CO6	Develop real world big data application using Apache Spark with Python programming.	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	**Bloom's Level**					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1	√					
CO2			√			
CO3		√				
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1	3	3	-	-	-	-	-	-	-	3	1	3
CO2	3	3	3	3	3	-	-	-	3	-	-	2	3	3	3
CO3	3	1	3	1	3	-	-	-	3	3	3	3	3	3	3
CO4	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3
CO5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3
CO6	3	3	3	3	3	1	-	1	3	3	3	3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introducing Big Data, Hadoop, and Spark: Introduction to Big Data, Distributed Computing, and Hadoop, A Brief History of Big Data and Hadoop, Hadoop Explained; Introduction to Apache Spark: Apache SparkBackground, Uses for Spark, Programming Interfaces to Spark, Submission Types for Spark Programs, Input/Output Types for Spark Applications, The Spark RDD, Spark and Hadoop; Functional Programming Using Python: Data Structures Used in Functional Python Programming, Python Object Serialization, Python Functional Programming Basics;

UNIT – 2

Understanding the Spark Cluster Architecture: Anatomy of a Spark Application:Spark Driver, Spark Workers and Executors, The Spark Master and Cluster Manager; Spark Applications Using the Standalone Scheduler: Spark Applications Running on YARN Deployment; Modes for Spark Applications Running on YARN: Client Mode, Cluster Mode, Local Mode Revisited; Learning Spark Programming Basics: Introduction to RDDs,Loading Data into RDDs, Creating an RDD from a File or Files, Methods for Creating RDDs from a Text File or Files, Creating an RDD from an Object File, Creating an RDD from a Data Source, Creating RDDs from JSON Files, Creating an RDD Programmatically;

UNIT – 3

Operations on RDDs: Key RDD Concepts, Basic RDD Transformations, Basic RDD Actions, Transformations on PairRDDs, MapReduce and Word Count Exercise, Join Transformations, Joining Datasets in Spark, Transformations on Sets, Transformations on Numeric RDDs; Advanced Programming Using the Spark Core API: Shared Variables in Spark: Broadcast Variables, Accumulators, Exercise: Using Broadcast Variables and Accumulators; Partitioning Data in Spark: Partitioning Overview, Controlling Partitions, Repartitioning Functions, Partition-Specific or Partition-Aware API Methods; RDD Storage Options: RDD Lineage Revisited, RDD Storage Options, RDD Caching, Persisting RDDs, Choosing When to Persist or Cache RDDs, Checkpointing RDDs, Exercise: Checkpointing RDDs;

UNIT – 4

Processing RDDs with External Programs: Data Sampling with Spark; Understanding Spark Application and Cluster Configuration: Spark Environment Variables, Spark Configuration Properties; Optimizing Spark: Filter Early, Filter Often, Optimizing Associative Operations, Understanding the Impact of Functionsand Closures, Considerations for Collecting Data, Configuration Parameters for Tuning and Optimizing Applications, Avoiding Inefficient Partitioning, Diagnosing Application Performance Issues; Machine Learning with Spark: Machine Learning Primer, Machine Learning Using Spark MLlib, Exercise: Implementing a Recommender Using Spark MLlib, Machine Learning Using Spark ML;

TEXT BOOKS:

1. Aven, Jeffrey. Data Analytics with Spark Using Python. Addison-Wesley Professional, 2018.
2. Bengfort, Benjamin, and Jenny Kim. Data analytics with Hadoop: an introduction for data scientists." O'Reilly Media, Inc.", 2016.
3. Sridhar Alla, Big Data Analytics with Hadoop 3, published by Packt Publishing Ltd, May 2018
4. SubhashiniChellappan, DharanitharanGanesan, Practical Apache Spark Using the Scala API, A Press, 2018.

REFERENCE BOOKS:

1. Michael Minelli, Michele chambers, AmbigaDhiraj: Big data, big analytics, Wiley, 2013.
2. P. Tan, M. Steinbach, V. Kumar, Introduction to Data Mining, Addison-Wesley, 2005.
3. J. Han, M. Kamber, Data Mining: Concepts and Techniques, 2nd ed. Morgan Kaufmann, 2005.

JOURNALS/MAGAZINES:

1. IEEE,Introduction to the IEEE Transactions on Big Data
2. Elsevier,Big data research journal Elsevier
3. Springer, Journal on Big Data Springer.
4. ACM DL,The Journal of Machine Learning Research-ACM

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106104189
2. https://onlinecourses.nptel.ac.in/noc20_cs92/preview
3. https://iisc.talentsprint.com/cds/?utm_source=googlesearch&utm_medium=tcpa&utm_campaign=ts-googlesearch-iisc-cds-tcpa-similar-audiences-roi&utm_content=data-science-program&utm_term=Analytics%20training%20courses&gclid=Cj0KCQjw8uOWBhDXARIsAOxKJ2HfWKGqqpZ7Gm0dBPDgkwWaj0BqSZBzuWvcqmbF5AOvYvxYSB5lvFcaAlO_EALw_wcB
4. https://www.simplilearn.com/pgp-data-engineering-certification-training-course?utm_source=google&utm_medium=cpc&utm_term=big%20data%20analysis%20online%20course&utm_content=11233548673-137256573987-586850068745&utm_device=c&utm_campaign=Search-DataCluster-PG-BigData-CDE-Purdue-IN-Main-AllDevice-adgroup-SEMR-09Mar2022-BD-Analysis-Course-Phrase&gclid=Cj0KCQjw8uOWBhDXARIsAOxKJ2GINP8K1hXBRF4Qu6cWTaZ714GQYvQR_CL4ff9qM6whNg_Xx2vLFmcaAjMTEALw_wcB

SELF-LEARNING EXERCISES:

1. SQL and NoSQL Programming with Spark
2. Stream Processing and Messaging Using Spark

Course Title	**Computer Networks**				**Course Type**	**HC**
Course Code	**B22EF0503**	**Credits**	**3**		**Class**	**V Semester**
	LTP	**Credits**	**ContactHours**	**Work Load**	**Total Number of Classes Per Semester**	**Assessment in Weightage**
	Lecture	**3**	**3**	**3**		

Course Structure	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

The main emphasis of this course is on the organization and management of local area networks (LANs). The course description include learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and about Open Systems Interconnection (OSI) communication model with TCP/IP protocol; This course provides knowledge of error detection and recovery; local area networks; bridges, routers and gateways; network naming and addressing; and local and remote procedures. This course also emphasis on User Datagram Protocol, TCP Congestion Control; DNS Message Formatting and RemoteLogin Protocols.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the protocol stacks (OSIandTCP/IP) for data communication.
2. Discuss the MAC protocols, error detection & correction strategies for data transmission over the networking devices.
3. Describe the standards for data communication with routing protocols.
4. Illustrate the client server communication using TCP or UDP protocols and other application level protocols.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	Pos	PSOs
CO1	Make use of the physical layer concepts in computer communications and networking.	1 to 3	1
CO2	Analyze and Design the computer network with simplicity, scalability and better performance.	1 to 5	2
CO3	Appraise the working principles of Internet.	1,2,5	3
CO4	Compile the effectiveness of MAC Layer, Network Layer and Transport Layer Protocols in designing network applications.	1 to 4	2
CO5	Summarize the key components and protocols used in interconnection of the Network.	1,3,4	1,3
CO6	Demonstrate different application and transport protocols used in real world application.	1 to 5	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2				√		
CO3			√			
CO4			√			
CO5		√				
CO6		√	√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2										2		

CO2	3	3	3	2	2									2	
CO3	3	2			2										3
CO4	3	3	2	2										2	
CO5	2		2	2									3		3
CO6	3	3	3	3	2									3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction to Data Communication and Networking: Internet history and Internet today, Data Communications, Networks, Network Topologies, Classification of Networks, Protocols & Standards Layered Architectures: Tasks, The OSI model, Layers in OSI model, TCP/IP Protocol suite, Addressing

Introduction to switching: Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks, Physical Layer: Introduction to Transmission Media, Periodic Analog signals, Digital signals, Nyquist bit rate, shanon capacity, performance, PCM, DM, Parallel transmission, serial transmission, ASK, FSK, PSK, QAM, AM, FM, PM. Introduction to Network Tools: WireShark, PacketTracer, NS3, etc.

UNIT – 2

Coding: Line Coding, Introduction to Multiplexing: FDM, WDM, TDM, FHSS, DSSS.
Error Detection and Correction: Introduction, cyclic Codes: CRC, Internet checksum. Framing, DataLink Protocols: Point-to-Point Protocol.

MAC Protocols: classification of MAC protocols, Random access (ALOHA, CSMA/CD, CSMA/CA), Controlled Access (Reservation, Polling, Tokenpassing), Channelization Protocols (FDMA, TDMA, CDMA)
Introduction to Networking Devices: Repeaters, Hubs, Bridges, Routers, and High layered switches, Gateways, Virtual LAN.

UNIT – 3

Standards: IEEE Standards, Standard Ethernet, Gigabit Ethernet. IEEE 802.11: Architecture, MAC Sub layer, Addressing Mechanism.

Network Layer: IPv4 addresses, IP Datagram format, ICMP Messages, Introduction to Mobile IP for mobility management, IPv6 addresses, IPv6 Packet Format, Transition from IPv4 to IPv6, Routing algorithms (DistanceVector, Link State and Path vector), Unicast Routing protocols (RIP, OSPF). Awareness on BGP, Introduction to Multicasting protocols, brief introduction to multicast protocols such DVMRP, MOSPF, PIM.

UNIT – 4

Transport Layer: Introduction to Stop and Wait, GoBack-N, Selective repeat N, Piggybacking. Services and portnumbers, User Datagram Protocol (UDP): UDP Segment, Transmission Control.Protocol (TCP): TCP Segment, TCP Connection Setup, Application of TCP and UDP.TCP flow control, TCP error control, TCP Congestion Control and options, Introduction to SCTP services and features.

Application Layer: Client server programming using UDP and TCP, DNS, SMTP. Introduction to Remote LoginProtocols: TELNET Protocol and SSH Protocol.

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
Part-A			

1	a) Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool.	RJ-45 connector, IO Connector, Crimping Tool, Twisted pair Cable, Cable Tester.	Cable Crimping, Standard Cabling and Cross Cabling, IO connector crimping and testing the crimped cable using a cable tester can be done successfully.
	b) Install and Configure Wired and Wireless NIC and transfer files between systems in LAN and Wireless LAN.	NIC, Adapter	Installation and configuration of Wired and Wireless (remotely) NIC and transfer files between systems in LAN and Wireless
			LAN between two systems in a LAN can be done successfully.
	c) Install and configure Network Devices: HUB, Switch and Routers.	HUB, Switch, Router and configuration software	Gain the knowledge on configuring the different Connecting devices.
	d) Connect the computers in Local Area Network.	Computer Systems with connecting media.	Interconnection and building a simple LAN.
2	a) Establish Peer to Peer network connection using two systems using Switch and Router in a LAN.	Computer Systems with connecting media.	Configuration of peer to peer network communication
	b) Configure Internet connection and use IPCONFIG, PING/Tracer and Netstatutilities to debug the network issues.	Connected Computer Systems.	Configure Internet connection
	c) Transfer files between systems in LAN using FTP Configuration, install Printserver in a LAN and share the printer in a network.	Connected Computer Systems with printer.	File transfer between systems in LAN using FTP Configuration.
	d) Study of basic network command and Network configuration commands.	Command Prompt	Network configuration
3	In information theory and coding theory with applications in computer science and telecommunication, error detection and correction or error control are techniques that enable reliable delivery of digital data over unreliable communication channels. Many communication channels are subject to channel noise, and thus errors may be introduced during transmission from the source to a receiver. Error detection techniques allow detecting such errors, while error correction enables reconstruction of the original data in many cases. Write a Program for Implementation of anyone mechanism for Error Detection/Error Correction Techniques.	CRC Hamming Code	Error detection and control in data transmission.
4	A routing algorithm is a procedure that lays down the route or path to transfer data packets from source to the destination. They help indirecting Internet traffic efficiently. Routing algorithm mathematically computes the best path, i.e. “least – cost path” that the packet can be routed through. Write a Program for Implementation of any Routing algorithms.	Distance vector &Linkstate routing	Routing in networks before the communication begins.
Part B: MiniProject1: Design of Corporate Network			

1	Configuring a Switched network and Study of VLAN's and assigning a PC based on the VLAN.	Windows/LinuxOS, Packet Tracer	Switch and VLANConfiguration.
2	Implementing an IP Addressing Scheme Configuring WEP on a WirelessRouter. Interpreting Ping and Traceroute Output	Windows/LinuxOS, Packet Tracer	Router configuration and connectivity checking.
3	Configuring Static Routing. Configuring Dynamic Routing protocols RIP, OSPF.	Windows/LinuxOS, Packet Tracer	Static and Dynamic Routing over a network
4	Examining Network Address Translation (NAT). Configuring a Cisco Router as a DHCP Server	Windows/LinuxOS, Packet Tracer	Configuration and working of NAT with setup of DHCP server.
Part C: Mini Project 2: Performance Analysis of TCP and UDP applications over the different Topologies of network			
1	Consider Six nodes and demonstrate the different ways of connecting the mintopology methods. Also specify the different transmission media with specific channel specifications.	Python, NS3, Ubuntu.	Create an interface between the devices using different topologies.
2	Configure the IP address of the nodes in the specified network. Achieve the port specifications for different applications. Apply and Demonstrate the TFTP on the specified Network using UDP. Observe the trace results.	Python, NS3, Ubuntu.	Analyze the performance using UDP based applications
3	Apply and Demonstrate the FTP and TELNET on the specified network using TCP. Observe the trace results.	Python, NS3, Ubuntu.	Analyze the performance using TCP based applications
4	Apply and Demonstrate the Congestion and Error Controlling mechanism in the specified networks. Observe the trace results.	Python, NS3, Ubuntu.	Analyze the congestion and error controlling in TCP based Applications.

TEXT BOOKS:

1. Behrouz A Forouzan, "Data Communications and Networking", 5th Edition, McGraw–Hill, 2016.
2. NaderF.Mir,"Computer and Communication Networks", Pearson Education, 2009.

REFERENCE BOOKS:

1. Alberto Leon-Garcia and Indra idjaja, "Communication Networks – Fundamental Concepts and Key Architectures", 2nd Edition Tata McGraw–Hill, 2004.
2. Andrew S.Tanenbaum, "Computer Networks", 4th Edition, Pearson Education, 2005.
3. Larry L. Peterson and Bruce S. Davie, "Computer Networks- A system Approach", 5th Edition, Elsevier, 2012.
4. William Stallings, "Data and Computer Communications", 10th Edition, Pearson Education, 2008.
5. Douglas E.Comer, "Internetworking with TCP/IP Vol.1", 6th Edition, Pearson, 1995.

JOURNALS/MAGAZINES

1. IEEE Transactions on Networking.
2. Elsevier Journal of Computer Networks
3. Springer Journal of communications and Information networks.

SWAYAM NPTEL/MOOCs:

1. https://www.udemy.com/topic/computer-network/
2. https://www.coursera.org/courses?query=computer%20network
3. https://nptel.ac.in/courses/106/105/106105183/
4. https://www.edx.org/learn/computer-networking

SELF-LEARNING EXERCISES:

1. SDN, Wifi, WiMAX, 4G, 5G, Satellite Networks, MPLS, VPN, ATM, Bluetooth Architecture. World Wide Web (WWW).

<table>
<tr><td>Course Title</td><td colspan="3">Cloud Computing</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EH0501</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

This course provides a comprehensive study of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). It gives insight into various cloud infrastructure and management mechanisms. It provides the various functional domain architecture.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Discuss the various Cloud computing service models like Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).
6. Explain the working of cloud computing technologies like datacenter technology, web technology, multitenant technology and service technology.
7. Illustrate the use of various cloud computing mechanisms like load balancer, automated scaled listener, failover system in real world applications.
8. Categories the cloud technology architecture formalize various functional domains within cloud.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify basic requirements related to cloud computing technologies	1 to 5,6,8,11,12	1,3
CO2	Compare and contrast different services of cloud computing viz. Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).	1 to 5,6,11,12	1,3
CO3	Summarize the Broadband Networks and Internet Architecture used in cloud.	1 to 5,6,11,12	1, 3
CO4	Shows the working of cloud computing technologies like data center technology, virtualization technology, web technology, multitenant technology and service technology.	1 to 5,6,11,12	1
CO5	Interpret various cloud computing mechanisms like load balancer, automated scaled listener, failover system and more.	1 to 5,6,11,12	1,3
CO6	Illustrate the cloud technology architecture formalize various functional domains.	1 to 5,6,11,12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

<table>
<tr><td rowspan="2">CO#</td><td colspan="6">Bloom's Level</td></tr>
<tr><td>Remember (L1)</td><td>Understand (L2)</td><td>Apply (L3)</td><td>Analyze (L4)</td><td>Evaluate (L5)</td><td>Create (L6)</td></tr>
</table>

CO1	√					
CO2		√				
CO3		√				
CO4			√			
CO5		√				
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	2		2			2	3	3		3
CO2	3	3	3	3	2	2					2	3	3		3
CO3	3	3	3	3	2	2					2	3	3		3
CO4	3	3	3	3	2	2					2	3	3		
CO5	3	3	3	3	2	2					2	3	3		3
CO6	3	3	3	3	2	2					2	3	3		3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT
THEORY:

UNIT – 1

Introduction to Cloud Computing: Origins and Influences; Basic Concepts and Terminology; Goals and Benefits; Risks and Challenges.
Fundamental Concepts and Models: Roles and Boundaries; Cloud Characteristics; Cloud Delivery Models; Cloud Deployment Models.

UNIT – 2

Cloud Computing Technologies: Broadband Networks and Internet Architecture; Data Center Technology; Virtualization Technology; Web Technology; Multitenant Technology; Service Technology; Case study.
Cloud Infrastructure Mechanisms: Logical Network Perimeter; Virtual Server; Cloud Storage Device; Cloud Usage Monitor; Resource Replication; Ready-made environment.

UNIT – 3

Specialized Cloud Mechanisms: Automated Scaling Listener; Load Balancer; SLA Monitor; Pay-per-use Monitor; Audit Monitor; Failover System; Hypervisor; Resource cluster; Multi-device Broker; State Management.
Cloud Management Mechanisms: Remote Administration System; Resource Management System; SLA Management System; Billing Management System.

UNIT – 4

Fundamental Cloud Architectures: Workload Distribution Architecture; Resource Pooling Architecture; Dynamic Scalability Architecture; Elastic Resource Capacity Architecture; Service Load Balancing Architecture; Cloud Bursting Architecture; Elastic Disk Provisioning Architecture; Redundant Storage Architecture.

Advanced Cloud Architectures: Hypervisor Clustering Architecture; Load Balanced Virtual Server Instances Architecture; Non-Disruptive Service Relocation Architecture; Zero Downtime Architecture; Cloud Balancing Architecture; Resource Reservation Architecture; Dynamic Failure Detection and Recovery Architecture; Bare-Metal Provisioning Architecture; Rapid Provisioning Architecture; Storage Workload Management Architecture.

TEXT BOOKS:

5. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, “Cloud Computing: Concepts, Technology & Architecture”, PHI, 2019. Cloud Computing: Concepts, Technology & Architecture (pearsoncmg.com)
6. Kai Hwang, Geoffrey C. Fox, Jack J Dongarra, “Distributed and Cloud Computing”, MK, 2012.
7. Dan C. Marinescu, Cloud Computing: Theory and Practice, MK
8. Michael Miller, “ Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online”, Que Publishing, August 2008.

REFERENCE BOOKS:

1. Rajkumar Buyya, James Broberg, Andrzej Goscinski, “Cloud Computing- Principles and Pradigms”, Wiley.
2. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, “Cloud Computing, A practical approach”, TATA McGraw HILL.
3. DharanipragadaJanakiram,” Grid and Cloud Computing”, McGraw-Hill 2016.
4. Gautam Shroff, “Enterprise Cloud Computing- Technology, Architecture, Applications”, CAMBRIDGE.

JOURNALS/MAGAZINES:

1. IEEE Transactions on Cloud Computing
2. Journal of Cloud Computing -Advances, Systems and Applications, Springer Open.
3. International Journal of Cloud Computing, INDERSCIENCE Publishers.
4. International Journal of Cloud Applications and Computing (IJCAC), IGI Global.

SWAYAM/NPTEL/MOOCs:

1. Cloud Computing Course - SWAYAM
2. Google Cloud Computing Foundation Course - NPTEL
3. Introduction to Cloud Computing by IBM - Coursera

SELF-LEARNING EXERCISES:

1. https://www.vmware.com/try-vmware/try-hands-on-labs.html
2. https://www.cloudpro.co.uk/case-studies
3. https://www.ibm.com/cloud/case-studies/

Professional Elective 2

<table>
<tr><td>Course Title</td><td colspan="4">Pattern Recognition</td><td colspan="2">Course Type</td><td colspan="2">SC</td></tr>
<tr><td>Course Code</td><td>B21EHS511</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>0</td><td>50</td><td>50</td></tr>
</table>

COURSE CONTENT

THEORY:

UNIT-1

Fundamentals and Representations: What is Pattern Recognition?, Different Paradigms for Pattern Recognition, Applications **Representations:** Data Structures for Pattern Recognition, Representation of Clusters, Proximity Measures, Size of Patterns, Abstractions of the Data Set, Feature Extraction, Feature Selection, Evaluation of Classifiers, Evaluation of Clustering.

UNIT-2

Nearest Neighbour Based Classifiers: Introduction to Nearest Neighbour (NN) algorithm, variants of NN algorithm, use of NN for transaction databases, efficient algorithms, Data reduction, Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, Bayesian Belief Network

UNIT-3

Hidden Markov models: introduction to Markov models for classification, Hidden Markov Models (HMM), classification using HMM, Decision Trees (DT): Introduction, DT for PR, Construction of DT, splitting at the nodes, Over fitting & Pruning, Example of Decision Tree Induction.

UNIT-4

Clustering: introduction to Clustering, Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, kmeans, Isodata), clustering large data sets, Applications of Clustering.

COURSE OUTCOMES(COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Outline the variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.	1,2	1,2
CO2	Analyze and relate research perspectives in the pattern recognition area verbally and in writing.	1,2,3,4	1,2,3
CO3	Apply performance evaluation methods for pattern recognition, and critique comparisons of techniques made in the research literature.	1-5	1,2,3
CO4	Apply pattern recognition techniques to real-world problems such as document analysis and recognition.	1-5	1,2,3
CO5	Develop simple pattern classifiers, classifier combinations, and structural pattern recognizers in the real world applications.	1-5	1,2,3
CO6	Evaluate various pattern recognition model for any real world problem.	1-5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3			√			
CO4						√
CO5			√			
CO6						√

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3	3	
CO2	3	3	3	3									3	3	3
CO3	1	1	3	3	3								3	3	3
CO4	1	1	3	3	3								3	3	3
CO5	1	1	3	3	3								3	3	3
CO6	1	1	3	3	3								3	3	3

Note:1-Low,2-Medium,3-High

TEXTBOOKS:

1. V Susheela Devi, M Narsimha Murthy,“ Pattern Recognition (An Introduction)”, Universities Press, 2011.
2. Beyerer, Jürgen, Matthias Richter, and Matthias Nagel, “Pattern recognition: introduction, features, classifiers and principles”, Walter de Gruyter GmbH & Co KG, 2017.

REFERENCE BOOKS:

1. Duda R. O., P.E.Hart, D.G. Stork, “Pattern Classification”, John Wiley and sons, 2000
2. Fukunaga, Keinosuke,“Introduction to statistical pattern recognition”, Elsevier, 2013.
3. Theodoridis, Sergios, et al,“Introduction to pattern recognition: a matlab approach”, Academic Press, 2010.
4. Bishop, Christopher M,“Pattern recognition and machine learning”, springer, 2006.

JOURNALS/MAGAZINES:

1. IEEE Pattern recognition and machine learning
2. ACM International Journal of Pattern Recognition and Artificial Intelligence
3. Elesevier Pattern Recognition

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/117/108/117108048/
2. https://www.coursera.org/learn/data-patterns
3. https://www.classcentral.com/course/swayam-pattern-recognition-and-application-14228

SELF-LEARNINGEXERCISES:

1. Context Dependent Classification
2. Clustering: Sequential Algorithms, Hierarchical

Course Title	Predictive Analytics				Course Type		SC	
Course Code	B22EHS512	Credits	3		Class		V Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	3	3	3	**42**	**-**	**50**	**50**

COURSE OVERVIEW:

It is focused on Modelling, estimation and prediction. Estimation and prediction using linear regression, Multiple Linear Regression: Estimating the Regression Coefficients, Estimation and prediction using logistic regression, Tree-Based Methods are aimed to be discussed in this course.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Illustrate Modelling, estimation and prediction
2. Describe estimation and prediction using linear and multiple linear regression.
3. Discuss Estimation and prediction using logistic regression
4. Explain Tree-Based Methods

COURSEOUTCOMES(COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand statistical learning for modeling and understanding complex datasets.	1 to 3	1,2
CO2	Select simple regression analysis method applicable to predictive analytics.	1 to 3	1,2
CO3	Apply Multiple Linear Regression analysis methods to model the linear relationship between the explanatory variables and response variables.	1 to 5	1,2
CO4	Use logistic regression analysis methods applicable to identify new trends and patterns, predict likelihoods, and test predictive hypotheses.	1 to 5	1,2,3
CO5	Apply Tree-Based Methods to evaluate patterns in data to identify risks and opportunities.	1 to 3, 5 to 7	1,2,3
CO6	Implement predictive analytics to analyze real-life business problems.	1 to 3, 5 to 7	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3			√			

CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2										3	2	
CO2	2	2	2										3	2	
CO3	2	1	1	1	1								3	2	
CO4	2	3	3	1	2								3	2	2
CO5	2	1	1		1	1	1						3	2	2
CO6	2	2	2		1	1	1						3	2	2

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY:

UNIT – 1

Statistical Learning: Fundamentals of Statistical Learning, Introduction to Supervised Versus Unsupervised Learning. Regression model building framework: Problem definition, Data pre-processing; Model building; Diagnostics and validation.

UNIT – 2

Simple Linear Regression: Estimating the Coefficients, Assessing the Accuracy of the Coefficient Estimates, Assessing the Accuracy of the Model, Significance tests, Residual analysis, Confidence and Prediction intervals.

UNIT – 3

Multiple Linear Regression: Estimating the Regression Coefficients, Interpretation of regression coefficients, Categorical variables, Non-constant Variance of Error Terms - Heteroscedasticity, Multicollinearity, outliers, Auto regression and transformation of variables, Regression model building.

UNIT – 4

Logistic Regression: Logistic function, The Logistic Model, Estimating the Regression Coefficients, Making Predictions, Multiple Logistic Regression, Logistic Regression for more than 2 Response Classes. Tree-Based Methods: Regression Trees, Classification Trees.

TEXTBOOKS:

1. James, Witten, Hastie and Tibshirani "An Introduction to Statistical Learning: with Applications in R" y, Springer, 1st. Edition, 2013.
2. Alberto Cordoba, "Understanding the Predictive Analytics Lifecycle", Wiley, 2014.

REFERENCEBOOKS:

4. Eric Siegel, Thomas H. Davenport, "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die", Wiley, 2013.
5. James R Evans, "Business Analytics – Methods, Models and Decisions", Pearson2013.
6. R. N. Prasad, Seema Acharya, "Fundamentals of Business Analytics", Wiley, 2015.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/7100342?arnumber=7100342
2. https://ieeexplore.ieee.org/document/9523703

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.swayam2.ac.in/imb20_mg19/preview
2. https://www.udemy.com/topic/predictive-analytics/
3. https://www.futurelearn.com/courses/predictive-analytics

SELF-LEARNINGEXERCISES:

6. https://www.ibm.com/in-en/analytics/predictive-analytics

Course Title	Operation Research				Course Type		SC	
Course Code	B22EHS513	Credits	3		Class		IV Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Tota	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

Operations Research is the discipline of applying analytical methods to solve complex problems and make better decisions. It uses mathematical modelling, analysis, and optimization techniques in a holistic approach, OR facilitates in transforming data into information and information into insights. Its applications range from engineering to management, and from industry to the public sector. In Computer Science OR finds its application in Algorithms, Machine learning, and Artificial intelligence.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand and apply the fundamental concepts of linear programming.
2. Understand and apply different techniques to solve transportation and assignment problems.
3. Understand and apply different dynamic programming and integer programming techniques on OR problems to achieve optimality.
4. Understand and apply game theory for decision making problems.

COURSEOUTCOMES(COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
1	Apply simplex method to solve linear programming problems and perform sensitivity analysis.	1,2,3,4,5,6	1,2,3
2	Apply different techniques to solve transportation problems and achieve optimality.	1,2,3,4,5,6	1,2,3
3	Apply different techniques to solve assignment problems and achieve optimality.	1,2,3,4,5,6	1,2,3
4	Apply Dynamic programming to solve muti stagecoach problem and achieve optimality.	1,2,3,4,5,6	1,2,3
5	Apply Integer programming to solve linear programming problems and achieve optimality.	1,2,3,4,5,6	1,2,3
6	Apply game theory and techniques on problems to take decisions and achieve optimality.	1,2,3,4,5,6	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1	√	√	√			
CO2	√	√	√			
CO3	√	√	√			
CO4	√	√	√			
CO5	√	√	√			
CO6	√	√	√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO2	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO3	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO4	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO5	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3
CO6	3	3	3	3	3	1	-	-	-	-	-	1	3	2	3

Note:1-Low,2-Medium,3-High

UNIT- 1

Introduction, Linear Programming – 1

Introduction: The origin, nature, and impact of OR defining the problem and gathering data; Formulating a mathematical model; Deriving solutions from the model; Testing the model; Preparing to apply the model; Implementation. Introduction to Linear Programming: Prototype example; The linear programming (LP) model. Assumptions of LP; Additional examples. The essence of the simplex method; Setting up the simplex method; Algebra of the simplex method; the simplex method in tabular form; Tie breaking in the simplex method, Post optimality analysis, Duality Theory.

UNIT- 2

Linear Programming - 2

Transportation Problems: Solving Balanced Transportation problems: NWCR Rule, Minimum cost method, Vogel's Approximation method (Penalty method), Basic Feasible solution, degenerate basic feasible solutions; finding optimal solution to the transportation problem: Stepping Stone method, MODI method or u-v method, Optimum solution with degenerate basic feasible solution.

Assignment Problems: Assignment problem, properties of the optimal solution, solving the assignment problem – Hungarian method, the optimality of the Hungarian Algorithm

UNIT- 3

Dynamic and Integer Programming Dynamic Programming-Multistage decision process, Forward and Backward approach, Resource Allocation Problem Integer Programming – Graphical representation, Gomory's cutting plane method-concept of a cutting plane, Gomory's method for integer programming problems, branch and bound methods.

UNIT- 4

Game Theory, Decision Analysis

Game Theory: The formulation of two persons, zero sum games; Solving simple games- a prototype example; Games with mixed strategies; Graphical solution procedure; Solving by linear programming, Extensions. Decision Analysis: A prototype example; Decision making without experimentation; Decision making with experimentation; Decision trees.

TEXTBOOKS:

1. Frederick S Hillier, Gerals J Lieberman, Bodhibrata Nag, PreetamBasu, Introduction to Operations Research, , 9th Edition, McGraw Hill Education, Special Indian Edition, 2012.

2. G Srinivasan, Operations Research Principles and Applications, 2nd Edition, PHI Learning Private Limited, 2010.

REFERENCE BOOKS

1. Hamdy A. Taha, Operations Research An Introduction, , 8th Edition, Pearson Education, 2007.
2. S D Sharma, Operations Research Theory, Methods & Applications, 10th Edition,Kedarnath Ramnath & Co.
3. J K Sharma, Operations Research Theory & Applications, 5th Edition, Macmillan

SELF-LEARNING COMPONENT

1. https://www.coursera.org/learn/operations-research-modeling#syllabus
2. https://www.udemy.com/course/optimization-with-excel-operations-research-without-coding/

SWAYAM/NPTEL/COURSERA

1. https://nptel.ac.in/courses/110106062
2. https://onlinecourses.nptel.ac.in/noc22_ma48/preview
3. https://onlinecourses.swayam2.ac.in/cec20_ma10/preview

Course Title	**Quantum Computing**				**Course Type**		**PE**	
Course Code	**B22EHS514**	**Credits**	**3**		**Class**		**Semester**	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Leture	3	3	3				
	Theory	-	-	-	Theory	Practical	CIE	SEE
	Practice	-	-	-				
	Total	**3**	**3**	**3**	**42**	**-**	**50**	**50**

COURSE OVERVIEW:

In this course the students shall learn quantum computing, Quantum Algorithms, Quantum Cryptography, Quantum Information Theory, Quantum Key Exchange, Quantum Teleportation, Rudimentary quantum computing is introduced using the Qubit quantum computer and associated simulators.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Describe the basics of Quantum Computing, Algorithms.
2. To introduce the fundamentals of quantum computing.
3. The problem-solving approach using finite dimensional mathematics.

COURSEOUTCOMES(COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Importance the basics of quantum computing.	1 to 5,9 10,12	1,2

CO2	Explain the physical implementation of Qubit.	1 to 5,9.10,12	1,2
CO3	Illustrate the quantum architecture and hardware.	1 to 5,9,10,12	1,2,3
CO4	Analyze the Quantum algorithms and their implementation.	1to 5,9,10,12	1,2
CO5	Compare the different types of quantum algorithm and real world Quantum Computing Applications.	1to 5,9,10,12	1,3
CO6	Develop the impact of Quantum Computing on Cryptography.	1to 5,9,10,12	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4		√				
CO5		√				
CO6			√			

COURSE ARTICULATION MATRIX

CO#/	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2				3	3		1	3	3	
CO2	3	3	2	3	1				3	3		1	3	3	
CO3	3	3	2	3	3				3	3		1	3	3	3
CO4	3	3	2	3	1				3	3		1	3	3	
CO5	3	2	3	3	3				3	3		1	3		3
CO6	3	3	2	3	3				3	3		1		3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

Unit-1

Introduction to Essential Linear Algebra: Some Basic Algebra, Matrix Math and Vector Spaces, Algebra of Complex Numbers, Complex Numbers Graphically and Vector Representations of Complex Numbers.

Unit-2

Basic Physics for Quantum Computing: Quantum Physics Essentials, Basic Atomic Structure, Quantum Decoherence, Quantum Electrodynamics and Feynman Diagram Quantum Entanglement.

Unit-3

Quantum Architecture: Quantum Circuits and Gates, The D-Wave Quantum Architecture and Quantum Computing Applications.
Quantum Hardware: Qubits, Addressing Decoherence, Topological Quantum Computing.

Unit-4

Quantum Algorithms: Deutsch's Algorithm, Simon's Algorithm, Shor's Algorithm, Grover's Algorithm and RSA .
The Impact of Quantum Computing on Cryptography: Asymmetric Cryptography, Specific Algorithms and Applications.

TEXTBOOKS

1.Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press

2.Dr. Chuck Easttom, Quantum Computing Fundamentals, Pearso

REFERENCE BOOKS:

1. Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. Basic Concepts. Vol. Basic Tools and Special Topics, World Scientific.
3. Pittenger A. O., An Introduction to Quantum Computing Algorithms
4. Qiskit Textbook: https://qiskit.org/textbook/preface.html
5. YouTube Quantum Learning series
6. https://www.youtube.com/playlist?list=PLOFEBzvs-Vvp2xg9-POLJhQwtVktlYGbY

SWAYAM NPTEL / MOOCs:

1. **https://nptel.ac.in/courses/104104082**
2. **https://nptel.ac.in/courses/106106232**

Course Title	**R-Programming**				**Course Type**		**PE (SC)**	
Course Code	**B22EHS515**	**Credits**	**3**		**Class**		**VI Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Theory	-	-	-	Theory	Practical	CIE	SEE
	Practice							
	Total	**3**	**3**	**3**	**42**	**-**	**50**	**50**

COURSE OVERVIEW:

R is a block-structured programming language used for statistical computations, data analysis and visualization. In this course, students learn the Fundamental concepts of R, data analysis, accessing packages, statistical concepts, object-oriented programming and graphical interpretation.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the fundamentals of R programming.
2. Demonstrate the data handling functions using data frames.
3. Illustrate the linear and mathematical functions to perform statistical operations on data.
4. Compare Graphics features and apply object-oriented concepts for real-world applications.

COURSE OUTCOMES(COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the programming fundamentals of R programming.	1,5,12	1-3
CO2	Interpret R script to handle the data frames and perform matrix like operations.	1,2,5,12	1-3
CO3	Implement logical operations, statistical operations, and many more for complex problems.	1,2,3,12	1-3
CO4	Demonstrate the conditional and looping operations to control the flow of data	1	1-3
CO5	Apply object-oriented concepts and demonstrate the mathematical, statistical, and linear operations in R programming.	1,2,5,12	1-3
CO6	Analyze the R graphics features for the given real-world application	1,2,3,4,5,12	1-3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3			√			
CO4			√			
CO5			√			
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				2							2	3	3	3
CO2	3	3			3							3	3	3	3
CO3	3	3	3									3	3	3	3
CO4	3												3	3	3
CO5	3	3			3							3	3	3	3
CO6	3	3	2	3	3							3	3	3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

UNIT – 1

Introduction to R: Introduction to Functions, some important R Data Structures –Help functions in R, Vectors –Scalars, Vectors, Arrays, and Matrices, Declarations, recycling, Common Vector operations, Using all and any, Vectorised operations, NA and NULL values, Filtering, Vectorised if-then else, Vector Equality, Vector Element names.

UNIT – 2

Matrices, Arrays, Lists and Data Frames: Creating matrices, General Matrix operations, Applying Functions to Matrix Rows and Columns, Adding and deleting rows and columns, Vector/Matrix Distinction, Avoiding Dimension Reduction, Higher Dimensional arrays, lists –Creating lists, General list operations, accessing list components and values, applying functions to lists, recursive lists. Data Frames- Creating Data Frames, Matrix-like operations in frames, Merging Data Frames, Applying functions to Data frames.

UNIT – 3

R Programming structures: Control statements, Arithmetic and Boolean operators and values, Default values for arguments, return values, Functions are objects, Environment and Scope issues, Writing Upstairs, Recursion, Replacement functions, Tools for composing function code, Math and Simulations in R- Math functions, functions for statistical Distributions, Sorting, Linear Algebra operations, Set operations, simulation programming in R.

UNIT – 4

OBJECT-ORIENTED PROGRAMMING: S3 Classes, S4 Classes, managing your objects, Input/Output-Accessing keyboard, and monitor, Reading and writing files, Accessing the internet, String Manipulation, Graphics –Creating Graphs, Customizing Graphs, saving graphs to files, Creating three-dimensional plots.

TEXTBOOKS:

1.Norman Matloff, “The Art of R Programming: A Tour of Statistical Software Design”, No Starch Press, 2011. ISBN-13: 978-1-59327-384-2

REFERENCEBOOKS:

1. Mark Gardener, “Beginning R – The Statistical Programming Language”, Wiley, 2013
2. Robert Knell, “Introductory R: A Beginner's Guide to Data Visualization, Statistical Analysis and programming in R”, Amazon Digital South Asia Services Inc, 2013.
3. Jared P. Lander, “R for Everyone: Advanced Analytics and Graphics”, Addison-Wesley Data & Analytics Series, 2013.

Tutorials for References:

1. https://www.tutorialspoint.com/r/index.htm
2. https://www.javatpoint.com/r-tutorial
3. https://www.w3schools.com/r/

Professional Elective 3

<table>
<tr><td>Course Title</td><td colspan="4">Human Computer Interaction</td><td colspan="2">Course Type</td><td colspan="2">PE(SC)</td></tr>
<tr><td>Course Code</td><td>B22EHS521</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE DESCRIPTION

This course presents the foundations of Human Computer Interaction (HCI). The contents are structured into phases comprising: Basic definitions and motivations of HCI, interaction paradigms, design principles and models, User-centred design methods comprising user studies, design approaches for interfaces and interaction, evaluation methods and techniques for data analysis, Research frontiers of HCI, including accessibility, universal design, and pervasive computing (ubiquitous, mobile and wearable computing).

The overall objective of the Course is as follows:

COURSE OBJECTIVE

1. Explain the capabilities of both humans and computers from the viewpoint of human information processing.
2. Describe typical human-computer interaction (HCI) models and styles, as well as various HCI paradigms.
3. Demonstrate the use of an interactive design process and universal design principles in designing HCI systems.
4. Illustrate the use of different evaluation methods.

COURSE OUTCOME

On successful completion of this course; the student will be able to:

CO1	Identify the suitable positioning and pointing device to be used to work with the given application.
CO2	Develop the user interface by Selecting an effective style for the given real-world applications.
CO3	Make use of different UI design rules to develop a user interface for a real-world application.
CO4	Compare the different evaluation techniques used to measure the quality of User Interface.

Course Outcomes	**Program Outcomes**														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	1	2	-	-	-	-	-	-	-	3	-	-
CO2	3	2	1	1	2	-	-	-	-	-	-	-	-	3	-
CO3	3	2	2	3	3	-	-	-	-	-	-	-	3	3	-
CO4	2	3	3	2	2	-	-	-	-	-	-	-	-	-	-
CO5	2	3	3	2	2	-	-	-	-	-	-	-	-	-	-
CO6	2	3	3	2	2	-	-	-	-	-	-	-	-	-	-

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT- 1

Introduction to Human and the Computer: Human: Input-output channels, Human memory, thinking: reasoning and problem solving, Emotion, Individual differences, Psychology and the design of interactive systems. The computer: Positioning, pointing and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, sensors and special devices, Paper: printing and scanning, Memory, Processing and networks.

UNIT -2

Interaction and Paradigms: Models of interaction, Frameworks and HCI, Ergonomics, Interaction styles, Elements of the WIMP interface, Interactivity, The context of the interaction. Paradigms: Paradigms for interaction. Interaction design basics: The process of design, User focus, Scenarios, Navigation design, Screen design and layout, Iteration and prototyping.

UNIT- 3

HCI in the software process and Design rules: The software life cycle, Usability engineering, Iterative design and prototyping. Principles to support usability, Standards, Guidelines, Golden rules and heuristics, HCI patterns. Universal designs.

UNIT- 4

Evaluation techniques: Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, choosing an evaluation method.

Self-learning component:

Designing user support systems, Ubiquitous computing applications research, Hypertext, multimedia and the World Wide Web.

TEXT BOOKS

1. Alan Dix, Janet Finlay, Gregory Abowd & Russell Beale, Human-Computer Interaction. 3rd Edition. Prentice Hall, 2004.
2. Julie A. Jacko, Human-Computer Interaction Handbook, 3rd Edition, CRC Press, 2012.
3. Ben Shneiderman, Catherine Plaisant, Designing the User Interface, 6th Edition, Addison Wesley, 2017.

REFERENCE BOOKS:

1. Jonathan Lazar, Jinjuan Heidi Feng, & Harry Hochheiser Research Methods in Human- Computer Interaction, Wiley, Second edition, 2010.
2. ACM, International Journal of Human-Computer Studies.
3. IEEE, Transactions on Human-Machine Systems.

Course Title	Natural Language Processing				Course Type		PE(SC)	
Course Code	B22EHS522	Credits	3		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

The intent of the course is to give introduction to Natural Language Processing (NLP, a.k.a. computational linguistics), the study of computing systems that can process, understand, or communicate in human language. The primary focus of the course will be on understanding various NLP tasks as listed in the course syllabus, algorithms for effectively solving these problems, and methods for evaluating their performance. There will be a focus on statistical algorithms to acquire the knowledge needed to perform language processing.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of natural language processing and python
2. Discuss how to access the text corpora and Lexical Resources
3. Demonstrate the writing the structured programs to process the raw text
4. Describe role of Classifiers in Text processing.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Summarize the fundamentals of natural language processing.	1 to 5,9,10,12	1,2,3
CO2	Appraise how to access the text corpora and Lexical Resources	1 to 5, 9,10,12	1,2,3
CO3	Analyze large volume text data generated from a range of real-world applications.	1 to 5, 9,10,12	1,2,3
CO4	Demonstrate semantics and pragmatics of English language for text processing.	1 to 5, 9,10,12	1,2,3
CO5	Estimate the skills for writing the structured programs to process the raw text.	1 to 5, 9,10,12	1,2,3
CO6	Apply different classifiers for Text processing.	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2					√	
CO3				√		
CO4		√				
CO5					√	
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			1					3				3	3	3	
CO2					2						1	3	3	3	
CO3			1					3			1	3	3	3	
CO4			3					3			1	3	3	3	
CO5			3		3			2				3	3	3	3
CO6								2			1	3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Language Processing and python, Accessing Text corpora and Lexical Analysis: Computing with language: Texts and words, a closer look at python: texts as list of words, computing with language: simple statistics, Automatic natural language understanding; Accessing Text Corpora, Conditional Frequency Distributions, Lexical Resources, WordNet, Introduction to NLTK Tool.

UNIT – 2

Processing Raw Text: Accessing Text from the Web and from Disk, Strings: Text Processing at theLowest Level, Text Processing with Unicode, Regular Expressions for Detecting Word Patterns, Useful Applications of Regular Expressions, Normalizing Text,

Regular Expressions for Tokenizing Text, Segmentation, Formatting: From Lists to Strings,
Object-Oriented Programming: Working with Objects; Implementing Classes; Object Construction; Static Variables and Methods, Packages; Nested Classes; Documentation Comments; Interfaces; Static, Default and Private Methods in interface; Lambda Expressions; Method and Constructor References; Local and Anonymous Classes.

UNIT – 3

Categorizing and Tagging words: Using a Tagger, Using a Tagger, Mapping Words to Properties Using Python Dictionaries, Automatic Tagging, N-Gram Tagging, Transformation-Based Tagging, How to Determine the Category of a Word.

UNIT – 4

Classifying Text: Supervised Classification: Examples, Evaluation; Decision Trees, Naive Bayes Classifiers, Maximum Entropy Classifiers, Modelling Linguistic Patterns.

TEXT BOOKS:

1. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", OReilly Media, 2009.
2. Yuxi (Hayden) Liu, "Python Machine Learning by Example", Packt publisher, 2017.

REFERENCE BOOKS:

1. James Allen, "Natural Language Understanding", Benjamin-Cummings Publishing Co, Inc., 1995.
2. Christopher D. Manning and HinrichSchutze, "Foundations of Statistical Natural Language Processing", The MIT Press, 1999.
3. Randolf Quirk, Sidney Greenbaum, Geoffrey Leech, Jan Svartvik, "A Comprehensive Grammar of English Language", Cambridge University Press, 1987.

JOURNALS/MAGAZINES:

1. Springer Journal on Natural Language Process
2. Springer Journal on Natural Language Process
3. Elsevier Journal on Natural Language Process
4. ACM Transactions on Language Processing
5. Elsevier Journal of cognitive systems research

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/ Natural Language Process
2. https://www.classcentral.com/course/ Natural Language Process
3. https://nptel.ac.in/courses/476/876/3323106156/

SELF-LEARNING COMPONENT:

Extracting information from Text, Exploring the 20 Newsgroups with Text Analysis Algorithms, Stock Price prediction with Regression Algorithms, Best Practices: i) Data preparation stage ii) Training sets generation stage iii) Model training, evaluation and selection stage.

PRACTICE:

Sl. No.	List of Programs
1	NLTK is a leading platform for building Python programs to work with human language data. It provides easy-to-use interfaces to over 50 corpora and lexical resources such as WordNet, along with a suite of text processing libraries for classification, tokenization, stemming, tagging, parsing, and semantic reasoning, wrappers for industrial-strength NLP libraries, and an active discussion forum. Write a python program to extract tokens from the input sentence of English language using python NLTK toolkit.

2	An incredible amount of unstructured text data is generated every day by social media, web pages, and a variety of other sources. But without the ability to tame and harness that data, you'll be unable to glean any value from it. In this course, learn how to translate messy text data into powerful insights using Python. Instructor Derek Jedamski begins with a quick review of foundational NLP concepts, including how to clean text data and build a model on top of vectorized text. He then jumps into more complex topics such as word2vec, doc2vec, and recurrent neural networks. Develop a python program to create social network structure of LinkedIn profile using python NLTK toolkit.
3	Analyzing movie reviews data and try to predict whether the review is positive or negative. Familiarity with some machine learning concepts will help to understand the code and algorithms used. Develop a program to analyze the review comments of a movie trailer to provide rating using Python NLTK Toolkit.
4	Cluster is a process of grouping similar items together. Ecah group, also called as a cluster, contains items that are similar to each other. Clustering algorithms are unsupervised learning algorithms Develop a program to cluster similar text documents using Python NLP Toolkit.
5	A popular NLP application called Machine Translation. In Machine Translation, you take in a bunch of words from a language and convert these words into another language. Develop a NLP program to convert simple sentences from one language to another.
6	Sentiment Analysis is the process of 'computationally' determining whether a piece of writing is positive, negative or neutral. It's also known as opinion mining, deriving the opinion or attitude of a speaker. Analyse twitter sentimental data set to predict the sentiments.
7	While the voice of an individual is unique, secure authentication through voice recognition can be a challenge in some cases – for instance, if the user has a sore throat or cold. It is therefore important to prevent unauthorized users from hacking into the database by mimicking someone else's voice. Develop program to recognize speech for authentication.
8	Text summarization is the process of creating a short, accurate, and fluent summary of a longer text document. It is the process of distilling the most important information from a source text. Automatic text summarization is a common problem in machine learning and natural language processing (NLP). Automatic text summarization methods are greatly needed to address the ever-growing amount of text data available online to both better help discover relevant information and to consume relevant information faster. Perform document summarization using NLP toolkit.
9	An IVR system's effectiveness is rated by the percentage of callers who ask to speak to a live operator. The lower the percentage, the more successful the system. Of course there are some IVR systems that never give you the option of speaking to a live operator. Develop an IVR system for REVA University.
10	Again, for services and email clients not mentioned here, you can almost always prevent emails from getting sent to spam simply by adding the sender to your address book or contacts. If it has an option to mark as "Not Spam", "Remove From Spam", or something similar, you can always click that too. However, it's generally better to add a sender Develop a program to classify mails to spam.

Course Title	**IoT Architecture and Protocols**				**Course Type**	**SC**	
Course Code	**B22EHS523**	**Credits**	**3**		**Class**	**V Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes**	**Assessment in Weightage**	
	Lecture	**3**	**3**	**3**			
	Tutorial	**-**	**-**	**-**	**Theory**	**CIE**	**SEE**
	Practical	**-**	**-**	**-**			
	Total	**3**	**3**	**3**	**42**	**50%**	**50%**

COURSE OVERVIEW

This course covers the insights of architecture, protocols used in IoT applications, IoT reference models.

COURSE OBJECTIVE (S):

The objectives of this course are to:
1. Make students know the basic concept and architecture
2. Enable for different design protocols used for an embedded system for IoT applications.
3. Get Insights about the IoT enabled technology
4.Demonstrate to read and store data from sensors, and to monitor and control IoT devices.
5.Discuss IoT programming to develop larger smart products useful for the society/industry

COURSE OUTCOME

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Summarize the essentials of IoT and its applications.	1,2,12	1,2
CO2	Outline the concepts of IoT Architecture Reference model.	1,2,3,5,9,12	1,2
CO3	Analyze various IoT Application layer Protocols.	3,4,5,7	2, 3
CO4	Apply IP based protocols and Authentication Protocols for IoT.	2,3,4,5,8,12	2,3
CO5	Analyse the techniques to transmit the data of any sensor to cloud using a WiFi module.	1,3,4,5,6,8	2,3
CO6	Develop an IoT-based systems for any applications.	1,2,3,4,5,6,8,12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
CO1		√				
CO2		√				
CO3				√		
CO4			√			
CO5				√		
CO6			√			

COURSE ARTICULATION MATRIX

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
2	2										3	2	2	
3	3	2		2				3			3	2	2	

		3	2	2		2							2
	3	2	3	2			3				2		3
3		3	3	2	2		2						2
3	3	2	2	2	2		2				3	2	

Unit 1

Introduction to IOT, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Applications of IOT

Unit 2

Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, Arduino Board details. The IoT Architectural Reference Model as Enabler, IoT in Practice: Examples: IoT in Logistics and Health, IoT Reference Model: Domain, information, functional and communication models;

Unit 3

IoT Reference Architecture: Architecture, Functional, information, deployment and operation views; SOA based Architecture, API-based Architecture, OPENIoT Architecture for IoT/Cloud Convergence.

Unit 4

Application Protocols for IoT: UPnP, CoAP, MQTT, XMPP. SCADA, WebSocket; IP-based protocols: 6LoWPAN, RPL; Authentication Protocols; IEEE 802.15.4.

Case study: Cloud-Based Smart-Facilities Management, Healthcare, Environment Monitoring System.

Text books/Reference Books:

1.The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012

2.Architecting the Internet of Things,Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer,2011.

3.Bassi, Alessandro, et al, “Enabling things to talk”, Springer-Verlag Berlin An, 2016.

4.David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017

5.Hersent, Olivier, David Boswarthick, and Omar Elloumi. The internet of things: Keyapplications and protocols. John Wiley & Sons, 2011.

6.Buyya, Rajkumar, and Amir Vahid Dastjerdi, eds. Internet of Things: Principles and paradigms. Elsevier, 2016.

Course Title	**Cognitive Computing**	**Course Type**	**PE(SC)**

Course Code	B22EHS524	Credits	3		Class	V Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Theory	3	3	3			
					Theory	CIE	SEE
	Practical	-	-	-			
	Total	3	3	3	42	50	50

COURSE OVERVIEW:

This course gives the insights of self-learning systems that utilize Artificial Intelligence/ Machine Learning models to mimic the way of human thought process. Eventually, this course will be helpful to facilitate the building of HCI solutions which are capable of solving problems.

COURSE OBJECTIVE (S):

The objectives of this course are to:
1. Identify how Artificial Intelligence, Machine Learning and Cognitive Computing are related and used for application development.
2. Identify, design and assess Cognitive Computing and Artificial Intelligence challenges/ issues with social impact.
3. Visualize the data characteristics, preprocessing and Understand the Patterns for further application development.

COURSEOUTCOMES(COs)

After the completion of the course, the student will be able to

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate a broad knowledge of concepts and issues in Cognitive Computing.	1 to 6	1,2
CO2	Explore the technical and managerial issues in developing and using applications based on cognitive computing and Artificial Intelligence Applications techniques.	1 to 6	1,2
CO3	Apply and assess Cognitive Computing and Artificial Intelligence Applications in an organizational setting	1 to 6	1,2
CO4	Understanding on different Perception and sensing data	1 to 6	1,2
CO5	Design a Real-Time information Based Evacuation Decision support system for emergency management	1 to 6	1,2
CO6	Understand Current Trends and Research Issues and applications of Cognitive computing	1 to 6	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level

CO#	Remember (L1)	Understand (L2)	Apply (L3)	**Analyze (L4)**	**Evaluate (L5)**	Create (L6)
CO1		√	√			
CO2			√	√		
CO3			√			
CO4		√	√			
CO5			√			
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	3	1							3	3	
CO2	3	3	3	3	3	1							2	2	
CO3	3	3	3	2	2	1							2	3	
CO4	3	3	3	3	3	1							3	3	
CO5	3	3	3	2	3	1							3	3	
CO6	2	3	2	3	3	1							3	3	

COURSE CONTENTS THEORY:

UNIT-1

Introduction to Cognitive Computing: Definition, concepts, and historical background, Cognitive Systems and Models: Understanding cognitive architectures and systems, Cognitive Processes: Perception, attention, memory, problem-solving, and decision-making, Cognitive Task Analysis: Methods for analyzing cognitive tasks and processes.

UNIT-2

Brain Signals and Feature extraction, Types of Brain signals, case study, Feature extraction methods and their analysis, Models of Understanding Cognition or Mind: Neuroscientific Model, Psychological Model, Representational Model, Computational Model, Isomorphic Model, Multiple realizable Model, Multiple Draft Model, Sub personal Model.

UNIT-3

Cognitive Computing in Virtual Reality (VR) and Augmented Reality (AR): Introduction to Virtual Reality (VR) and Augmented Reality (AR), Fundamentals and applications. Cognitive Aspects of VR/AR: Understanding the impact of VR/AR on perception and cognition. VR/AR Interaction Design: Designing intuitive and effective interfaces for VR/AR applications. Immersive Experience Design: Creating immersive experiences using cognitive computing principles.

UNIT-4

Human-Computer Interaction (HCI) and User Experience (UX) Design: Introduction to Human-Computer Interaction: Basic principles and concepts. User-Centered Design: Understanding user needs, prototyping, and evaluation. Cognitive Aspects of HCI: Mental models, human memory, and attention in interface design. Multi-modal Interfaces: Designing interfaces for multiple input/output modes.

TEXTBOOKS:

1. Friedenberg, Jay, Gordon Silverman, and Michael J. Spivey. *Cognitive science: an introduction to the study of mind*. Sage Publications, 2021.
2. Shapiro, Lawrence. *Embodied cognition*. Routledge, 2019.
3. REFERENCE BOOKS:
4. LaValle, Steven M. *Virtual reality*. Cambridge university press, 2023..
5. Still, Brian, and Kate Crane. *Fundamentals of user-centered design: A practical approach*. CRC press, 2017.

JOURNAL/ MAGAZINES:

1. Cognitive computing: https://www.springer.com/journal/12559/
2. International Journal of Cognitive Computing in Engineering, http://www.keaipublishing.com/en/journals/international-journal-of-cognitive-computing-in-engineering/
3. IEEE Transactions on Cognitive and Developmental Systems, https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=7274989

SWAYAM/NPTEL/MOOC:

1. Swayam : Course Name : Fundamentals Of Artificial Intelligence, By Prof. Shyamanta M Hazarika, IIT Guwahati.
2. NPTEL: Course Name : Human Computer Interaction (HCI), unded by -MHRD, Govt. of India National Mission on Education Through Information and Communication Technology.
3. Coursera: Mind and Machine Specialization (https://www.coursera.org/specializations/mind-machine)

SELF-LEARNING EXERCISES:

1. Cognitive function measurement tools and software.

2. Selected topics from research papers.

Course Title	**Augmented Reality and Virtual Reality**				**Course Type**		**SC**	
Course Code	**B22EHS525**	**Credits**	**3**		**Class**		**V Semester**	
Course Structure	TLP	Credits	Contact Hours		Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-		Theory	Practical	CIE	SEE
	-	-	-					
	Total	**3**	**3**	**3**	**42**	**-**	**50**	**50**

COURSE OVERVIEW:
This course covers basic concepts of augmented reality and virtual reality. The course also introduces the student to the working of projects in both AR & VR. The course also helps the student to understand the current state of AR & VR. Further, this course helps the student to explore the use cases of AR & VR.

COURSE OBJECTIVE (S):
The objectives of this course are to:

6. Explain the basic concepts in augmented reality and virtual reality.

7. Illustrate the consuming content in augmented reality and virtual reality.
8. Explore the current state of augmented reality and virtual reality and its use cases.
9. Demonstrate the augmented reality and virtual reality projects.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	P S
CO1	Describe the concepts in augmented reality and virtual reality.	1 to 5,9,10,	1 ,
CO2	Explain the factors, features, and the current issues with augmented reality and virtual reality.	1 to 5, 9,10,1 2	1 , 3
CO3	Illustrate the consuming content in augmented reality and virtual reality.	1 to 5, 9,10,1	1 ,
CO4	Explore the current state of augmented reality and virtual reality and its use cases.	1 to 5, 9,10,1	1 ,
CO5	Apply the concepts of ROS Command tools and GUI tools	1 to 5, 9,10,1	1 ,
CO6	Demonstrate the augmented reality and virtual reality projects.	1 to 5, 9,10,1	1 ,

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply (L3)	Analyze	Evaluate	Create (L6)
CO1		√				
CO2		√				
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2				3	3		2	2		3
CO2	3	3	3	2	1				3	3		2	2		3
CO3	3	3	3	2	1				3	3		2	2		3
CO4	3	3	3	2	2				3	3		2	2		3
CO5	3	2	2	2	3				3	3		2	2		3
CO6	3	2	2	2	3				3	3		2	2		3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT
THEORY:

UNIT – 1

Defining Augmented Reality and Virtual Reality: Introducing Augmented Reality (AR) and Virtual Reality (VR), Looking at Some Other Types of AR & VR, Taking a Quick History Tour, Evaluating the Technology Hype Cycle.

Exploring the Current State of Augmented Reality and Virtual Reality: Looking at the Available Form Factors, Focusing on Features, Considering Controllers, Recognizing the Current Issues with AR & VR.

UNIT – 2

Consuming Content in Augmented Reality and Virtual Reality: Exploring Consumer-Grade AR & VR, Identifying Near-Future Hardware, Comparing Current and Future Options, Assessing Your Project's Technology Needs, Choosing AR & VR.

UNIT – 3

Planning Your Augmented Reality and Virtual Reality Project: Defining Your AR & VR Project, Exploring Design Principles in AR & VR, Defining Your Social Experience.

Creating Content for Augmented Reality and Virtual Reality: Assessing Design Software, Capturing Real Life, Assessing Development Software, Distributing Your Content.

UNIT – 4

Exploring Augmented Reality and Virtual Reality Use Cases: Art, Education, Entertainment, Healthcare, Gaming, Aerospace, Retail, Military, Real Estate, Advertising and Marketing.

TEXT BOOKS:

4. Paul Mealy, "Virtual & Augmented Reality For Dummies", John Wiley & Sons, First Edition, 2018.

REFERENCE BOOKS:

4. Timothy Jung and M. Claudia Tom Dieck, "Augmented Reality and Virtual Reality – Empowering Human, Place and Business", Springer, First Edition, 2018.
5. Dengzhe Ma, Jürgen Gausemeier, Xiumin Fan and Michael Grafe, "Virtual Reality & Augmented Reality in Industry", Springer, First Edition, 2011.

JOURNALS/MAGAZINES:

1. International Journal of Virtual and Augmented Reality (IJVAR). Springer, Virtual Reality.

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/specializations/virtual-reality
2. https://www.coursera.org/learn/augmented-reality
3. https://www.udemy.com/course/virtual-reality/
4. https://www.udemy.com/tutorial/develop-augmented-reality-book-ar-business-card-with-unity/what-is-augmented-reality/
5. https://elearn.nptel.ac.in/shop/iit-workshops/ongoing/foundation-course-on-virtual-reality-and-augmented-reality/

SELF-LEARNING EXERCISES:

1. Google Translate
2. Amazon AR View

3. AR City
4. Ingress and Pokémon Go
5. InkHunter
6. Sketch AR

Course Title	Big Data Analytics Lab				Course Type		HC	
Course Code	B22EF0505	Credits	1		Class		V Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Practical	1	2	2				
	Total	1	2	2	-	28	25%	25%

Professional Elective 4

COURSE OVERVIEW:

This course is to familiarize the students with most important information technologies used in manipulating, storing, and analyzing big data. The Spark framework is introduced to the students to perform big data analytics using PySpark. The course demonstrates the application of PySpark in solving any big data analytics problem. The course also demonstrates the usage of machine learning with PySpark to analyse large datasets.

COURSE OBJECTIVES:

1. Discuss the fundamentals of Spark distributed system and Big Data Analytics.
2. Demonstrate Big Data Processing with Python and PySpark.
3. Describe the implementation of Real-Time Analytics with PySparkin real world Applications.
4. Illustrate the working of Machine Learning applications suitable to handle big data using PySpark.

COURSE OUTCOMES:
On successful completion of this course; the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Illustrate the fundamentals of Spark distributed framework for Big Data Analytics.	1,2,3,4,5,9,10,11	1,2,3
CO2	Demonstrate Big Data Processing with PySpark to solve simple real world problems.	1,2,3,4,5,9,10,11	1,2,3
CO3	Design Real-Time Analytics with PySparkfor real world Applications.	1,2,3,4,5,9,10,11	1,2,3
CO4	Develop data and processing models using Python based PySparkfor real world Big data Applications	1,2,3,4,5,9,10,11	1,2,3
CO5	Design Real-Time Analytics with PySpark for real world Applications.	1,2,3,4,5,9,10,11	1,2,3
CO6	Develop data and processing models using Python based PySpark for real world Big data Applications.	1,2,3,4,5,9,10,11	1,2,3

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2			✓			
CO3		✓				
CO4			✓			
CO5			✓			
CO6			✓			

COURSE ARTICULATION MATRIX

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3				1	1	1	1	3	3	3
CO2	3	3	3	3	3				2	1	2	3	3	3	3
CO3	3	3	3	3	3				2	1	2	3	3	3	3
CO4	3	3	3	3	3				3	3	2	3	3	3	3
CO5	3	3	3	3	3				2	1	2	3	3	3	3
CO6	3	3	3	3	3				3	3	2	3	3	3	3

PRACTICE:

S.N.	Title of the Experiment	Tools and Techniques	Expected Skill/Ability
	PART-A		
	Introduction: Installing PySpark on Colab	Windows/Linux OS, IDE/Colab	Understanding the process of Installation of Java and PySpark on Colab
1.	Perform the following operations: a. Create a SparkContext object b. Create anRDD from set of words ("scala", "java", "hadoop", "spark", "akka", "spark vs hadoop", "pyspark", "pyspark and spark") using *parallelize()* function. c. Find the total count of the words in the RDD d. Filter out and print the strings containing the word "spark" from the RDD	Windows/ Linux OS, IDE/Colab	Understand the skill of creating RDDs in PySpark

2.	Given the two RDDs: a. x created from the ordered pairs: ("spark", 1) and ("hadoop", 4) b. y created from the ordered pairs: ("spark", 2), ("hadoop", 5). Perform the join operation on the RDDs created above, and print the resulting RDD.	Windows/ Linux OS, IDE/Colab	Understand the skill of performing operations on RDDs in PySpark
3.	Create an RDD of set of numbers and perform the sum of these numbers using an *accumulator()* function in Spark context.	Windows/ Linux OS, IDE/Colab	Understand the skill of performing operations on RDDs in PySpark
4.	Create an RDD from the existing file having CSV data, using *read()* and *load()* functions and display the top 5 rows of the data set. And also display the statistical results from the data frame (Note: It only works for numerical values).	Windows/ Linux OS, IDE/Colab	Understand the skill of performing operations on RDDs in PySpark
5.	Create an RDD from the external text file. Find the word count in the text file using various transformation and action functions in PySpark.	Windows/ Linux OS, IDE/Colab	Understand the skill of performing operations on RDDs in PySpark
6.	Given the following data. Data = [("James","Sales","NY",90000,34,10000), ("Michael","Sales","NV",86000,56,20000), ("Robert","Sales","CA",81000,30,23000), ("Maria","Finance","CA",90000,24,23000), ("Raman","Finance","DE",99000,40,24000), ("Scott","Finance","NY",83000,36,19000), ("Jen","Finance","NY",79000,53,15000), ("Jeff","Marketing","NV",80000,25,18000), ("Kumar","Marketing","NJ",91000,50,21000)], with the following schema schema = ["employee_name","department","state","salary","age ","bonus"] Perform the following using the aforementioned data. i. create an RDD from the above data using its schema ii. create the PySparkdataframe from the RDD created. iii. Using groupBy() function, display the salaries of the employees state-wise. iv. Display the state-wise salaries that are greater than 1 lakh v. Display the state-wise salaries in descending order.	Windows/ Linux OS, IDE/Colab	Understand the skill of creating PySparkdata frames from RDD and then performing operations on PySpark RDDs in PySpark
7.	Given the following data data = [("1", "john jones"), ("2", "tracey smith"), ("3", " amy sanders")], along with the following schema of the data columns = ["Seqno","Name"]	Windows/ Linux OS, IDE/Colab	Understand the skill of creating PySparkdata frames from

	Perform the following using the afore mentioned data. vi. create an RDD from the above data using its schema vii. create the PySparkdataframe from the RDD created. viii. Write python functions to convert the first letter of every string into upper case. ix. Use the above python function as udf in pySpark to convert the data in the dataframe and display the result.		RDD and then performing operations on PySpark RDDs in PySpark
	PART-B (Mini-Project)		
8	plement and demonstrate any real life big data problem using any of the publicly available big data sets.	dows/Linux OS, IDE/Colab	erature Surveying, Project Implementation, Seminars, IPR Filing, Paper Publication

Note: During the examination, the student is expected to do one of the first 7 exercises from Part-A by choosing on lots. The student is also expected to develop a Mini-Project using PySpark to solve some real time data analytics application. The overall examination marks are distributed into Part-A and Part-B. Part-B includes demonstration of project and submission of project report.

TEXT BOOKS:

1. Feng, Wenqiang. "Learning Apache Spark with Python." (2019): 231.
2. Mengle, Saket SR, and Maximo Gurmendez. Mastering machine learning on Aws: advanced machine learning in Python using SageMaker, Apache Spark, and TensorFlow. Packt Publishing Ltd, 2019.

REFERENCE BOOKS:

1. Michael Minelli, Michele chambers, AmbigaDhiraj,”Big data, big analytics”, Wiley, 2013.

JOURNALS/MAGAZINES

1. IEEE, Introduction to the IEEE Transactions on Big Data.
2. Elsevier, Big data research journal Elsevier.

Springer, Journal on Big Data Springer.

Course Title	**Computer Networks lab**				**Course Type**		**HC**	
Course Code	**B20EF0506**	**Credits**	**1**		**Class**		**V Semester**	
Course Structure	**TLP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Theory	-	-	-				
	Practice	1	2	2	**Theory**	**Practical**	**CIE**	**SEE**
	-	-	-	-				
	Total	1	2	2	-	26	25	25

COURSE OVERVIEW:

This course introduces to networking and Internet protocols via programming and hands-on labs using different tools viz. ns3, NMAP, packet tracer. The concept learnt are understood more clearly pertaining to TCP/IP protocol architecture; user datagram protocol (UDP); multicasting; transmission control protocol (TCP); standard Internet services, and protocol usage by common Internet applications. Sockets programming; client/server; peer-to-peer; Internet addressing; TCP sockets; UDP sockets; Router and switch configurations, network topology, wireless internetworking, Network protocol analyzers; traffic generation...

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the ns3 simulator, installation and its application.
2. Illustrate the creation of point to point link, TCP, UDP protocols its connection.
3. Demonstrate the connection establishment of network computing devices.
4. Discuss tracking, testing, analyzing the network.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Outline the protocol stacks (OSI and TCP/IP) used for data communication	1 to 5,9,10,12	1,3
CO2	Analyze the connection establishment of network computing devices using Packet tracer	1 to 5, 9,10,12	1,3
CO3	Develop a program for star topology in C++ and understand data transfer with NetAnim	1 to 5, 9,10,12	2, 3
CO4	Make use of TCP dump to understand and analyze the network characteristics	1 to 5, 9,10,12	1,3
CO5	Apply NMAP to understand network behavior for spurious activity	1 to 5, 9,10,12	1,3
CO6	Demonstrate the wireshark tool for protocol analysis	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3				√		
CO4					√	
CO5				√		
CO6					√	

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2				3	3		2	3		3

CO2	3	3	2	2	1				3	3		2	3		3
CO3	3	3	2	2	2				3	3		2	1	1	3
CO4	3	3	3	1	2				3	3		2	1	-	3
CO5	3	2	2	2	3				3	3		2	3		3
CO6	3	2	2	3	3				3	3		2	3	2	3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	**Title of the Experiment**	**Tools and Techniques**	**Expected Skill /Ability**
1	Introduction to: (a) discrete event simulation, (b) ns3, (c) ns3 Installation, (d) NetAnim.	NS3, NetAnim, Nmap	Understand the meaning of dicrete event simulatior like NS3.Gain knowledge to install the ns3 software in Ubuntu.UnderstandNetAnim and its installation.
2	Write a NS3 program to connect two nodes with a point to point link, which have unique interface. Analyze the network performance using UDP client server.	NS3(Installed with NetAnim), Wireshark.	Understand to establish point to point network. Create an interface to point to point link. Anylize the Network performance usibg client server
3	Write a NS 3 program to demonstrate bus topology. Analyze the performance using UDP based applications.	NS3(Installed with NetAnim), Wireshark.	Create Bus Topology. Analyze the performance using UDP based applications.
4	Write a NS 3 program to demonstrate star topology. Analyze the performance using UDP based applications.	NS3, Wireshark	Create Star Topology. Analyze the performance using UDP based applications
5	Write a NS3 program to implement FTP using TCP bulk transfer, Analyze the performance	NS3, Wireshark.	Impliment FTP protocol to analyze the flow of bulk transfer. Anlyze the performance of Application Protocols.
6	Write a NS3 program to connect two nodes with a point to point link, which have unique interface. Analyse the traffic control using TCP by changing suitable parameters.	NS3, Trace Matices, Wirushark	Create Point to point link with unique interface. Analyze the flow of traffic control of Application Protocols.
7	Write NS 3 Program to configure two nodes on an 802.11b physical layer, with802.11b NICs in adhoc mode, and by default, sends one packet of 1000 (application) bytes to the other node. The physical layer is configured to receive at a fixed RSS (regardless of the distance and transmit power); therefore, changing position of the nodes has no effect. Analyze the performance.	NS3(Installed with NetAnim and Wifi Libraries)	Implement the wireless Technology in Adhoc mode. Anayze the performace by changing the position of nodes.
8	Install wireshark, and analyze the packets using it on a selected interface. Apply filters and check the packets.	Wireshark, I/O Graph Tools.	Install the wireshark tool for packet analysis. Apply the filters and anlysze the packet parameters.
9	Install packet tracer, and consider a topology and configure VLAN	Packet Tracer	Install the Packet tracer. Create and Configure a simple Virtual Local Area Network(VLAN)

10	Install NMAP, and execute atleast 10 commands to demonstrate the scanning of networks hosts and ports.	NMAP, Commands to Scan the system.	Install Nmap in both Windows and Ubantu Platform. Demonstrate the scanning of networks hosts and ports using suitable commends.

TEXTBOOKS:

1. Behrouz A Forouzan, "Data Communications and Networking", 5th Edition, McGraw – Hill, 2016.
2. Nader F. Mir, "Computer and Communication Networks", Pearson Education, 2009

Course Title	**Cloud Computing Lab**				**Course Type**		**HC**	
Course Code	**B22EH0502**	**Credits**	**1**		**Class**		**VI Semester**	
Course Structure	**TLP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Theory							
	Practice	**1**	**2**	**2**	**Theory**	**Practical**	**CIE**	**SEE**
	-	-	-	-				
	Total	**1**	**2**	**2**		**28**	**25**	**25**

COURSE OVERVIEW:

Cloud Computing is emerging rapidly as the new computing paradigm of the coming decade. The Cloud Computing Lab will provide the students with access to virtual machines running various operating systems and applications. At present the cloud computing is focusing on areas like Resource allocation in clouds, Cloud Security, Big Data Analytics, Software Defined Networks, Cloud Storage and Cloud for Telecom sector.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. To provide hands on experience to create a Virtual Machine platform.
2. To simulate the Cloud Environment for different entity configuration using cloudsim.
3. Ability to understand the Hadoop framework for bigdata computation.
4. To demonstrate the installation of OpenNebula and kubernates cluster.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	**Course Outcomes**	**POs**	**PSOs**
CO1	Understand the creation of virtual environment and perform the communication between the physical and virtual machine.	1,2,5	1,2
CO2	Make use of Cloudsim to build a Cloud Computing platform for different entity configurations.	1,2,3,5	1,2
CO3	Illustrate the MapReduce programs on Hadoop and analyze the results for different workloads.	1,2,3,5	1,2
CO4	Demonstrate the installation of OpenNebula Cloud platform.	1,2,3,5	1,2
CO5	Analyze the creation of kubernates cluster for containerized applications.	1,2,3,5	1,2
CO6	Compare and contrast different cloud platforms with case-studies.	1,2,3,5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5				√		
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	3								3		1
CO2	3	1	3	1	3								3		3
CO3	3	2	3	1	3				2			2	3		3
CO4	3	1	2	1	2								3		1
CO5	3	2	3	1	3								3		3
CO6	3	1	3	1	3				3	2		3	3	1	3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Demonstrate on the Virtual Environment on hypervisor. a) Communication between the VM's. b) The backup and restore mechanism.	Windows/Linux OS, hypervisor, vSphere Client	Understanding to create virtual machine, communication between Physical and Virtual Machine
2.	Demonstrate the mechanism of cloning and create a switch with multiple networks having the different VM's.	Windows/Linux OS, hypervisor, vSphere Client	Creating multiple Virtual machines with multiple networks.

3.	Demonstrates how to simulate a Data Center with one host and run one Cloudlet on it using Cloudsim.	Windows/Linux OS, IDE, Cloudsim	Understand Cloudsim and build a network with different entity configuration
4.	Demonstrates how to create a datacenter with one host, two virtual machines and run two cloudlets on it. Both virtual machine (vm1, vm2) has same machine configuration.	Windows/Linux OS, IDE, Cloudsim	Understand Cloudsim and build a network with different entity configuration
5.	Demonstrates how to create a datacenter with two hosts, two virtual machines and run two cloudlets on it. The cloudlets run in VMs with different MIPS requirements. The second VM will have twice the priority of virtual machine one (VM1) and so cloudlet will receive twice CPU time to complete the execution.	Windows/Linux OS, IDE, Cloudsim	Understand Cloudsim and build a network with different entity configuration
6.	Demonstrate how to create two datacenters with one host each and run two cloudlets on them.	Windows/Linux OS, IDE, Cloudsim	Understand Cloudsim and build a network with different entity configuration
7.	Implement and Evaluate the performance of MapReduce program on word count for different file size.	Windows/Linux OS, IDE, Cloudera	Understand Map Reduce concept
8.	Implement and Evaluate the performance of MapReduce program on character count for different file size.	Windows/Linux OS, IDE, Cloudera	Understand Map Reduce concept
9.	The Front-end is the central part of an OpenNebula installation and is the very first thing that needs to be deployed. Typically it's a host where the OpenNebula server-side components are installed and which is responsible for the management of an entire virtualization stack. It can be a physical host or a virtual machine. Demonstrate the installation of OpenNebula cloud	Linux OS	Understand installation of Open Source Cloud Computing Platform.

	Computing and host the Virtual Machines.		
10.	Demonstrate the step by step installing and deploying of the kubernates cluster.	Linux OS	Understand installation process.

Additional Lab Programs

Further exploring of following programs to be discussed:

1. Understanding and Creation of AWS EC2 VMs
2. Web Server, Firewall Access and Monitoring Cloud Usage in AWS Cloud Computing
3. Virtual Private Cloud in AWS
4. AWS Simple Notification Service {SNS)
5. Installing Docker Engine on EC2 Instance
6. Work Queues in Docker
7. Setting-Up Jenkins in Docker
8. Configuring AWS EMR Cluster
9. Configuring AWS Lambda
10. Exploring Users and Groups in Identity and Access Management (IAM) service in AWS Cloud Computing.

Course Title	**Skill Development Course - 3**				**Course Type**		**SDC**	
Course Code	**B22EH0503**	**Credits**	**2**		**Class**		**V Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	-	-	-				
	Tutorial	-	-	-	**Theory**	**Practical**	**CIE**	**SEE**
	Practical	2	4	4				
	Total	2	4	4	-	56	50%	50%

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	**Course Outcomes**	**POs**	**PSOs**
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3

CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	**Bloom's Level**					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATIONMATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3

CO10										3			3	3	3
CO11											3		3	3	3
CO12												3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Skill development-2:
Students will be offered training and certifications on the trending technologies from the industry experts.
The students are evaluated and certified after the training programs.

Course Title	**Computer Networks lab**				**Course Type**		**HC**	
Course Code	**B20EF0506**	**Credits**	**1**		**Class**		**V Semester**	
Course Structure	**TLP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Theory	**-**	**-**	**-**				
	Practice	**1**	**2**	**2**	**Theory**	**Practical**	**CIE**	**SEE**
	-	**-**	**-**	**-**				
	Total	**1**	**2**	**2**	**-**	**28**	**25**	**25**

COURSE OVERVIEW:

This course introduces to networking and Internet protocols via programming and hands-on labs using different tools viz. ns3, NMAP, packet tracer. The concept learnt are understood more clearly pertaining to TCP/IP protocol architecture; user datagram protocol (UDP); multicasting; transmission control protocol (TCP); standard Internet services, and protocol usage by common Internet applications. Sockets programming; client/server; peer-to-peer; Internet addressing; TCP sockets; UDP sockets; Router and switch configurations, network topology, wireless internetworking, Network protocol analyzers; traffic generation...

COURSE OBJECTIVE (S):

The objectives of this course are to:
1. Explain the ns3 simulator, installation and its application.
2. Illustrate the creation of point to point link, TCP, UDP protocols its connection.
3. Demonstrate the connection establishment of network computing devices.
4. Discuss tracking, testing, analyzing the network.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	**Course Outcomes**	**POs**	**PSOs**
CO1	Outline the protocol stacks (OSI and TCP/IP) used for data communication	1 to 5,9,10,12	1,3
CO2	Analyze the connection establishment of network computing devices using Packet tracer	1 to 5, 9,10,12	1,3
CO3	Develop a program for star topology in C++ and understand data transfer with NetAnim	1 to 5, 9,10,12	2, 3
CO4	Make use of TCP dump to understand and analyze the network characteristics	1 to 5, 9,10,12	1,3

CO5	Apply NMAP to understand network behavior for spurious activity	1 to 5, 9,10,12	1,3
CO6	Demonstrate the wireshark tool for protocol analysis	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1			√			
CO2			√			
CO3				√		
CO4					√	
CO5				√		
CO6					√	

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2				3	3		2	3		3
CO2	3	3	2	2	1				3	3		2	3		3
CO3	3	3	2	2	2				3	3		2	1	1	3
CO4	3	3	3	1	2				3	3		2	1	-	3
CO5	3	2	2	2	3				3	3		2	3		3
CO6	3	2	2	3	3				3	3		2	3	2	3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1	Introduction to: (a) discrete event simulation, (b) ns3, (c) ns3 Installation, (d) NetAnim.	NS3, NetAnim, Nmap	Understand the meaning of dicrete event simulatior like NS3.Gain knowledge to install the ns3 software in Ubuntu.UnderstandNetAnim and its installation.
2	Write a NS3 program to connect two nodes with a point to point link, which have unique interface. Analyze the network performance using UDP client server.	NS3(Installed with NetAnim), Wireshark.	Understand to establish point to point network.

			Create an interface to point to point link. Anylize the Network performance usibg client server
3	Write a NS 3 program to demonstrate bus topology. Analyze the performance using UDP based applications.	NS3(Installed with NetAnim), Wireshark.	Create Bus Topology. Analyze the performance using UDP based applications.
4	Write a NS 3 program to demonstrate star topology. Analyze the performance using UDP based applications.	NS3, Wireshark	Create Star Topology. Analyze the performance using UDP based applications
5	Write a NS3 program to implement FTP using TCP bulk transfer, Analyze the performance	NS3, Wireshark.	Impliment FTP protocol to analyze the flow of bulk transfer. Anlyze the performance of Application Protocols.
6	Write a NS3 program to connect two nodes with a point to point link, which have unique interface. Analyse the traffic control using TCP by changing suitable parameters.	NS3, Trace Matices, Wirushark	Create Point to point link with unique interface. Analyze the flow of traffic control of Application Protocols.
7	Write NS 3 Program to configure two nodes on an 802.11b physical layer, with802.11b NICs in adhoc mode, and by default, sends one packet of 1000 (application) bytes to the other node. The physical layer is configured to receive at a fixed RSS (regardless of the distance and transmit power); therefore, changing position of the nodes has no effect. Analyze the performance.	NS3(Installed with NetAnim and Wifi Libraries)	Implement the wireless Technology in Adhoc mode. Anayze the performace by changing the position of nodes.
8	Install wireshark, and analyze the packets using it on a selected interface. Apply filters and check the packets.	Wireshark, I/O Graph Tools.	Install the wireshark tool for packet analysis. Apply the filters and anlysze the packet parameters.
9	Install packet tracer, and consider a topology and configure VLAN	Packet Tracer	Install the Packet tracer. Create and Configure a simple Virtual Local Area Network(VLAN)
10	Install NMAP, and execute atleast 10 commands to demonstrate the scanning of networks hosts and ports.	NMAP, Commands to Scan the system.	Install Nmap in both Windows and Ubantu Platform. Demonstrate the scanning of networks hosts and ports using suitable commends.

TEXTBOOKS:

1. Behrouz A Forouzan, “Data Communications and Networking”, 5th Edition, McGraw – Hill, 2016.
2. Nader F. Mir, “Computer and Communication Networks”, Pearson Education, 2009

<table>
<tr><td>Course Title</td><td colspan="4">Skill Development Course - 3</td><td colspan="2">Course Type</td><td colspan="2">SDC</td></tr>
<tr><td>Course Code</td><td>B22EHO503</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>2</td><td>4</td><td>4</td></tr>
<tr><td>Total</td><td>2</td><td>4</td><td>4</td><td>-</td><td>56</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OUTCOMES (CO’S):

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3
CO10										3			3	3	3
CO11											3		3	3	3
CO12												3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Skill development-2:
Students will be offered training and certifications on the trending technologies from the industry experts.
The students are evaluated and certified after the training programs.

3rd Year Detailed Syllabus

VI SEMESTER

VI SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE /MC/S DC	Credit Pattern L	T	P	Total Credit	Contact Hours / Week	Examination CIE Marks	SEE Marks	Total Marks	Course category (As per AICTE)
1	B22XXO61X	Open Elective – 2 (general)	OE	3	0	0	3	3	50	50	100	POE
2	B22EH0601	Neural Networks and Deep Learning	HC	3	0	0	3	3	50	50	100	PCC
3	B22EH0602	Business Intelligence and Analytics	HC	3	0	0	3	3	50	50	100	PCC
4	B22EF0602	Web Technology	HC	3	0	0	3	3	50	50	100	PCC
5	B22EF0603	Agile Development and DevOps	HC	3	0	0	3	3	50	50	100	PCC
6	B22ETS61X	Professional Elective – 4	SC	3	0	0	3	3	50	50	100	PEC
7	B22EHS62X	Professional Elective – 5	SC	3	0	0	3	3	50	50	100	PEC
8	B22EF0606	Web Technology Lab	HC	0	0	1	1	2	25	25	50	PCC
9	B22EH0603	Business Intelligence Lab	HC	0	0	1	1	2	25	25	50	PCC
10	B22EH0604	Neural Networks and	HC	0	0	1	1	2	25	25	50	PCC

		Deep Learning Lab										
11	B22EH0605	Mini Project (research based)	HC	0	0	2	2	4	50	50	50	PCC
Total				21	0	5	26	31	475	475	900	
TOTAL SEMESTER CREDITS				26								
TOTAL CUMULATIVE CREDITS				140								
TOTAL CONTACT HOURS				31								
TOTAL MARKS				900								

Open Electives 2

Course Title	**Foundations of Artificial Intelligence and Machine Learning**				**Course Type**		**OE**	
Course Code	**B22EH0611**	**Credits**	**3**		**Class**		**Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW:

The course "Foundations of Artificial Intelligence and Machine Learning" provides an in-depth introduction to the fundamental concepts, theories, and techniques of artificial intelligence (AI) and machine learning (ML). This course aims to equip students with a solid foundation in AI and ML and empower them to apply these principles to real-world problems. Throughout the course, students will gain a comprehensive understanding of the key components of AI and ML, including data preprocessing, feature engineering, model selection, and evaluation. They will learn about different types of machine learning algorithms, such as supervised learning, unsupervised learning, and reinforcement learning, and explore their applications across various domains. The course will start by laying the groundwork with an exploration of the basic principles and theories behind AI and ML. Students will examine the mathematical foundations and concepts underlying machine learning algorithms, enabling them to grasp the fundamental mechanisms behind these models.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Gain a solid understanding of the fundamental principles and theories of AI and ML.
2. Develop proficiency in applying different machine learning algorithms to real-world datasets.
3. Acquire the skills to preprocess and engineer data effectively for machine learning tasks.
4. Evaluate and compare the performance of different machine learning models using appropriate metrics.
5. Explore the ethical implications and considerations inherent to AI and ML systems.
6. Apply critical thinking and problem-solving skills to design and develop effective machine learning solutions.

COURSEOUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Recall the fundamental concepts and terminology of artificial intelligence and machine learning.	1 to 5,9 10,12	1,2
CO2	Explain the principles and theories behind artificial intelligence and machine learning.	1 to 5,9.10,12	1,2
CO3	Identify the different types of machine learning algorithms and their applications.	1 to 5,9,10,12	1,2,3
CO4	Demonstrate an understanding of the mathematical foundations of machine learning algorithms.	1to 5,9,10,12	1,2
CO5	Apply machine learning algorithms to real-world datasets for solving classification and regression problems.	1to 5,9,10,12	1,3
CO6	Evaluate the performance of machine learning models using appropriate metrics and techniques.	1to 5,9,10,12	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3		√				
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2				3	3		1	3	3	3
CO2	3	3	2	3	1				3	3		1	3	3	3
CO3	3	3	2	3	3				3	3		1	3	3	3
CO4	3	3	2	3	1				3	3		1	3	3	3
CO5	3	2	3	3	3				3	3		1	3	3	3
CO6	3	3	2	3	3				3	3		1		3	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

Unit-1
Introduction: What Is AI?, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art. **Intelligent Agents**: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents. **Solving Problems by Searching**: Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed search strategies.

Unit-2
Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments. **Constraint Satisfaction Problems**: Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.

Unit-3
Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias
Decision tree Learning : Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.

Unit-4
Artificial neural network : Introduction, Neural Network representation, Appropriate problems, Perceptrons, Backpropagation algorithm.
Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm, k-nearest neighbor learning, locally weighted regression, Radial basis functions.

TEXTBOOKS

1. Stuart Russell and Peter Norvig, Artificial Intelligence, Third Edition 2010, Pearson Education, Inc.
2. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.

REFERENCE BOOKS:

1. Rich, E., Knight, K., & Nair, S. (2009). Artificial Intelligence. Tata McGraw Hill.
2. Learning, M. (1997). Tom Mitchell. Publisher: McGraw Hill.

SWAYAM NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_cs56/preview
2. https://onlinecourses.nptel.ac.in/noc23_cs18/preview

GitHub Links:
https://github.com/topics/artificial-intelligence

Sample Assignments for Internal Assessment:

1. Perform sentiment analysis on a given dataset using machine learning techniques.

2. Develop a chatbot using natural language processing techniques.

3. Build a recommendation system for an e-commerce website.

4. Implement a decision tree algorithm for classification.

5. Compare and contrast various machine learning algorithms for a given dataset.

6. Design a neural network model for image classification.

7. Develop a spam email classifier using a Naive Bayes algorithm.

8. Implement a reinforcement learning algorithm for an autonomous agent in a grid world environment.

9. Build a predictive model for stock market forecasting using time series analysis.

Course Title	**Business Intelligence**				**Course Type**		**OE**	
Course Code	B22EH0612	**Credits**	**3**		**Class**		**VI Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	3	3	3	**42**		**50**	**50**

COURSE OVERVIEW:

This course provides an inception to the concepts of business intelligence (BI) as components and functionality of information systems. It introduces the business intelligence and predictive analytics concepts, where a student gains overview of all aspects of business process modeling, data warehousing and mining required for the business implementation in the real world.

COURSE OBJECTIVE (S):
The objectives of this course are to:

1. Understand the basics of Business Intelligence (BI).
2. Apply the concept of data integration and extraction process.
3. Illustrate the process of data analysis and visualization required to understand organizational data.
4. Demonstrate the ability to make better decisions by showing current and historical data within their business context.

COURSE OUTCOMES (COs)
After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs

CO1	Understand modern concepts, theories, and research in the field of Business Intelligence (BI).	1,2,3,4,5,6	1,2,3
CO2	Identify the different visualization techniques used to represent the real time data.	1,2,3,4,5,6	1,2,3
CO3	Illustrate modern BI practices, including knowledge integration, sourcing, and managing BI solutions real time problems.	1,2,3,4,5,6,10,12	1,2,3
CO4	Make use of BI enabling technologies in organizational settings.	1,2,3,4,5,6	1,2,3
CO5	Apply and generate BI Visualization reports to communicate the real world problems.	1,2,3,4,5,6,10,11 ,12	1,2, 3
CO6	Analyze business intelligence to database and other enterprise systems solutions fo complex engineering	1,2,3,4,5,6,10,11 ,12	1,2,3

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3			√			
CO4			√			
CO5			√			
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	3	2	2							2		1
CO2	3	1	1	1	2	2							3		1
CO3	3	3	2	1	2	1				2		2	2	3	2
CO4	3	1	2	1	2	2							2		3
CO5	3	3	3	1	3	1				2	2	2	3	1	2
CO6	3	2	3	1	3	2				2	1	2	2	1	2

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT
THEORY:

UNIT – 1

Introduction to Business Intelligence:

Overview; Changing Business Environments and computerized decision support, Framework for Business Intelligence (BI), Why a BI Program?, Transaction processing vs. Analytic processing, Successful BI Implementation, Major Tools and Techniques of BI.

UNIT – 2

Data Warehousing:

Definitions and concepts, Process Overview, Architectures, Data Integration & the Extraction, Transformation, & Load (ETL) Process, Development, Implementation Issues, Real-Time data warehousing, Security Issues, Case Studies and Examples.

UNIT – 3

Predictive Analytics and Data Mining:

Predictive modeling project methodology, Tasks for Developing and Using Models, Selecting Tools, Architecture for Predictive Analytics and Data Mining, Analytical Sandboxes, Analytical Hubs, Business Analytics and Advanced Analytics Layers, Big Data Analytics, Data Visualization

UNIT – 4

Business Intelligence Implementation:

Integration & Emerging Trends: Overview, BI and Integration Implementation, Connecting BI Systems to database & other enterprise systems, On-demand BI, Issues of Legality, Privacy and Ethics, Emerging topics in BI: An Overview.

Text book/s:

1. Efraim Turban, Ramesh Sharda , Dursun Delen , Business Intelligence and Analytics: Systems for Decision Support,Pearson,2018
2. Rick Sherman, Business Intelligence Guidebook: From Data Integration to Analytics, Elsevier Inc, 2015.
3. David Loshin, Business Intelligence: The Savvy Manager's Guide, Getting Onboard with Emerging IT, Morgan Kaufmann, First edition, 2003.

References:

1. Marlon Dumas et. al., Fundamentals of Business Process Management, Springer, ebook, 2012.
2. Van der Aalst, Process Mining: Discovery, Conformance and Enhancement of Business Processes, Third edition, 2011.

<table>
<tr><td>Course Title</td><td colspan="4">Neural Networks and Deep Learning</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EH0601</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td></td><td></td><td></td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE-PRE-REQUISITE- Complete knowledge on basics of python programming & python libraries.

COURSE OVERVIEW:

In the last decade due to availability of cheap computation, several neural network approaches had been explored in order to advance the performance of many state-of-the-art visual recognition problems such as image searching, understanding, medical applications, autonomous vehicles such as drones and self-driving cars etc. All these problems relies of efficient, accurate and robust solutions for basic vision tasks such like image classification, localization and detection. In this course students will be given an exposure to the details of neural networks as well as deep learning architectures and to develop end-to-end models for such tasks. Students will learn to implement, train and debug their own neural networks.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. To introduce the students with machine learning fundamentals for solving real world scenario applications and Apply suitable machine learning techniques for data handling and to gain knowledge from it.
2. Acquire theoretical knowledge on setting hypothesis for pattern recognition.
3. To design own models for the specific applications and optimize them efficiently
4. Evaluate the performance of algorithms and to provide solution for various real-world applications.

COURSE OUTCOMES(COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the optimization techniques for various Machine Learning models	1 to 5,9,10,12	1,2,3
CO2	Develop methods of data representations in machine learning environment	1 to 5, 9,10,12	1,2,3
CO3	Create probabilistic and unsupervised learning models for handling unknown pattern.	1 to 5, 9,10,12	1,2,3
CO4	Classify Machine learning models for Non-linear systems	1 to 5, 9,10,12	1,2,3
CO5	Understand basic machine learning models and prediction techniques.	1 to 5, 9,10,12	1,2,3
CO6	Apply machine learning models in speech and image processing applications	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2						√
CO3						√
CO4		√				
CO5			√			
CO6	√					

COURSE ARTICULATION MATRIX

CO#/ Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2				3	3		2	3		3
CO2	3	3	2	2	2				3	3		2	3		3
CO3	3	3	2	2	2				3	3		2		3	3
CO4	3	3	3	2	2				3	3		2		3	
CO5	3	2	2	2	3				3	3		2	3		3
CO6	3	2	2	2	3				3	3		2	3		3

Note:1-Low,2-Medium,3-High

COURSE CONTENT

THEORY:

UNIT – 1

Basics of artificial neural networks (ANN): Artificial neurons, Computational models of neurons, Structure of neural networks, Functional units of ANN for pattern recognition tasks

Feedforward neural networks: Pattern classification using perceptron, Multilayer feedforward neural networks (MLFFNNs), Backpropagation learning, Empirical risk minimization, Regularization, Autoencoders.

UNIT – 2

Deep neural networks (DNNs): Difficulty of training DNNs, Greedy layerwise training, Optimization for training DNNs, Newer optimization methods for neural networks (AdaGrad, RMSProp, Adam), Second order methods fo**Convolution neural networks (CNNs):** Introduction to CNNs – convolution, pooling, Deep CNNs, Different deep CNN architectures – LeNet, AlexNet, VGG, PlacesNet, Training a CNNs: weights initialization, batch normalization, hyperparameter optimization, Understanding and visualizing CNNs training, Regularization methods (dropout, drop connect, batch normalization)

UNIT – 3

Recurrent neural networks (RNNs): Sequence modeling using RNNs, Back propagation through time, Long Short Term Memory (LSTM), Bidirectional LSTMs, Bidirectional RNNs, Gated RNN Architecture

UNIT – 4

Generative models: Restrictive Boltzmann Machines (RBMs), Stacking RBMs, Belief nets, Learning sigmoid belief nets, Deep belief nets.

Applications: Applications in vision, speech and natural language processing

TEXTBOOKS:

1 Ian Goodfellow and YoshuaBengio and Aaron Courville, “Deep Learning”, MIT Press, 2016.
2 S. Haykin, Neural Networks and Learning Machines , Prentice Hall of India, 2010
3. Bishop, C ,M., Pattern Recognition and Machine Learning, Springer, 2006.

REFERENCEBOOKS:

1. Satish Kumar, Neural Networks - A Class Room Approach, Second Edition, Tata McGraw-Hill, 2013.
2. Yegnanarayana, Artificial Neural Networks, Prentice- Hall of India, 1999
3. Ravindran, K. M. Ragsdell , and G. V. Reklaitis , ENGINEERING OPTIMIZATION: Methods and Applications , John Wiley & Sons, Inc. , 2016.
4. Antoniou, W. S. Lu, PRACTICAL OPTIMIZATION Algorithms and Engineering Applications, Springer, 2007.

JOURNALS/MAGAZINES:

1. IEEE Transactions on Neural Networks and Learning System
2. IEEE Transactions on Pattern Analysis and Machine Intelligence
3. Springer Journal of Deep Learning.
4. Elsevier journal on Deep learning Based Intelligent Systems
5. ACM Jounral on Machine Learning Research

SWAYAM/NPTEL/MOOCs:

1. https://www.cs.ox.ac.uk/people/nando.defreitas/machinelearning/
2. https://people.eecs.berkeley.edu/~jrs/189/
3. http://www.cse.iitm.ac.in/~ravi/courses/Introduction%20to%20Machine%20Learning.html
4. http://www.cse.iitm.ac.in/~ravi/courses/Introduction%20to%20Machine%20Learning.html
5. http://leap.ee.iisc.ac.in/sriram/teaching/DL20/
6. http://www.cse.iitm.ac.in/~miteshk/CS6910.html
7. https://www.cs.princeton.edu/courses/archive/spring16/cos495/
8. https://d2l.ai/
9. https://nptel.ac.in/courses/106106184
10. https://nptel.ac.in/courses/106106184
11. http://www.ai.mit.edu/courses/6.867-f03/exams.html
12. https://ml2.inf.ethz.ch/courses/aml/
13. https://www.studocu.com/in/document/kalinga-institute-of-industrial-technology/neural-networks-and-machine-learning/ml-extra-qbank/17982037
14. CSCI 5922: Neural Networks and Deep Learning (colorado.edu)
15. Berkeley AI Materials
16. Adit Deshpande – Engineering at Forward | UCLA CS '19 (adeshpande3.github.io)
17. Hamid Beigy (Deep Learning) (sharif.edu) 18. WTF Deep Learning!!! (wtf-deeplearning.github.io)
18. IIT Ropar – SudharIyenger – Deep Learning: NPTEL
19. CIS520 Machine Learning | Lectures / Lectures (upenn.edu)
20. Best : University of Toronto: CSC413/2516 Neural Networks and Deep Learning (Winter 2020) (csc413-2020.github.io)

21. Best : university of Pittuserberg:CS1678: Intro to Deep Learning (pitt.edu)
22. Best : Charles university: Deep Learning – Summer 2017/18 | ÚFAL (cuni.cz)
23. The Best : Deep Learning | ÚFAL (cuni.cz)
24. Best : University of Chicago: CMSC 35246 Deep Learning - University of Chicago (ttic.edu)
25. IIT Bombay: CS 344 - Artificial Intelligence/ CS 386 - Artificial Intelligence Lab. Spring 2008 (iitb.ac.in)
26. University of Princeton: Introduction to Deep Learning: Home Page (princeton.edu)
27. The Best : http://www.cs.toronto.edu/~rgrosse/courses/csc421_2019/
28. http://www.cs.umd.edu/~djacobs/CMSC828DeepLearning/Syllabus18.htm
29. https://www.cs.ox.ac.uk/people/nando.defreitas/machinelearning/
30. http://www.cs.umd.edu/~djacobs/CMSC828DeepLearning/Syllabus18.htm
31. https://mriquestions.com/deep-learning-dl.html
32. IIT: https://nptel.ac.in/courses/106106184
33. https://www.deeplearning.ai/program/deep-learning-specialization/
34. IITMadras: http://www.cse.iitm.ac.in/~miteshk/CS6910.html 36. NPTEL: https://nptel.ac.in/courses/106106184
35. http://www.cs.umd.edu/~djacobs/CMSC828DeepLearning/Syllabus18.htm
36. https://flatironschool.com/blog/deep-learning-vs-machine-learning/
37. https://nptel.ac.in/courses/117105084
38. https://www.youtube.com/watch?v=rvMVqPsXL10
39. https://stackify.com/learn-python-tutorials/
40. https://www.simplilearn.com/tutorials/deep-learning-tutorial/deep-learning-algorithm
41. https://analyticsindiamag.com/8-free-resources-tools-to-learn-pytorch-in-2021/
42. https://www.mathworks.com/videos/matlab-for-deep-learning-1530256241637.html
43. https://www.youtube.com/watch?v=bOIZ74rOik0

SELF-LEARNINGEXERCISES:

1. Advanced Python Programming
2. R Programming
3. Linear Algebra
4. Probability and statistics
5. Image Processing

Course Title	Business Intelligence and Analytics				**Course Type**		**Theory**	
Course Code	B22EH0602	**Credits**	**2**		**Class**		**VI Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	2	2	2	**28**		**50**	**50**

COURSE OVERVIEW:

This course provides an inception to the concepts of business intelligence (BI) as components and functionality of information systems. It introduces the business intelligence and predictive analytics concepts, where a student gains overview of all aspects of business process modeling, data warehousing and mining required for the business implementation in the real world.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the basics of Business Intelligence (BI).

2. Apply the concept of data integration and extraction process.
3. Illustrate the process of data analysis and visualization required to understand organizational data.
4. Demonstrate the ability to make better decisions by showing current and historical data within their business context.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand modern concepts, theories, and research in the field of Business Intelligence (BI).	1,2,3,4,5,6	1,2,3
CO2	Identify the different visualization techniques used to represent the real time data.	1,2,3,4,5,6	1,2,3
CO3	Illustrate modern BI practices, including knowledge integration, sourcing, and managing BI solutions real time problems.	1,2,3,4,5,6,10,12	1,2,3
CO4	Make use of BI enabling technologies in organizational settings.	1,2,3,4,5,6	1,2,3
CO5	Apply and generate BI Visualization reports to communicate the real world problems.	1,2,3,4,5,6,10,11 ,12	1,2, 3
CO6	Analyze business intelligence to database and other enterprise systems solutions fo complex engineering	1,2,3,4,5,6,10,11 ,12	1,2,3

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3			√			
CO4			√			
CO5			√			
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	3	2	2							2		1
CO2	3	1	1	1	2	2							3		1
CO3	3	3	2	1	2	1				2		2	2	3	2
CO4	3	1	2	1	2	2							2		3
CO5	3	3	3	1	3	1				2	2	2	3	1	2

CO6	3	2	3	1	3	2				2	1	2	2	1	2

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Introduction to Business Intelligence:

Overview; Changing Business Environments and computerized decision support, Framework for Business Intelligence (BI), Why a BI Program? , Transaction processing vs. Analytic processing, Successful BI Implementation, Major Tools and Techniques of BI.

UNIT – 2

Data Warehousing:

Definitions and concepts, Process Overview, Architectures, Data Integration & the Extraction, Transformation, & Load (ETL) Process, Development, Implementation Issues, Real-Time data warehousing, Security Issues, Case Studies and Examples.

UNIT – 3

Predictive Analytics and Data Mining:

Predictive modeling project methodology, Tasks for Developing and Using Models, Selecting Tools, Architecture for Predictive Analytics and Data Mining, Analytical Sandboxes, Analytical Hubs, Business Analytics and Advanced Analytics Layers, Big Data Analytics, Data Visualization

UNIT – 4

Business Intelligence Implementation:

Integration & Emerging Trends: Overview, BI and Integration Implementation, Connecting BI Systems to database & other enterprise systems, On-demand BI, Issues of Legality, Privacy and Ethics, Emerging topics in BI: An Overview.

Text book/s:

1. Efraim Turban, Ramesh Sharda , Dursun Delen , Business Intelligence and Analytics: Systems for Decision Support,Pearson,2018
2. Rick Sherman, Business Intelligence Guidebook: From Data Integration to Analytics, Elsevier Inc, 2015.
3. David Loshin, Business Intelligence: The Savvy Manager's Guide, Getting Onboard with Emerging IT, Morgan Kaufmann, First edition, 2003.

References:

1. Marlon Dumas et. al., Fundamentals of Business Process Management, Springer, ebook, 2012.
2. Van der Aalst, Process Mining: Discovery, Conformance and Enhancement of Business Processes, Third edition, 2011.

<table>
<tr><td>Course Title</td><td colspan="3">Web Technology</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EF0602</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VI Semester</td></tr>
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<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

Building on the basic Web Technologies unit in the CSE course, students will learn to create more dynamic and interactive websites using JavaScript. Advanced HTML, CSS, and basic JavaScript enhances the client-side webpages and students will learn to use these technologies for their specific purposes. Students begin working with server-side scripting and web applications development using Server side scripting.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Build dynamic web pages with the help of various HTML tags and perform validation using Java Script objects by applying different event handling mechanisms.
2. Comprehend the importance of CSS in designing a creative and dynamic website and embedding Java Script code in HTML.
3. Understand and be able to develop JavaScript code to access the DOM structure of web document and object properties.
4. Develop dynamic web pages with usage of server-side scripting.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of HTML tags and CSS to build web pages for various applications.	1 to 5, 9,10,12	1,2,3
CO2	Demonstrate the usage of form data to validate the correctness of given input.	1 to 5, 9,10,12	1,2,3
CO3	Apply the variety of presentation effects in HTML documents, including explicit positioning of elements using CSS.	1 to 5, 9,10,12	1,3
CO4	Prepare a HTML document for Interactive webpage using JavaScript.	1 to 5, 9,10,12	1,3
CO5	Analyze the concepts of server side technologies for dynamic web applications.	1 to 5, 9,12	1,3
CO6	Illustrate the concept of ReactJS for creation of reusable UI Components.	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)

CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5				√		
CO6				√		

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	3	1	3				3	1		3	3	1	2
CO2	3	3	3	1	3				3	1		3	3	1	2
CO3	3	1	3	1	3				3	1		3	3		3
CO4	3	1	3	1	3				3	1		3	3		2
CO5	3	1	3	1	3				3			3	3		3
CO6	2	1	2	1	2				2			2	2	1	2

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit 1

Introduction to Web Essentials and HTML:

Clients, Servers, and Communication, The Internet-Basic Internet Protocols -The World Wide Web, HTTP request message-response message, Web Clients Web Servers-Case Study, Markup Languages: XHTML. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics-Some Fundamental HTML Elements-Relative, The <span> and<div> tags ,Lists, Tables.

Unit 2

Forms and Style Sheets

HTML Frames and Forms.Introduction to CSS, Levels of style Sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images , Conflict resolution.

Unit 3

JavaScript

Java Script Client side scripting using JavaScript, Introduction to JavaScript, internal and external Java script files, variables, control statements, loops, Arrays, string handling , functions, How to write functions inJavaScript, inputting and outputting from form elements to JavaScript, DOM concept, creating html elements using JavaScript. Drawing 2D shapes, handling events.

Unit 4

ReactJS

Introduction to ReactJS and its syntax, Introduction to Components: Communication between Component, Types of Components, States and Props: What is State and its significance, Read State and Set state, Passing data to components using props, React JS Environment setups: Node Setup, NMP installation, How to write optimized code in React JS, React with Redux: What is React Redux, Why React Redux, Install and Setup.

TEXT BOOKS:

1. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.
2. The Complete Reference, HTML and CSS by Thomas A Powell latest edition
3. Learning React, Free unaffiliated eBook created from stack overflow contributors. The Complete Reference, HTML and CSS by Thomas A Powell latest edition

REFERENCE BOOKS:

1. Web Programming, building internet applications, Chris Bates 2nd edition, Wiley Dremtech
2. Java Script, D.Flanagan, O'Reilly, SPD

JOURNALS/MAGAZINES:

1. https://www.inderscience.com/jhome.php?jcode=IJWET
2. http://www.w3schools.com/
3. http://getbootstrap.com/

SWAYAM/NPTEL/MOOCs:

1. http://nptel.ac.in
2. https://www.udemy.com/course/angularjs-for-beginners-udemy/
3. https://www.coursera.org/learn/introduction-to-front-end-development

SELF-LEARNING EXERCISES:

1. Node JS, React JS
2. jQuery

<table>
<tr><td>Course Title</td><td colspan="4">Agile software development and DevOps</td><td>Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B22EF0603</td><td>Credits</td><td colspan="2">3</td><td>Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

The course provides students with a knowledge on the basic principles of software development life cycle, activities involved in software requirements engineering, software development, testing, evolution and maintenance. It introduces concepts such as software processes and agile methods and essential software development activities. New methods to approach old development problems with DevOps.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss the importance of the software development process.
2. Demonstrate the workflow of Automating process.
3. Explain the development of a software using Agile method
4. Illustrate with case study, the importance of DevOps.

COURSE OUTCOMES(COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply software development process to solve complex problems of engineering.	1,2	2
CO2	Make use of Agile principle for rapid software development and automation.	1,3	3
CO3	Summarize the basic principles of agile approach and need of integration, delivery and deployment.	1,3,5	1
CO4	Apply the concepts of process modeling and automation in real world applications.	1,3,5	2,3
CO5	Distinguish between the traditional SDLC and agile ALM model for efficient and effective product delivery	1,3,4	1
CO6	Develop the real-world applications using DevOps tools for continuous business improvement.	1,3,4,5,9	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3		√				
CO4			√			
CO5				√		
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3	3											3	3	
CO2	3		3												3
CO3	3		3		3								3		
CO4	3		3		3									3	3
CO5	3		3	3									3		
CO6	3		3	3	3				3					3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Requirements and Development process: Software Processes: Models, Process iteration, Process activities. Software Requirements: Functional and Non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document. Requirements Engineering Processes: Feasibility studies, Requirements elicitation and analysis.

UNIT – 2

Agile Application Life Cycle Management: Goals of Agile Application Life Cycle Management, Why Is Agile ALM Important? Understanding the Paradigm Shift, Rapid Iterative Development, Focus on12 Agile Principles, Agile Manifesto, Fixed Time box Sprints, Customer Collaboration, Requirements and Documentation.

UNIT – 3

Automating the agile ALM: Goals of Automating the Agile ALM, Why Automating the ALMIs Important, Tools, Do Tools Matter? Process over Tools, Understanding Tools in the Scope of ALM, Staying Tools Agnostic, Commercial versus Open Source, Automating the Workflow, Process Modeling Automation, Managing the Lifecycle with ALM, Broad Scope of ALM Tools, Achieving Seamless Integration, Managing Requirements of the ALM, Creating Epics and Stories, Systems and Driven Development, Environment Management, Gold Copies, Supporting the CMDB, Supporting Operations, Incident Management, Project Management, Planning the PMO, Planning for Implementation, Evaluating and Selecting the Right Tools, Defining the Use Case, Training Is Essential, Vendor Relationships, Keeping Tools Current.

UNIT – 4

DevOps: Goals of DevOps, Why Is DevOps Important? Where Do I Start? How Do I Implement DevOps? Developers and Operations Conflicts, Developers and Operations Collaboration, Need for Rapid Change, Knowledge Management, the Cross-Functional Team, Is DevOps Agile? The DevOps Ecosystem, Moving the Process Upstream, Left-Shift, Right-Shift, DevOps inDev, DevOps as Development, Deployment Pipeline, Dependency Control, Configuration Control, Configuration Audits, QA and DevOps, Information Security, Infrastructure as Code, Taming Complexity, Automate Everything, Disaster Recovery and Business Continuity, Continuous Process Improvement.

TEXT BOOKS:

1. Ian Summerville, “Software Engineering”, 8th Edition, Pearson Education,2007.
2. BobAiello and LeslieSachs, “Agile Application Life cycle Management Using DevOps to Drive Process Improvement”, Addison Wesly, First printing, 2016.

REFERENCE BOOKS:

1. Roger S, “Software Engineering-A Practitioner’s Approach”, seventh edition, Pressman, 2010.
2. Roger Pressman, Ian sommerville, “Software Engineering”, Pearson, 9th edition,2010.
3. HansVanVliet, “Software Engineering: Principles and Practices”, Wiley,2008.
4. Richard Fairley, “Software Engineering Concepts”, McGraw-Hill ,2008
5. ACM Transactions on Software Engineering and Methodology (TOSEM).
6. IEEE Transactions on Software Engineering.

JOURNALS/MAGAZINES:

1. Journal of Software Engineering Research and Development
2. International Journal of Agile and Extreme Software Development
3. A decade of agile methodologies: Towards explaining agile software development
4. Journal of Systems and Software

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/course/devops-core-fundamentals
2. https://www.scaledagile.com/certification/courses/safe-devops/
3. https://www.coursera.org/learn/devops-culture-and-mindset
4. https://www.coursera.org/learn/uva-darden-continous-delivery-devops

SELF-LEARNING EXERCISES:

1. Case study on Critical system
2. Case study on ATM using agile method

Professional Elective 4

<table>
<tr><td>Course Title</td><td colspan="4">Computer Vision</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EHS611</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The automatic analysis and understanding of images by the system have occupied significant importance in all applications. This course provides an introduction to computer vision, including fundamentals of image formation, camera imaging geometry, feature detection, feature matching, motion estimation, motion tracking, and image classification.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the foundation of image formation, measurement, and analysis.
2. Analyze the methods for robust image matching and alignment;
3. Gain exposure to object and scene recognition and categorization from images;
4. Able to develop the theoretical and practical skills necessary to build computer vision applications.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the basics of image formation, Camera	1 to 5	1,2
CO2	Apply morphological process and region growing methods for image processing.	1 to 5	1,2
CO3	Make use of threshold techniques for Feature detection, feature matching, and edge detection in images.	1 to 5	1,2
CO4	Use clustering-based segmentation methods for image synthesis.	1 to 5	1,2
CO5	Analyze reconstruction algorithm for 3D objects	1 to 5	1,2
CO6	Evaluate appropriate techniques for object recognition and detection in computer vision-based applications.	1 to 5	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5				√		
CO6					√	

COURSE ARTICULATION MATRIX

CO# / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1								3	3	1
CO2	3	2	2	1	1								3	3	1
CO3	3	2	2	2	2								3	3	1
CO4	3	2	1	2	2								3	3	2
CO5	3	2	2	2	2				2			2	3	3	2
CO6	3	2	2	2	2				2			2	3	3	2

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introduction to computer vision, Image formation: Geometric primitives and transformation, Photometric image formation, The Digital Camera, Sources, Shadows and Shading: Local shading models- point, line and area sources; photometric stereo, Camera calibration.

UNIT – 2

Image processing: Point operators, Linear filtering, Fourier transforms, Feature detection and matching: Points and patches, Edge detection: Estimating Derivatives with Finite Differences, Noise, and Edges and Gradient-based Edge Detectors.

UNIT – 3

Segmentation using clustering methods: Human Vision and applications, Segmentation by graph theoretic clustering, Fitting: Hough transform, Fitting lines, Fitting curves, Structure from motion: Two frame structure from motion, Dense motion estimation: Parametric motion, Spline based Motion.

UNIT – 4

3D reconstruction: Shape from X, Active rangefinding, Surface representation, Point-based representations, Volumetric representations, Model-based reconstruction, Recognition: Object detection, Face recognition, Instance recognition, category recognition.

TEXT BOOKS:

1. Szeliski R. Computer vision: algorithms and applications. Springer Science & Business Media; 2010.
2. Forsyth, David, and Jean Ponce. Computer vision: A modern approach. Prentice hall, 2011.

REFERENCE BOOKS:

1. Shapiro LG, Stockman GC. Computer Vision: Theory and Applications. 2001.
2. Trucco, Emanuele, and Alessandro Verri. Introductory techniques for 3-D computer vision. Vol. 201. Englewood Cliffs: Prentice Hall, 1998.

JOURNALS/MAGAZINES:

1. IEEE-T-PAMI (IEEE Transactions on Pattern Analysis and Machine Intelligence)
2. IJCV (International Journal of Computer Vision) - Springer.

SWAYAM/NPTEL/MOOCs:

1. Swayam: Computer vision By Prof.Jayanta Mukhopadhyay, IIT Kharagpur.
2. Coursera: An Introduction to computer vision and image processing, Aije Egwaikhide and Joseph Santarcangelo.

SELF-LEARNING EXERCISES:

1. Case study on Veggie vision: A system for checking out vegetables.

2. Case study on identifying humans via the Iris of an eye.

Course Title	**Bioinformatics**				**Course Type**		**PE(SC)**	
Course Code	**B22EHS612**	**Credits**	**3**		**Class**		**VI Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**42**	**0**	**50**	**50**

COURSE OVERVIEW:

This course introduces the basics of bioinformatics, modern genomics and the experimental tools and databases. In this course, students gain extensive knowledge and experience on sequence alignment and scoring methods. An introduction to the key concepts proteomics and biodata analysis using Bio python are covered.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the concepts of computational biology and biological databases.
2. Illustrate the various sequence alignment methods.
3. Discuss the concepts of genomes and the different approaches to analyze the genomes.
4. Demonstrate the significance of proteomics and analysis with Bio python.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	Pos	PSOs
CO1	Outline the concepts of computational biology and biological databases.	1,2 5,6,8,12	1,2,3
CO2	Integrate sequence alignment methods to evaluate sequence similarity and homology.	1 to 5,6,8,12	1,3
CO3	Develop models of organisms and communities to predict their behavior under different environmental conditions.	1 to 5,6,8,12	1,2,3
CO4	Understand Microarray gene expression profiles.	1,2,6,8,12	1,3
CO5	Apply genome analysis, mapping and genome sequencing.	1 to 5,6,8,12	1, 3
CO6	Make use of Bio python for solving bioinformatics task.	1 to 5,6,8,12	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			

CO3		√	√			
CO4		√				
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			1	1		2				2	3	3	3
CO2	3	3	2	1	2	1		2				2	3		3
CO3	3	3	2	2	1	1		2				2	3	2	3
CO4	3	3				1		2				2	3		3
CO5	3	3	3	2	2	1		2				2	3		3
CO6	3	3	2	2	2	1		2				2	3	2	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY:

UNIT – 1

Basics of Bioinformatics: Introduction to Bioinformatics; Bioinformatics applications; Molecular Biology and Bioinformatics; Introduction to major biological databases; Bioinformatics tools; Information Search; Information Retrieval.

UNIT – 2

Sequence Alignment: Alignment of pair of sequences; Sequence Analysis; Sequence Alignment; Methods of Sequence Alignment; Dynamic programming algorithm; Concept of scoring matrix; Global; local- Pair wise alignment; Methods of multiple sequence alignment; Evaluating multiple alignments.

UNIT – 3

Genomics and Microarray: Genomics; Understanding Genomics; Genome Analysis; Genome Mapping; Genome Annotation; Sequence assembly problem; Genome sequencing; Structural and Functional Genomics.

Microarray: Understanding of microarray data; Working with DNA Microarray; Gene Expression profiles; Data sources and tools for Microarray analysis.

UNIT – 4

Proteomics and Bio python: Proteomics; Tools and techniques in proteomics; protein protein interactions; methods of gene family identification; biomarkers; introduction; biomarker classification; biomarker discovery. Bio python: Introduction; Control Statements; Sequences alignment; Database search using Bio python.

TEXTBOOKS:

1. S C Rastogi, N Mendiratta and P Rastogi, " Bioinformatics: Methods and Applications" , ISBN : 978-81-203-4785-4, PHI Learning Private Limited, 2015.
2. David W Mount,” Bioinformatics- Sequence and Genome Analysis”, second Edition, CBS Publishers, 2014.
3. Lesk, A. K., “Introduction to Bioinformatics” 4th Edition, Oxford University Press, 2013.
4. Andreas D. Baxevanis, B. F. Francis Ouellette,” BIOINFORMATICS A Practical Guide to the Analysis of Genes and Proteins”, 2nd Edition, Wiley Inderscience, 2001.

REFERENCEBOOKS:

1. Cynthia Gibas, PerJambeck, Developing Bioinformatics Computer Skills O’Reilly MediaInc a 2001.
2. David Edwards, Jason Eric Stajich, David Hansen, Bioinformatics Tools and Applications, Springer, 2009.

3. Attwood, T.K., Parry, D.J., Smith, Introduction to Bioinformatics, Pearson Education, 2005.

JOURNALS/MAGAZINES:

1. https://academic.oup.com/bioinformatics
2. BMC Bioinformatics
3. Proteins: Structure, Function and Bioinformatics
4. IEEE/ACM Transactions on Computational Biology and Bioinformatics
5. Journal of Bioinformatics and Computational Biology
6. Bentham Science- Current Bioinformatics

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_bt06/Bioinformatics: Applications and Algorithms
2. https://www.classcentral.com/course/swayam-bioinformatics-algorithms
3. https://www.coursera.org/specializations/genomic-data-science

SELF-LEARNINGEXERCISES:

1. Electronic Libraries
2. Data Mining in Biological Databases

Gene Prediction Method

Course Title	**Cyber Law and Digital Forensics**				**Course Type**		**OE**	
Course Code	**B22EHS613**	**Credits**	**3**		**Class**		**IV Semester**	
	TLP	Credits	Contact Hours	Work Load	Total Number of Classes		Assessment in Weightage	
	Theory	3	3	3				
	Practice				Theory	Practical	CIE	SEE
	-	-	-	-				
Course	**Total**	**3**	**3**	**3**	**42**	**--**	**50**	**50**

COURSE OVERVIEW:

This course gives an overview of cybercrime targeted at any computing resources and its associated interconnections/ Networks. In addition, it provides various insights into interpersonal cybercrime and how cyberlaw frameworks are dealing with the same across the world. It also includes the principles and concepts of digital forensics like digital investigations, data and file recovery methods, and digital forensics analysis and tools.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Study various cyber laws and exclusively Indian evidence law.
2. Analyze the effectiveness of cyber laws in various aspects of cybercrimes.
3. Illustrate the need for computer forensics and apply tools in use.
4. Examine the cyber law application under a real time scenario.
5. Overview the type of attacks and challenges in present scenario.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Illustrate the basic interface of technology and cyber law.	1,2,6,7,8,12	1,2
CO2	Infer various cyber laws and cybercrimes under Indian evidence law.	1 to 5,8,12	1,2
CO3	Analyze the need for computer forensics.	1to 3, 5,8,12	1,2

CO4	Analyze the utility of the cyber laws in different aspects of cybercrimes.	1 to 4,6,7 ,8,12	1,2,3
CO5	Apply a few computers forensic tools to any applications.	1 to 6,8,12	1,2,3
CO6	Evaluate the knowledge on cyber law and forensics in real life cases.	1 to 6, 8,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3				√		
CO4				√		
CO5			√			
CO6					√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1			2	2	3				3	3	3	
CO2	1	1	1		1			3				2	3	3	
CO3	1	1	1		1			3				2	3	3	
CO4	1	1	2	1		2	2	3				2	3	3	3
CO5	1	1	2	1		2	2	2				2	3	3	3
CO6	1	1	2		3	2		3				2	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Cyber Space: Fundamental definitions -Interface of Technology and Law – Jurisprudence and-Jurisdiction in Cyber Space - Indian Context of Jurisdiction - Enforcement agencies – Need for IT act - UNCITRAL – E-Commerce basics. Information Technology Act, 2000 - Aims and Objects — Overview of the Act – Jurisdiction

UNIT – 2

Cyber Crimes and Indian Evidence Law: Meaning of Cyber Crimes –Different Kinds of Cybercrimes – Cybercrimes under IPC, Cybercrimes under the Information Technology Act,2000 - Cybercrimes under International Law - Hacking Child Pornography, Cyber Stalking, Software Piracy, Violation of Privacy on Internet - Data Protection and Privacy – Indian Court cases.

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UNIT – 3

Introduction to Computer Forensics: Understanding computer forensics, computer forensics versus other related disciplines, A brief History of computer Forensics, understanding case laws, developing computer forensics resources, Preparing for computer investigations, Understanding law enforcement agency investigations, Following the legal process, Understanding corporate investigations, Establishing company policies, Displaying warning Banners.

UNIT – 4

Current Computer Forensics Tools: Evaluating Computer Forensics Tool Needs, Types of Computer Forensics Tools, Tasks Performed by Computer Forensics Tools, Tool Comparisons, Other Considerations for Tools, Computer Forensics Software Tools, Command-Line Forensics Tools, UNIX/Linux Forensics Tools, Other GUI Forensics Tools, Computer Forensics Hardware Tools, Forensic Workstations, Using a Write-Blocker.

TEXT BOOKS:

1. Nilakshi Jain , Ramesh Menon "Cyber Security and Cyber Laws" Willey Publishers, 1^{st} Edition, October 2020.
2. Pavan Duggal "Cyber Security Law" ,2^{nd} Edition,2019.
3. Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, India Edition, 2016
4. Cory Altheide, Harlan Carvey, Digital Forensics with Open Source Tools, Syngress imprint of Elsevier.

REFERENCE BOOKS:

1. Nhien-An Le-Khac , Kim-Kwang Raymond Choo "Cyber and Digital Forensic Investigations: A Law Enforcement Practitioner's Perspective" 2020 Edition
2. MarjieT.Britz, ―Computer Forensics and Cyber Crime‖: An Introduction‖, 3rd Edition, Prentice Hall, 2013.

JOURNALS/MAGAZINES:

1. https://heinonline.org/HOL/LandingPage?handle=hein.journals/glj103&div=13&id=&page=Sood,
2. Vivek. Cyber Law Simplified. Tata McGraw-Hill Education, 2001.
3. https://delhidistrictcourts.nic.in/ejournals/CYBER%20LAW.pdf
4. https://www.sciencedirect.com/science/article/pii/S1742287606000703
5. https://www.sciencedirect.com/science/article/pii/S0167404815001595

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/course/cyber-law-for-every-professional-dr-pavan-duggal-clu/
2. https://www.coursera.org/learn/digital-forensics-concepts
3. https://onlinecourses.swayam2.ac.in/cec20_lb06/preview

<table>
<tr><td>Course Title</td><td colspan="4">Soft Computing</td><td colspan="2">Course Type</td><td colspan="2">PE</td></tr>
<tr><td>Course Code</td><td>B22EHS614</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

Soft computing techniques are becoming even more popular and particularly amenable to model the complex behaviors of most geotechnical engineering systems since they have demonstrated superior predictive capacity, compared to the traditional methods. This course presents an overview of some soft computing techniques as well as their applications in underground excavations.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the fundamental concepts and Definition involved in Soft computing techniques.
2. Understand the basic ideas of fuzzy logic, fuzzy sets, fuzzy relations, and fuzzy reasoning, and demonstrate how they may be applied to real time problems.
3. Identify essential tools in machine learning that have drawn increasing attention in neuroscience
4. Implement the elementary searching techniques in solving the real time problem.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the Soft computing techniques such as fuzzy logic, genetic algorithms, artificial neural networks, machine learning, and expert systems.	1-5	1-3
CO2	Perform current state of soft computing techniques and describes the advantages and disadvantages of soft computing compared to traditional hard computing techniques.	1-5	1-3
CO3	Understand the guiding principle of soft computing is to exploit the tolerance for imprecision, uncertainty, and partial truth to achieve tractability, robustness, low solution cost, better rapport with reality.	1-5	1-3
CO4	Apply the knowledge gained from the soft computing techniques to solve real time problem.	1-5	1-3
CO5	Design a framework with low-cost and very high performance digital processors memory chips.	1-5	1-3
CO6	Make use of soft computingtechniques being used successfully in many domestic, commercial, and industrial applications.	1-5	1-3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2		√				
CO3		√				
CO4			√	√	√	√
CO5			√	√	√	√
CO6				√	√	√

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3								3	3	3
CO2	3	3	3	3	3								2	2	2
CO3	3	3	3	2	2								2	3	3
CO4	3	3	3	3	3								3	3	3
CO5	3	3	3	2	3								3	3	3
CO6	3	3	3	2	3								3	3	3

Note: 1-Low, 2-Medium, 3-High

Unit-1:

Introduction to Soft Computing: What is Soft Computing?,Fuzzy Systems, Rough Sets, Artificial Neural Networks, Evolutionary Search Strategies; Fuzzy Sets: Crisp Sets: Basic Concepts, Operations on Sets, Properties of Sets; Fuzzy Sets: Fuzziness/Vagueness/Inexactness, Set Membership, Fuzzy Sets, Fuzzyness vs. Probability, Features of Fuzzy Sets; Fuzzy Membership Functions: Some Popular Fuzzy Membership Functions, Transformations, Linguistic Variables, Operations on Fuzzy Sets; Fuzzy Relations: Crisp Relations, Fuzzy Relations, Operations on Fuzzy Relations; Fuzzy Extension Principle: Preliminaries, The Extension Principle;

Unit-2

Fuzzy Logic:Crisp Logic: Propositional Logic, Predicate Logic, Rules of Inference; Fuzzy Logic Basics: Fuzzy Truth Values; Fuzzy Truth in Terms of Fuzzy Sets; Fuzzy Rules: Fuzzy If-Then, Fuzzy If-Then-Else, Fuzzy Reasoning, Fuzzy Quantifiers, Generalized Modus Ponens, Generalized Modus Tollens;Fuzzy Inference Systems:Introduction:Fuzzification of the Input Variables; Application of Fuzzy Operators on the Antecedent Parts of the Rules; Evaluation of the Fuzzy Rules; Aggregation of Output Fuzzy Sets Across the Rules; Defuzzification of the Resultant Aggregate Fuzzy Set: Centroid Method, Centre-of-Sums (CoS) Method, Mean-of-Maxima (MoM) Method; Fuzzy Controllers: Fuzzy Air Conditioner Controller;

Unit-3

Artificial Neural Networks: Basic Concepts: Introduction: The Biological Neuron, The Artificial Neuron, Characteristics of the Brain; Computation in Terms of Patterns:Pattern Classification, Pattern Association; The McCulloch–Pitts Neural Model; The Perceptron: The Structure, Linear Separability, The XOR Problem; Neural Network Architectures: Single Layer Feed Forward ANNs, Multilayer Feed Forward ANNs, Competitive Network, Recurrent Networks; Activation Functions: Identity Function, Step Function;

Unit-4

Elementary Search Techniques: State Spaces; State Space Search: Basic Graph Search Algorithm, Informed and Uninformed Search; Exhaustive Search: Breadth-first Search (BFS), Depth-first Search (DFS), Comparison Between BFS and DFS, Depth-first Iterative Deepening, Bidirectional Search, Comparison of Basic Uninformed Search Strategies; Heuristic Search: Best-first Search, Generalized State Space Search, Hill Climbing, The A/A* Algorithms, Problem Reduction, Means-ends Analysis, Mini-Max Search, Constraint Satisfaction, Measures of Search; Production Systems;

Text Book:

1. SAMIR; CHAKRABORTY ROY (UDIT.). (2013). SOFT COMPUTING: Neuro-fuzzy and Genetic Algorithms; neuro-fuzzy and Genetic Algorithms. Pearson.

Reference Book:

2. Ray, K. S. (2014). Soft Computing and Its Applications, Volume One: A Unified Engineering Concept (Vol. 1). CRC Press.

JOURNALS/MAGAZINES:

1. IEEE Pattern recognition and machine learning

2. ACM International Journal of Pattern Recognition and Artificial Intelligence
3. Elesevier Pattern Recognition

SELF-LEARNING EXERCISES:

1. Pick a research problem statement and design solution for the same.

<table>
<tr><td>Course Title</td><td colspan="4">Computer Graphics and Multimedia</td><td colspan="2">Course Type</td><td colspan="2">PE</td></tr>
<tr><td>Course Code</td><td>B22EHS615</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2"></td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

This course introduces techniques, algorithms and principles of interactive computer graphics and multimedia animation, this course also prepares for study in real-time rendering, realistic image synthesis, and computer animation. The course has major topics related to graphics system and graphics programming. The transformation of objects once created in homogenous and general coordinate system. It introduce with different kind of viewing the objects in parallel and perspective modes. It also introduces the multimedia and its types.

COURSE OBJECTIVE (S):

Objectives of this course are to:
1. Explain the basic principles of 3-dimensional computer graphics using Software and Hardware.
2. Describe the basics of Geometric transformation systems.
3. Demonstrate the use of two- and three-dimensional viewing pipeline.
4. To become familiar with various software programs used in the creation and implementation of multi-media.

5. To appreciate the importance of technical ability and creativity within design practice.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Develop interactive computer graphics programs	1 to 5	1
CO2	Apply three dimensional transformations for a real-world application	1 to 5	2
CO3	Identify requirements and constraints of two and three-dimensional viewing pipeline.	1 to 5	2,3
CO4	Understand the concepts of clipping and visible surface detection in 2D and 3D viewing, and Illumination Models	1 to 5	2,3
CO5	Understood Different types of Multimedia File Format.	1 to 5	1,2
CO6	Design Animations for the given real-world application.	1 to 5	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level

	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1						√
CO2			√			
CO3		√				
CO4						√
CO5		√				
CO6						√

COURSE ARTICULATION MATRIX

CO#/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**3**	**1**	**3**								**3**		
CO2	**3**	**2**	**3**	**2**	**3**									**3**	
CO3	**3**	**3**	**2**	**2**	**3**								**3**	**3**	
CO4	**2**	**1**	**2**	**2**	**3**								**2**		
CO5	**3**	**2**	**3**	**2**	**1**								**3**	**3**	
CO6	**2**	**1**	**2**	**2**	**2**									**3**	**3**

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

Applications of computer graphics, A graphics system, Images: Physical and synthetic, Imaging Systems, The synthetic camera model, The programmer's interface, Graphics architectures, Graphics Programming: The Sierpinski gasket, Programming Two Dimensional Applications, The OpenGL API, Primitives and attributes, Color, Viewing, Control functions, The Gasket program, Polygons and recursion, The three dimensional gasket.

UNIT – 2

Interaction, Input devices, Display Lists, Programming Event Driven Input, Menus, Building Interactive Models, Animating Interactive Programs, Three-dimensional Primitives, Coordinate Systems, Rotation, Translation and Scaling, Transformation in Homogeneous Coordinates, Concatenation of Transformations, OpenGL Transformation Matrices, Modeling a Colored Cube (Program).

UNIT – 3

Classical and computer viewing, Positioning of the camera, Simple projections, Projections in OpenGL, Hidden surface removal, Parallel-projection matrices, Perspective-projection matrices, Projections and Shadows,
Clipping; Line-segment clipping – Cohen Sutherland Clipping and Liang-Barsky Clipping; Polygon clipping; Clipping in three dimensions, Rasterization, Bresenham's algorithm.

UNIT – 4

Multimedia basics, Multimedia applications, Multimedia system architecture, Evolving technologies for multimedia, Defining objects for multimedia systems, Multimedia data interface standards, Multimedia databases. Compression and decompression, Data and file format standards, Multimedia I/O technologies, Digital voice and audio, video image and animation, Full motion video, Storage and retrieval technologies. Multimedia authoring and user interface, Hypermedia messaging, Mobile messaging, Hypermedia message component, creating hypermedia message.

Self-learning components: Integrated multimedia message standards, integrated document management, Distributed multimedia systems, BLENDER GRAPHICS Blender Fundamentals – Drawing Basic Shapes – Modelling – Shading & Textures

Text Books:

1. Edward Angel, Interactive Computer Graphics A Top Down Approach with OpenGL, Addison- Wesley, 5th Edition,2008
2. Andleigh, P. K and Kiran Thakrar, —Multimedia Systems and Design‖, PHI, 2003

Reference Books:

1. Donald Hearn and Pauline Baker M, —Computer Graphics", Prentice Hall, New Delhi, 2007
2. Foley, Van Damn, Feiner and Hughes, Computer Graphics: Principles and Practice. Addison Wesley.
3. Modeling in Computer Graphics: Proceedings of the IFIP WG 5.10 Working Conference Tokyo, Japan, April 8-12, 1991 (IFIP Series on Computer Graphics) by Tosiyasu L Kunii
4. Judith Jeffcoate, —Multimedia in practice: Technology and Applications‖, PHI, 1998.

Professional Electives 5

Course Title	**Stochastic Modelling and the Theory of Queues**				**Course Type**		**PE(SC)**	
Course Code	**B22EHS621**	**Credits**	**3**		**Class**		**VI Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	--	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**		**50**	**50**

COURSE OVERVIEW:

This is a UG level course on discrete stochastic processes and queuing, aimed at students working in areas such as communication networks, operations research, and machine learning. It covers basics probability theory, background in stochastic modeling, queuing concepts, queuing models and analyses, Markov chains in discrete as well as continuous time.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. To provide a thorough understanding of the mathematical foundations of telecommunication and computer communication networks
2. To teach the applications of Markov processes and queuing theory, to analyze the performance and address the design questions in circuit- and packet-switching networks

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	Pos	PSOs
CO1	Solve the characteristics of the random variable with the given probabilities	1 to 4, 12	1,2
CO2	Understand and apply various theoretical distributions	1 to 4, 12	1,2
CO3	Analyze different cases of stochastic processes along with their properties	1 to 4,12	1, 2
CO4	Use discrete time finite state Markov chain	1 to 4,12	1,2
CO5	Explain sufficient knowledge in principles of queuing theory	1 to 4, 12	1,2
CO6	Formulate concrete problems using queuing theoretical approaches.	1 to 4, 12	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3				√		
CO4			√			
CO5						√
CO6						√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2								2	2	2	
CO2	3	3	2	2								2	2	2	
CO3	3	3	2	2								2	2	2	
CO4	3	3	2	2								2	2	2	
CO5	3	3	2	2								2	2	2	
CO6	3	3	2	2								2	2	2	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT
THEORY:

UNIT – 1

STOCHASTIC MODELING AND THE THEORY OF QUEUES: Events, Sample Space, and Random Variables, Probability, Conditional Probability and Independence, Probability and Distribution Functions, Joint Distribution Functions, Conditional Probability for Random Variables, Independence between Random Variables, Convolution, Selected Discrete Random Variables, Continuous Random Variables and their Probability Functions, Selected Continuous Random Variables, Moments, Sample Mean and Sample Variance, Covariance and Correlation, Transforms, Multivariate Random Variables and Transform, Probability Inequalities and Their Dimensioning Applications, Limit Theorems, Link Dimensioning

UNIT – 2

Background in Stochastic Processes: General Concepts, Two Orderly and Memory less Point Processes, Markov Modulated Poisson Process, Discrete-time Markov-chains, Continuous Time Markov-chains

UNIT – 3

General Queuing Concepts: Notation, Utilization, Little's Formula, Work Conservation, PASTA, Queuing Models: Deterministic Queues, M/M/1, M/M/∞, Erlang B Formula

UNIT – 4

Queues with General Input: Reich's Formula, Queue Size Versus Virtual Waiting Time, Wong's Inequality **Queuing Networks:** Jackson Networks, Erlang Fixed-Point Approximation, A Markov Chain Simulation of a Mobile Cellular Network.

Stochastic Processes as Traffic Models: Parameter Fitting, Poisson Process, Markov Modulated Poisson Process (MMPP), Autoregressive Gaussian Process, Exponential Autoregressive (1) Process, Poisson Pareto Burst Process

TEXT BOOKS:

1. J. Medhi, Stochastic Models in Queueing Theory, Academic press
2. Kulkarni, Vidyadhar G., Modeling and Analysis of Stochastic Systems, CRC Press, 2016.

REFERENCE BOOKS:

1. Bertsekas, Dimitri P., and Robert G. Gallager, Data Networks, Prentice-Hall International, 1987.
2. Kumar, Anurag, Discrete Event Stochastic Processes, available onlinehttp://ece.iisc.ernet.in/~anurag/books/anurag/spqt.pdf

JOURNALS/MAGAZINES:

1. Stochastic Models - https://www.tandfonline.com/journals/lstm20
2. https://www.mdpi.com/journal/mathematics/special_issues/Stochastic_Models_Applications#
3. Queuing systems - https://www.springer.com/journal/11134/

SWAYAM/NPTEL/MOOCs:

1. Stochastic Modeling and the Theory of Queues By Prof. Krishna Jagannathan | IIT Madras - https://onlinecourses.nptel.ac.in/noc21_ee93/preview

SELF-LEARNING EXERCISES:

1. Non Birth and death processes
2. Non – Markovian queuing systems

Course Title	Social Network Analysis				Course Type		SC	
Course Code	B22EHS622	Credits	3		Class		VI Semester	
Course Structure	LTP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Lecture	3	3	3				
	Tutorial				Theory	Practical	CIE	SEE
	Practical	-	-	-				
	Total	3	3	3	42	-	50%	50%

COURSE OVERVIEW:

Social network analysis (SNA) is the process of investigating social structures through the use of networks and graph theory. It characterizes networked structures in terms of nodes (individual actors, people, or things within the network) and the ties, edges, or links (relationships or interactions) that connect them.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. To understand the concept of semantic web and related applications.
2. To learn knowledge representation using ontology.
3. To understand human behavior in social web and related communities.
4. To learn visualization of social networks.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply semantic web related applications.	1 to 5, 12	1,2,3
CO2	Classify the knowledge using ontology.	1 to 5, 12	1,2,3
CO3	Distinguish the human behavior in social web.	1 to 5,12	1,2,3

CO4	Identify the human behavior in related communities.	1 to 5,12	1,2,3
CO5	Analyze mining communities in social networks	1 to 5,12	1,2,3
CO6	Classify the Privacy Issues in social networks	1 to 5,12	1,2,3

BLOOM’S LEVEL OF THE COURSE OUTCOMES

CO#	**Bloom’s Level**					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1			√			
CO2		√				
CO3				√		
CO4		√				
CO5				√		
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	3							2	3		3
CO2	3	3	2	2	3							2	3		3
CO3	3	3	2	2	3							2		3	3
CO4	3	3	3	2	2							2		3	
CO5	3	2	2	2	3							2	3		3
CO6	3	2	2	2	3							2	3		3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT
THEORY:

UNIT – 1

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

UNIT – 2

Modeling, Aggregating And Knowledge Representation: Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modeling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.

UNIT – 3

Extraction And Mining Communities In Web Social Networks: Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.

UNIT – 4

Predicting Human Behaviour and Privacy Issues: Understanding and predicting human behavior for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.

TEXT BOOKS:

1.Peter Mika, —Social Networks and the Semantic Web‖, First Edition, Springer 2007.

2.BorkoFurht, —Handbook of Social Network Technologies and Applications‖, 1st Edition, Springer, 2010.

REFERENCE BOOKS:

1 GuandongXu ,Yanchun Zhang and Lin Li, —Web Mining and Social Networking – Techniques and applications‖, First Edition, Springer, 2011.

2 Dion Goh and Schubert Foo, —Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.

3 Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, —Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling‖, IGI Global Snippet, 2009.

4 John G. Breslin, Alexander Passant and Stefan Decker, —The Social Semantic Web‖, Springer, 2009.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/6921601
2. https://ieeexplore.ieee.org/document/6921602
3. https://towardsdatascience.com/social-network-analysis-from-theory-to-applications-with-python-d12e9a34c2c7
4. https://www.sciencedirect.com/topics/social-sciences/social-network-analysis

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_cs117/preview
2. https://www.edx.org/course/social-network-analysis-sna?index=product&queryID=73f65173c331f8cf6c722d23cc516ea2&position=1

SELF-LEARNING EXERCISES:

1. Anaconda IDE
2. Spyder
3. Jupiter

Course Title	**Robotic Process Automation**				**Course Type**		**PE**	
Course Code	**B22EHS623**	**Credits**	**3**		**Class**		**VI Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW:

Robotic Process Automation (RPA) offers many challenges for software developers and scientists. This course introduces the UiPath Robotic Process Automation concepts through UiPath Studio and UiPath Orchestrator where a student gains knowledge of how to build a bot to automate required tasks.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss the concepts of Robotics Process automation

2. Describe the sequence, flowchart, and control flow in automation tool

3. Demonstrate the data manipulation techniques

4. Demonstrate the usage of UI Explorer and Screen scraping

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of recording features in UiPath Studio to automate the repetitive tasks.	1 to 5	1,2,3
CO2	Apply appropriate Workflow Activities in UiPath Studio to automate the complex tasks using Flowchart and Sequence.	1 to 5	1,2,3
CO3	Build data table and data manipulation techniques in UiPath Studio to automate CSV / Excel workbook applications.	1 to 5	1,2,3
CO4	Design and Develop bot process using UI Explorer.	1 to 5	1,2,3
CO5	Design and Develop process to automate using Screen Scraping for complex applications.	1 to 5	1,2,3
CO6	Construct any real-world application by making use of the Automation features in RPA	1 to 5	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	3							3	3	2
CO2	3	3	3	2	3							3	3	2
CO3	3	3	3	2	3							3	3	2

CO4	3	3	3	2	3							3	3	2
CO5	3	3	3	2	3							3	3	2
CO6	3	3	3	2	3							3	3	2

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

UNIT – 1

What Is Robotic Process Automation: Scope and techniques of automation, Robotic process automation, About UiPath, Future of Automation. Record and Play: UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder, Step-by-step examples using the recorder.

UNIT – 2

Sequence. Flowchart and Control Flow: Sequencing the Workflow, Activities, Control Flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart, Step-by-step example using Sequence and Control Flow

UNIT – 3

Data Manipulation: Variables and Scope, Collections, Arguments-Purpose and use, Data table usage and examples, Clipboard management, File operation with step-by-step example, CSV/Excel to data table and vice versa with a step-by-step example

UNIT – 4

Taking Control of the Controls: Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls-mouse and keyboard activities, Working with UI Explorer, Handling events, Screen Scraping, When to use OCR, Types of OCR available, How to use OCR

TEXT BOOKS:

1. Alokmani Tripathi, “Learning Robotic Process Automation”, Packt Publishing, 2018.

2.E. Turban, R. Sharda, D. Delen, David King, “Business Intelligence”, Pearson India, 2010.

REFERENCE BOOKS:

1. Marlon Dumas et. al., “Fundamentals of Business Process Management”, Springer, ebook, 2012.

2. Van der Aalst, “Process Mining: Discovery, Conformance and Enhancement of Business Processes”, Third edition, 2011.

JOURNALS/MAGAZINES

1. https://rpa-journal.org/
2. https://www.sciencedirect.com/science/article/pii/S1877050921001393
3. https://ieeexplore.ieee.org/document/9001110./authors#authors

SWAYAM/NPTEL/MOOCs:

1. https://www.uipath.com/rpa/academy
2. https://www.coursera.org/specializations/roboticprocessautomation

3. https://www.udemy.com/topic/robotic-process-automation/

SELF-LEARNING EXERCISES:

1. Handling User Events
2. Assistant Bots

Course Title	Advance Deep Learning				Course Type	PE	
Course Code	B22EHS624	Credits	3		Class	V1	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Theory	3	3	3	Theory	CIE	SEE
	-	-	-	-			
	Total	**3**	**3**	**3**	**39**	**50**	**50**

COURSE OVERVIEW:

Advanced Deep Learning is an extension of traditional deep learning techniques that seeks to address more complex and challenging problems. It goes beyond simple feedforward neural networks and explores sophisticated architectures, optimization methods, and advanced applications.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explore advanced activation functions and initialization techniques for efficient training.
2. Implement the Transformer architecture for NLP tasks like language modeling and translation.
3. Analyze the working of Generative Adversarial Networks (GANs) and their training process.
4. Apply RL techniques to real-world scenarios such as robotics and gaming.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Analyze and evaluate advanced neural network architectures	1-5	1-3
CO2	Apply advanced optimization techniques and regularization methods	1-5	1-3
CO3	Design and implement sequence models for natural language processing	1-5	1-3
CO4	Implement and optimize deep reinforcement learning algorithms	1-5	1-3
CO5	Create and deploy generative models for various applications	1-5	1-3
CO6	Critically assess ethical and social implications of advanced deep learning	1-5	1-3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	√	√		
CO2		√	√			
CO3		√				
CO4			√	√	√	√
CO5			√	√	√	√
CO6				√	√	√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	3						3	3	3
CO2	3	3	3	3	3	3	3						2	2	2
CO3	3	3	3	2	2	2	2						2	3	3
CO4	3	3	3	3	3	3	3						3	3	3
CO5	3	3	3	2	3	3	3						3	3	3
CO6	3	3	3	2	3	3	3						3	3	3

Note: 1-Low, 2-Medium, 3-High

Unit-1:

Introduction: Review of basic neural networks, Activation functions, Initialization techniques, Optimization algorithms (e.g., Adam, RMSprop), Regularization (e.g., Dropout, L2 regularization), Advanced architectures (e.g., ResNet, DenseNet).

Unit-2: Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU), Attention Mechanisms, Transformer architecture, Applications in Natural Language Processing (NLP).

Unit-3:

Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs), Wasserstein GANs, Conditional GANs, Applications in image synthesis and data augmentation.

Unit-4: Markov Decision Processes (MDPs), Q-learning, Policy Gradient methods, Deep Q-Networks (DQNs), Proximal Policy Optimization (PPO), Applications in robotics and gaming..

Text Book:

1. Charu, C. Aggarwal. Neural networks and deep learning: a textbook. Spinger, 2018.
2. Jurafsky, Daniel, and James H. Martin. "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition."

Reference Book:

1. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep learning. MIT press, 2016.
2. Andrew, Alex M. "REINFORCEMENT LEARNING: AN INTRODUCTION by Richard S. Sutton and Andrew G. Barto, Adaptive Computation and Machine Learning series, MIT Press (Bradford Book), Cambridge, Mass., 1998, ISBN 0-262-19398-1

JOURNALS/MAGAZINES:

1. IEEE Transactions on Pattern Analysis and Machine Intelligence(SCI)
2. IEEE Transactions on Image Processing(SCI)
3. International Journal of Computer Vision(SCI)
4. Computer Vision and Image Understanding(SCI)
5. Image and Vision Computing(SCI)
6. Pattern Recognition(SCI)

SELF-LEARNING EXERCISES:

1. Pick a research problem statement and design solution for the same.

<table>
<tr><td>Course Title</td><td colspan="4">Genomics</td><td colspan="2">Course Type</td><td colspan="2">PE(SC)</td></tr>
<tr><td>Course Code</td><td>B22EHS625</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes
Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>0</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

This course includes the basics of Cell Biology and Molecular Biology with Genomics, and the experimental tools and databases. In this course, students gain extensive knowledge and experience on Molecular Genetics and Genome Mapping. An introduction to the key characteristics of Genomics, Biological Databases, and Genetics diseases for further analysis.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Understand the cell theory and the mechanisms of the central dogma of life.
6. Introduction to the basics of sequence analysis and molecular genetics.
7. Discuss the methods to characterise and manage the different types of biological data.
8. Introduce the types of cancer and molecular basis of cancer biology as a Case study.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Outline the concepts of Cell Biology and Gene functions.	1,2,6,8,12	1,2,3
CO2	Acquire the basic concept of genomics and functional genomics with various methods for genome sequencing and assembly.	1 to 5,6,8,12	1,2,3
CO3	Analyse the molecular mechanisms of gene regulation in prokaryotes and eukaryotes with the basis of their genomes.	1 to 5,6,8,12	1,2,3
CO4	Understand the molecular basics of life with cell cycle and cell division.	1,2,6,8,12	1,3
CO5	Apply theoretical knowledge and practical skills for the analysis of biological communities, cell population and gene-bank data mining.	1 to 5,6,8,12	1,3
CO6	Identify, locate and retrieve specific records from various biological databases	1 to 5,6,8,12	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√	√		
CO4		√				
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1	1		2				2	3	3	3

CO2	3	3	2	1	2	1		2				2	3		3
CO3	3	3	2	1	2	1		2				2	3	3	3
CO4	3	2				1		2				2	3		3
CO5	3	3	3	2	2	1		2				2	3		3
CO6	3	3	3	2	2	1		2				2	3	2	3

Note:1-Low,2-Medium,3-High

COURSE CONTENT
THEORY:

UNIT – 1
Introduction to Cell Biology and Gene Function: Molecular basis for life, Central dogma, Nucleic Acids, Gene, Genetic Code, Genomics, Human Genome Project, Proteins, Properties of Protein, Structure of Protein, Proteomics, Nomenclature of Protein Sequences, Functions of the genetic material, Evidence for DNA and RNA as the genetic material, The transport of molecules between the nucleus and the cytosol, The molecular mechanisms of endocytosis, and exocytosis.

Gene function at Molecular level- Replication, Transcription & Translation

UNIT – 2
Molecular Biology and Molecular Genetics: Molecular basis for life, An over view on biological organization (eg. human); Structural organization of prokaryotic and eukaryotic cells, Ultrastructure and functions of nucleus, mitochondria, plastids, endoplasmic reticulum, Golgi complex, lysosomes, microbodies, ribosomes. Cytoskeleton, Plant and animal cells, Variation in structure and function, Cell cycle and its importance, Phases of cell cycle, Genetic basis of syndromes and disorders.

UNIT – 3

Genome and Sequence Analysis with Gene Mapping: Introduction, Genome Analysis, Genome Annotation, Genome Mapping, The Sequence Assembly problem, Sequence comparison: Sequence alignment, Pair wise sequence alignment, Multiple sequence alignment and their importance, Genetic Mapping and Linkage Analysis, Physical Maps, Cloning the entire Genome, Genome Sequencing, Applications of Genetic Maps, Sequence Assembly Tools, Identification of Genes in Contigs, Basis of Gene Prediction, Gene Prediction Methods, Molecular evolution and Phylogenetic analysis

UNIT – 4
Biological Databases & Cancer Genetics: Motivation of biological database, Major Databases in Bioinformatics, Electronic Libraries, Nucleotide sequence databases - European Molecular Biology Laboratory (EMBL) - NCBI GenBank – DNA Data Bank of Japan (DDBJ), Protein amino acid sequence databases- UNIPROT, Protein Data Bank (PDB) Pfam-protein family database - GO-gene ontology, Swiss-Prot, Protein Sequence Motif Databases, Tools for Web Search, Data Retrieval Tools, Data Mining of Biological Databases.

Cancer Genetics: Definition, Types, Relationship of the cell cycle to cancer, Cancer and programmed cell death, Genetic basis for cancer, oncogenes, Tumour suppressor genes, Role of environmental factors in cancer and genetic pathways to cancer.

SELF-LEARNING EXERCISES:
1. Protein structure prediction
2. Homology and Similarity Tools
3. Biostatistics

TEXT BOOKS:
1. S C Rastogi, N Mendiratta and P Rastogi, " Bioinformatics: Methods and Applications" , ISBN : 978-81-203-4785-4, PHI Learning Private Limited, 2015.

2. David W Mount," Bioinformatics- Sequence and Genome Analysis", second Edition, CBS Publishers, 2014.
3. The Cell: A Molecular Approach, Geoffrey M. Cooper and Robert E Hausman, Oxford University press, 2015, 7th Edition
4. Genomes 4, T. A. Brown, Garland Science, 2017, 4th Edition
5. Andreas D. Baxevanis, B. F. Francis Ouellette," Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins", 2nd Edition, Wiley Inderscience, 2001.

REFERENCE BOOKS:

1. Mount D (2014) Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor
2. Lewin's Genes XII (2017) - Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick. Jones and Bartlett Publishers
3. iGenetics – A Molecular approach, 3rd edition (2016) – Peter J Russell, Pearson Benjamin Cummings, San francisco, USA
4. Attwood, T.K., Parry, D.J., Smith, Introduction to Bioinformatics, Pearson Education, 2005.
5. The Analysis of Gene Expression Data: An Overview of Methods and Software, Giovanni Parmigiani, Elizabeth S. Garrett, Rafael A. Irizarry, Scott L.Zeger

JOURNALS/MAGAZINES:

1 Briefings in Functional Genomics
2 BMC Bioinformatics
3 Proteins: Structure, Function and Bioinformatics
4 IEEE/ACM Transactions on Computational Biology and Bioinformatics
5 International Journal of Genomics
6 Bentham Science- Current Bioinformatics
7 Genomic Medicine

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_bt24/preview - Functional Genomics
2. https://onlinecourses.swayam2.ac.in/cec20_bt03/preview- Genetics and Genomics
3. https://www.coursera.org/specializations/genomic-data-science

Course Title	**Web Technology Lab**				**Course Type**		**HC**	
Course Code	**B22EF0606**	**Credits**	**1**		**Class**		**VI Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	-	-	-				
	Tutorial	-	-	-	**Theory**	**Practical**	**CIE**	**SEE**
	Practical	1	2	2				
	Total	**1**	**2**	**2**	**-**	**28**	**25%**	**25%**

COURSE DESCRIPTION:

The basics of Web application tools such as HTML, XHTML and CSS are introduced. The course also provides knowledge about advanced research topics such as XML, Perl PHP and Angular JS, Java Scripts.

COURSE OBJECTIVE (S):

1. Build dynamic web pages with the help of various HTML tags and perform validation using Java Script objects by applying different event handling mechanisms.
2. Comprehend the importance of CSS in designing a creative and dynamic website and embedding Java Script code in HTML.
3. Understand and be able to develop JavaScript code to access the DOM structure of web document and object properties.
4. Develop dynamic web pages with usage of server-side scripting.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of HTML tags and CSS to build web pages for various applications.	1- 4 ,9- 12	1,2,3
CO2	Demonstrate the usage of form data to validate the correctness of given input.	1-4,6,9-12	1,2
CO3	Build the variety of presentation effects in HTML documents, including explicit positioning of elements using CSS.	1-6,	1,2,3
CO4	Develop a well formed HTML document to create Interactive webpage by the use of JavaScript.	1-6	1,2,3
CO5	Apply the concepts of server side technologies for dynamic web applications.	1-6,	1,2,3
CO6	Utilize the concept of ReactJS for creation of reusable UI Components	1-6	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1					3	1	1	3	1	1	1
CO2	3	3	3	2		1			3	1	2	3	2	2	
CO3	3	3	2	2	1	2							2	2	1
CO4	2	3	2	3	1	1							2	2	1
CO5	3	3	2	2	1	1							2	2	1
CO6	2	3	2	3	1	1							2	2	1

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability

Part-A			
1.	Write JavaScript to validate the following fields of the Registration page. **1. First Name** (Name should contains alphabets and the length should not be less than 6 characters). **2. Password** (Password should not be less than 6 characters length). **3. E-mail id** (should not contain any invalid and must follow the standard pattern name@domain.com) **4. Mobile Number** (Phone number should contain 10 digits only). **5. Last Name and Address** (should not be Empty).	Web browser &any editor	Event handling capabilities of Java script
2.	Write a JavaScript code that displays text **"TEXT-GROWING"** with increasing font size in the interval of 100ms in RED COLOR, when the font size reaches 50pt it displays **"TEXT-SHRINKING"** in BLUE color. Then the font size decreases to 5pt.	Web browser & any editor	Event handling capabilities of Java script
3.	Write an HTML page that contains a selection box with a list of 5 countries. When the user selects a country, its capital should be printed next to the list. Add CSS to customize the properties of the font of the capital (color, bold and font size).	Web browser & any editor	Implementation of HTML Basics
4.	Write an HTML page that has one input, which can take multi line text and a submit button. Once the user clicks the submit button, it should show the number of characters, words and lines in the text entered using an alert message. Words are separated with white space and lines are separated with new line character.	Web browser & any editor	Implementation of HTML Basics
5.	elop and demonstrate JavaScript with POP-UP boxes and functions for the following problems: **nput:** Click on Display Date button using onclick ( ) function Output: Display date in the textbox. **nput:** A number n obtained using prompt Output: Factorial of n number using alert. **nput:** A number n obtained using prompt Output: A multiplication table of numbers from 1 to 10 of n using alert d) Input: A number n obtained using prompt and add another number using confirm **Output:** Sum of the entire n numbers using alert.	Web browser & any editor	
6.	elop and demonstrate the usage of inline, internal and external style sheet using CSS	Veb browser & any editor	Implementation of CSS
7.	te a program Develop and demonstrate, using JavaScript script, a XHTML document that contains three short paragraphs of text, stacked on top of each other, with only enough of each showing so that the mouse cursor can be placed over some part of them. When the cursor is placed over the exposed part of any paragraph, it should rise to the top to become completely visible. Modify the above document so that when a paragraph is moved from the top stacking position, it returns to its original position rather than to the bottom	Veb browser & any editor	Concepts of XHTML with Javascripts

8.	Write a XHTML Program using Java script to create a web page with images where these images navigate between images using: 1. click/arrow button 2. automation 3. Text/Image	Veb browser & any editor	Concepts of XHTML with Javascripts
9	te a XHTML Program using Java script to create multiple line of content. Use various buttons to 1. Adding new content 2. Replacing the existing content 3. Deleting the Content	Veb browser & any editor	Concepts of XHTML with Javascripts
10	monstrate how to create components in ReactJS 1. React functional components 2. React class-based component	Creating React Application And Installing Module	troduction to Virtual DOM

Course Title	Business Intelligence and Analytics Lab				**Course Type**		**HC**	
Course Code	B22EH0603	**Credits**	**1**		**Class**		**VI Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	1	2	2	**-**	**28**	**25**	**25**

COURSE OVERVIEW:

Business Intelligence Lab enables students to learn reporting tool Power BI which is used to uncover insights from data. This course will enable students to turn unrelated sources of real world data into coherent, visually immersive, and interactive insights.

COURSE OBJECTIVE (S):

The objectives of this lab are to:

1. Discuss connecting data from various data sources.
2. Illustrate creating reports using the Power BI Desktop Report view.
3. Discuss the representation of data using visuals such as graphs and charts using data models
4. Demonstrate creating dashboards to tell a story through visualizations.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs

CO1	Identify the data sources and importing data from various sources.	1,2,3,4,5	1,2,3
CO2	Apply the ETL process to construct the database and creation of sales data warehouse using SQL server.	1,2,3,4,5,10,12	1,2,3
CO3	Implement the calculated columns ,filtering data and conditional formatting usin Power BI	1,2,3,4,5,10,12	1,2, 3
CO4	Make use of complex bookmark report using visual modes.	1,2,3,4,5,10,12	1,2,3
CO5	Apply the visual representation of data using graphs and charts.	1,2,3,4,5,10,11,12	1,2,3
CO6	Design complete dashboard visualization of real world dataset	1,2,3,4,5,10,11,12	1,2,3

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4			√			
CO5			√			
CO6						√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	3								1	1	2
CO2	3	3	3	1	3					2		2	1	1	2
CO3	3	2	3	1	3					2		2	1	1	2
CO4	3	3	3	1	2					2		2	1	1	2
CO5	3	3	3	1	2					2	1	2	1	1	2
CO6	3	3	3	1	2					3	2	3	1	1	2

Note: 1-Low, 2-Medium, 3-High

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
Part-A			
1.	Import the legacy data from different sources such as (Excel , SqlServer, Oracle etc.) and load in the target system. (You can download sample database such as Adventureworks, Northwind, foodmart etc.)	Windows OS, IDE	Importing Data from varied sources
2.	Perform the Extraction Transformation and Loading (ETL) process to construct the database in the Sqlserver / Power BI.	Windows OS, IDE	ETL Process
3.	Download T-SQL for creation of Sales Data Warehouse or download it to "Create First Data Warehouse" and run it in your SQL Server.	Windows OS, IDE	SQL Server
4.	a. Create two simple calculated columns for film data (for Oscars and profitability). b. Calculate average floor areas for tall building data using calculated columns.	Windows OS, IDE	Calculated Columns
5.	Import skyscraper data, creating a new column and showing this in a chart controlled by a slicer	Windows OS, IDE	Filtering Data
6.	a. Load movies data and apply conditional formatting to a bar chart. b. Apply data bars to a chart to show the length of different films.	Windows OS, IDE	Conditional Formatting

7.	a. Make a more complex bookmark report by using DATA and SELECTED VISUAL modes. b. Use images and bookmarks to allow navigation between pages.	Windows OS, IDE	Drill-Through And Bookmarks
8.	Compare the heights of skyscrapers by country and city, and create a KPI. .	Windows OS, IDE	Charts
9.	Unpivot an excel pivot table to make it useable within a Power BI Data model.	Windows OS, IDE	Advanced Data Sources: Pivot Table
10.	Switch the Query editor file target from an Excel sheet to a SQL database.	Windows OS, IDE	Advanced Data Sources
11.	Use Query Editor to rename and split columns in a Game of Thrones worksheet.	Windows OS, IDE	Query Editor
12.	a. Use the NASA API to show a random image of somewhere in the Universe. b. Use the crime statistics API to show crimes in your area.	Windows OS, IDE	APIs Usage

Project Work:

Customer Churn analysis project, one can uncover what causes your customers to stop using your product or service. Use this Power BI project to analyze regional business growth and the profit distribution among customers. With the right visualization and data structure, they can receive extensive data. As part of the project, regional cash inflows will be considered, as well as product-specific churn over the course of time. To complete this beginner-friendly project, you will need the customer segmentation dataset. In this project, utilize Power BI data visualization options can be for different scenarios as given below:

1. Combo Charts, Bar Charts, Line Chart, Cards, Tables, etc., for overview page.
2. Column Charts, Bubble Charts, Point Maps, Tables, etc., for the customer segmentation page.

<table>
<tr><td>Course Title</td><td colspan="3">Neural Networks and Deep Learning lab</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EH0604</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">VI SEMESTER</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>Practice</td><td></td><td></td><td></td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>1</td><td>2</td><td>2</td><td>-</td><td>28</td><td>25</td><td>25</td></tr>
</table>

COURSE OVERVIEW:
Deep learning models stand for a new learning paradigm in artificial intelligence (AI) and machine learning. Recent breakthrough results in image analysis and speech recognition have generated a massive interest in this field because also applications in many other domains providing big data seem possible. On a downside, the mathematical and computational methodology underlying deep learning models is very challenging, especially for interdisciplinary scientists. For this reason, we perform the experiment on deep learning approaches.

COURSE OBJECTIVE (S):
The objectives of this course are to:
1. Understand and discover the characteristics of data
2. Understand and implement optimization techniques
3. Understand and Implement deep learning algorithms
4. Design Deep Learning models for real-time problem.

COURSE OUTCOMES (COs)
After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	To explore the data, usually by visualizing them in different ways to discover some characteristics of data	1 to 5,9,10,12	1,3
CO2	Identify the characteristics to figure out the next things to explore	1 to 5, 9,10,12	1,3
CO3	Understand and implement optimization techniques	1 to 5, 9,10,12	2, 3
CO4	To install TensorFlow and get a better understanding by implementing a classical deep learning algorithm.	1 to 5, 9,10,12	2
CO5	Apply CNN models using tensorflow	1 to 5, 9,10,12	1,3
CO6	To Design a multimodal Recurrent Neural Network (m-RNN) model	1 to 5, 9,10,12	1,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

<table>
<tr><td rowspan="2">CO#</td><td colspan="6">Bloom's Level</td></tr>
<tr><td>Remember (L1)</td><td>Understand (L2)</td><td>Apply (L3)</td><td>Analyze (L4)</td><td>Evaluate (L5)</td><td>Create (L6)</td></tr>
<tr><td>CO1</td><td></td><td></td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
</table>

CO2			√	√	√	√
CO3			√	√	√	√
CO4			√	√	√	√
CO5			√	√	√	√
CO6			√	√	√	√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2				3	3		2	3		3
CO2	3	3	2	3	2				3	3		2	3		3
CO3	3	3	2	3	2				3	3		2		3	3
CO4	3	3	3	2	2				3	3		2		3	
CO5	3	2	2	2	3				3	3		2	3		3
CO6	3	2	2	2	3				3	3		2	3		3

Note: 1-Low, 2-Medium, 3-High

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1.	This experiment guides you through the setup of scientific Python environment and provides useful references for self-reading.	The easiest way to setting up a scientific Python environment is to install the Anaconda for Python 3	Understand the add-on packages developed by Python community

2.	This Experiment guides you through the process of Exploratory Data Analysis (EDA) and discuss how you can leverage the Principle Component Analysis (PCA) to visualize and understand high-dimensional data.	Anaconda for Python 3	In the exploration step, you "explore" the data, usually by visualizing them in different ways, to discover some characteristics of data. Then, in the exploitation step, you use the identified characteristics to figure out the next things to explore.
3.	In this lab, we will apply the Decision Tree and Random Forest algorithms to the classification and dimension reduction problems using the Wine dataset.	Anaconda for Python 3	apply Decision Tree and Random Forest to the classification problem and the dimension reduction problem
4.	In this lab, we will guide you through the implementation of Perceptron and Adaline, two of the first machine learning algorithms for the classification problem. We will also discuss how to train these models using the optimization techniques.	Anaconda for Python 3	Understand and implement optimization techniques
5.	s lab guides you through the linear and polynomial regression using the Housing dataset. We will also extend the Decision Tree and Random Forest classifiers to solve the regression problem.	Anaconda for Python 3	Apply Decision Tree and Random Forest classifiers that we have learned from our previous labs to solve the regression problem.

6.	In this lab, you will learn how to install TensorFlow and get a better understanding by implementing a classical deep learning algorithm.	aconda for Python 3	install TensorFlow and get a better understanding by implementing a classical deep learning algorithm.
7	his lab, we will introduce a neural network, called the word2vec, that embeds words into a dense vector space where semantically similar words are mapped to nearby points.	aconda for Python 3	derstand how to embeds words into a dense vector space where semantically similar words are mapped to nearby points
8	:his lab, we will introduce two datasets, MNIST and CIFAR-10, then we will talk about how to implement CNN models for these two datasets using tensorflow. Then offer a guide to illustrate typical input pipeline of TensorFlow 2.0.	aconda for Python 3	ply CNN models using tensorflow
9	; lab guides how to load and use a pretrained VGG19 model and how to visualize what the CNN networks have learned in selected layers. This also introduces an interesting technique called "Style Transfer" and displays galleries of its creative outputs. Last but not least, we will also demonstrate how to save and load model during training and explain the TensorFlow family briefly.	aconda for Python 3	monstrate VGG19 model

10	his lab, we introduce how to design a model that can be given an image, and then generates suitable caption which can describe the image. To accomplish this, you'll use an attention-based model, which enables us to see what parts of the image the model focuses on as it generates a caption.	aconda for Python 3	Design a multimodal Recurrent Neural Network (m-RNN) model for generating novel sentence descriptions to explain the content of images

Course Title	**Mini Project (Research Based)**				**Course Type**		**HC**	
Course Code	**B22EH0605**	Credits	**2**		**Class**		**VI Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	-	-	-				
	Tutorial	-	-	-	**Theory**	**Practical**	**CIE**	**SEE**
	Practical	2	4	4				
	Total	**2**	**4**	**4**	**-**	**56**	**50%**	**50%**

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3

CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3

CO10									3			3	3	3
CO11										3		3	3	3
CO12											3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Skill development-2:
Students will be offered training and certifications on the trending technologies from the industry experts. The students are evaluated and certified after the training programs.

VII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE /MC/S DC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22XXO71X	Open elective –3	OE	3	0	0	3	3	50	50	100	POE
2	B22XXO72X	Open Elective - 4 (MOOC)	OE	3	0	0	3	3	50	50	100	POE
3	B22EH0701	Cryptography and Network Security	HC	3	0	0	3	3	50	50	100	PCC
4	B22EH0702	Skill Development course - 4 (MOOC)	SDC	1	0	1	2	3	50	50	100	SDC
5	B22EH0703	Internship	HC	0	0	2	2	4	50	50	100	PCC
6	B22EH0704/5	Project – Phase 1/startup	HC	0	0	3	3	6	50	50	100	PCC
Total				10	0	6	16	22	300	300	600	
TOTAL SEMESTER CREDITS				16								
TOTAL CUMULATIVE CREDITS				156								
TOTAL CONTACT HOURS				22								
TOTAL MARKS				600								

Open Elective 3

<table>
<tr><td>Course Title</td><td colspan="4">Neural Networks and Deep Learning</td><td colspan="2">Course Type</td><td colspan="2">OE</td></tr>
<tr><td>Course Code</td><td>B22EHO711</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td></td><td></td><td></td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE-PRE-REQUISITE- Complete knowledge on basics of python programming & python libraries.

COURSE OVERVIEW:

In the last decade due to availability of cheap computation, several neural network approaches had been explored in order to advance the performance of many state-of-the-art visual recognition problems such as image searching, understanding, medical applications, autonomous vehicles such as drones and self-driving cars etc. All these problems relies of efficient, accurate and robust solutions for basic vision tasks such like image classification, localization and detection. In this course students will be given an exposure to the details of neural networks as well as deep learning architectures and to develop end-to-end models for such tasks. Students will learn to implement, train and debug their own neural networks.

COURSE OBJECTIVE (S):

The objectives of this course are to:

6. To introduce the students with machine learning fundamentals for solving real world scenario applications and apply suitable machine learning techniques for data handling and to gain knowledge from it.
7. Acquire theoretical knowledge on setting hypothesis for pattern recognition.
8. To design own models for the specific applications and optimize them efficiently
9. Evaluate the performance of algorithms and to provide solution for various real-world applications.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the optimization techniques for various Machine Learning models	1 to 5,9,10,12	1,2,3
CO2	Develop methods of data representations in machine learning environment	1 to 5, 9,10,12	1,2,3
CO3	Create probabilistic and unsupervised learning models for handling unknown pattern.	1 to 5, 9,10,12	1,2,3

CO4	Classify Machine learning models for Non-linear systems	1 to 5, 9,10,12	1,2,3
CO5	Understand basic machine learning models and prediction techniques.	1 to 5, 9,10,12	1,2,3
CO6	Apply machine learning models in speech and image processing applications	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2						√
CO3						√
CO4		√				
CO5			√			
CO6	√					

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2				3	3		2	3		3
CO2	3	3	2	2	2				3	3		2	3		3
CO3	3	3	2	2	2				3	3		2		3	3
CO4	3	3	3	2	2				3	3		2		3	
CO5	3	2	2	2	3				3	3		2	3		3
CO6	3	2	2	2	3				3	3		2	3		3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT
THEORY

UNIT – 1

Basics of artificial neural networks (ANN): Artificial neurons, Computational models of neurons, Structure of neural networks, Functional units of ANN for pattern recognition tasks

Feedforward neural networks: Pattern classification using perceptron, Multilayer feedforward neural networks (MLFFNNs), Backpropagation learning, Empirical risk minimization, Regularization, Autoencoders

UNIT – 2

Deep neural networks (DNNs): Difficulty of training DNNs, Greedy layerwise training, Optimization for training DNNs, Newer optimization methods for neural networks (AdaGrad, RMSProp, Adam), Second order methods fo **Convolution neural networks (CNNs):** Introduction to CNNs – convolution, pooling, Deep CNNs, Different deep CNN architectures – LeNet, AlexNet, VGG, PlacesNet, Training a CNNs: weights initialization, batch normalization, hyperparameter optimization, Understanding and visualizing CNNs training, Regularization methods (dropout, drop connect, batch normalization)

UNIT – 3

Recurrent neural networks (RNNs): Sequence modeling using RNNs, Back propagation through time, Long Short Term Memory (LSTM), Bidirectional LSTMs, Bidirectional RNNs, Gated RNN Architecture

UNIT – 4

Generative models: Restrictive Boltzmann Machines (RBMs), Stacking RBMs, Belief nets, Learning sigmoid belief nets, Deep belief nets.

Applications: Applications in vision, speech and natural language processing

TEXT BOOKS:

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2016.
2. S. Haykin, Neural Networks and Learning Machines , Prentice Hall of India, 2010
3. Bishop, C ,M., Pattern Recognition and Machine Learning, Springer, 2006.

REFERENCE BOOKS:

1. Satish Kumar, Neural Networks - A Class Room Approach, Second Edition, Tata McGraw-Hill, 2013.
2. Yegnanarayana, Artificial Neural Networks, Prentice- Hall of India, 1999
3. Ravindran, K. M. Ragsdell , and G. V. Reklaitis , ENGINEERING OPTIMIZATION: Methods and Applications , John Wiley & Sons, Inc. , 2016.
4. Antoniou, W. S. Lu, PRACTICAL OPTIMIZATION Algorithms and Engineering Applications, Springer, 2007.

JOURNALS/MAGAZINES:

1. IEEE Transactions on Neural Networks and Learning System
2. IEEE Transactions on Pattern Analysis and Machine Intelligence
3. Springer Journal of Deep Learning.
4. Elsevier journal on Deep learning Based Intelligent Systems
5. ACM Jounral on Machine Learning Research

SWAYAM/NPTEL/MOOCs:

1. https://www.cs.ox.ac.uk/people/nando.defreitas/machinelearning/
2. https://people.eecs.berkeley.edu/~jrs/189/
3. http://www.cse.iitm.ac.in/~ravi/courses/Introduction%20to%20Machine%20Learning.html
4. http://www.cse.iitm.ac.in/~ravi/courses/Introduction%20to%20Machine%20Learning.html
5. http://leap.ee.iisc.ac.in/sriram/teaching/DL20/
6. http://www.cse.iitm.ac.in/~miteshk/CS6910.html
7. https://www.cs.princeton.edu/courses/archive/spring16/cos495/
8. https://d2l.ai/
9. https://nptel.ac.in/courses/106106184
10. https://nptel.ac.in/courses/106106184
11. http://www.ai.mit.edu/courses/6.867-f03/exams.html
12. https://ml2.inf.ethz.ch/courses/aml/
13. https://www.studocu.com/in/document/kalinga-institute-of-industrial-technology/neural-networks-and-machine-learning/ml-extra-qbank/17982037
14. CSCI 5922: Neural Networks and Deep Learning (colorado.edu)
15. Berkeley AI Materials
16. Adit Deshpande – Engineering at Forward | UCLA CS '19 (adeshpande3.github.io)
17. Hamid Beigy (Deep Learning) (sharif.edu) 18. WTF Deep Learning!!! (wtf-deeplearning.github.io)
18. IIT Ropar – Sudhar Iyenger – Deep Learning: NPTEL
19. CIS520 Machine Learning | Lectures / Lectures (upenn.edu)
20. Best : University of Toronto: CSC413/2516 Neural Networks and Deep Learning (Winter 2020) (csc413-2020.github.io)
21. Best : university of Pittuserberg:CS1678: Intro to Deep Learning (pitt.edu)
22. Best : Charles university: Deep Learning – Summer 2017/18 | ÚFAL (cuni.cz)
23. The Best : Deep Learning | ÚFAL (cuni.cz)
24. Best : University of Chicago: CMSC 35246 Deep Learning - University of Chicago (ttic.edu)
25. IIT Bombay: CS 344 - Artificial Intelligence/ CS 386 - Artificial Intelligence Lab. Spring 2008 (iitb.ac.in)
26. University of Princeton: Introduction to Deep Learning: Home Page (princeton.edu)
27. The Best : http://www.cs.toronto.edu/~rgrosse/courses/csc421_2019/
28. http://www.cs.umd.edu/~djacobs/CMSC828DeepLearning/Syllabus18.htm
29. https://www.cs.ox.ac.uk/people/nando.defreitas/machinelearning/
30. http://www.cs.umd.edu/~djacobs/CMSC828DeepLearning/Syllabus18.htm
31. https://mriquestions.com/deep-learning-dl.html

32. IIT: https://nptel.ac.in/courses/106106184
33. https://www.deeplearning.ai/program/deep-learning-specialization/
34. IITMadras: http://www.cse.iitm.ac.in/~miteshk/CS6910.html 36. NPTEL: https://nptel.ac.in/courses/106106184
35. http://www.cs.umd.edu/~djacobs/CMSC828DeepLearning/Syllabus18.htm
36. https://flatironschool.com/blog/deep-learning-vs-machine-learning/
37. https://nptel.ac.in/courses/117105084
38. https://www.youtube.com/watch?v=rvMVqPsXL10
39. https://stackify.com/learn-python-tutorials/
40. https://www.simplilearn.com/tutorials/deep-learning-tutorial/deep-learning-algorithm
41. https://analyticsindiamag.com/8-free-resources-tools-to-learn-pytorch-in-2021/
42. https://www.mathworks.com/videos/matlab-for-deep-learning-1530256241637.html
43. https://www.youtube.com/watch?v=bOIZ74rOik0

SELF-LEARNING EXERCISES:

4. Advanced Python Programming
5. R Programming
6. Linear Algebra
7. Probability and statistics
8. Image Processing

PRACTICE:

List of experiments

1. Environment Setup Make sure you have Homebrew installed: I would suggest starting a virtualenv for your development. It makes life so much easier when you have multiple projects with conflicting requirements; i.e. one works in Python 2.7 while the other is only compatible with Python 3.5+.(For every new installation below, please make sure you are in the virtualenv.) Install OpenAI gym according to the instruction. · Finally clone the "playground" code and install the requirements.
2. Simple Reinforcement Learning with Tensorflow: Q-Learning with Tables Q-Learning with Neural Networks. Solution: https://medium.com/emergent-future/simple-reinforcement-learning-with-tensorflow-part-0-q-learning-with-tables-and-neural-networks-d195264329d0
3. Consider the familiar child's game of tic-tac-toe. Two players take turns playing on a three-by-three board. One player plays Xs and the other Os until one player wins by placing three marks in a row, horizontally, vertically, or diagonally. If the board fills up with neither player getting three in a row, the game is a draw. Implement tic-tac-toe problem that would be approached with a method making use of a value function. Solution: https://towardsdatascience.com/reinforcement-learning-implement-tictactoe-189582bea542
4. Q-learning (Watkins & Dayan, 1992) learns the action value ("Q-value") and update it according to the Bellman equation. The key point is while estimating what is the next action, it does not follow the current policy but rather adopt the best Q value (the part in red) independently. Implement the Naive Q-Learning algorithm using tensorflow and openAI Gym environment.
5. Cartpole - also known as an Inverted Pendulum is a pendulum with a center of gravity above its pivot point. It's unstable, but can be controlled by moving the pivot point under the centre of mass. The goal is to keep the cartpole balanced by applying appropriate forces to a pivot point. Implement the same using a 2-layer densely connected neural network to learn Q values for the cart pole balancing problem. Solution: https: //lilianweng.github.io/lil-log/2018/05/05/implementing-deep-reinforcement-learning-models.html#deep-q-network
6. The game of Poker has many variants. One of the simplest settings is the head's up push-or-fold scenario, in no-limit Texas Hold'em Poker. In this scenario, there are only two players. The Small Blind (first player to act) has only two actions possible: folding, thus losing the current hand, or going all-in, risking all his chips. Once the small blind went all-in, the Big Blind (second player to act) has also two actions possible: folding, meaning he lost the hand or calling the small blind's all-in. Once the two players went all-in, the 5 community cards are dealt, and the best hand wins the pot. Implement a Q learning algorithm for no-limit head's up poker. Solution: https://github.com/scascar/PokerDeepLearning
7. Monte-Carlo policy gradient, also known as REINFORCE, is a classic on-policy method that learns the policy model explicitly. It uses the return estimated from a full on-policy trajectory and updates the policy parameters with policy gradient. The returns are computed during rollouts and then fed into the Tensorflow graph as inputs. Write a Program to calculate rollout and return During the episode. Solution: https://lilianweng.github.io/lil-log/2018/05/05/implementing-deep-reinforcement-learning-models.html#monte-carlo-policy-gradient
8. Suppose a wire frame forming a closed loop is dunked in soapy water to form a soap surface or bubble conforming at its edges to the wire frame. If the geometry of the wire frame is irregular but known, compute the shape of the surface using Monte Carlo methods. (https://web.stanford.edu/class/psych209/Readings/SuttonBartoIPRLBook2ndEd.pdf)

9. The actor-critic algorithm learns two models at the same time, the actor for learning the best policy and the critic for estimating the state value. Implementation the same which is similar to REINFORCE with an extra critic network. Solution: https://lilianweng.github.io/lil-log/2018/05/05/implementing-deep-reinforcement-learning-models.html#monte-carlo-policy-gradient
10. One traveling salesman is getting ready to go on a sales tour. Starting from his home town, in this case A, he needs to get to his destination, in this case F. There are many cities between A and F, and many different routes to take. Some of them carry costs, but on some of them, there is a way for the salesman to earn some money on his way. The aim is to choose the most affordable route from place A to place F. Implement the above concept in python.
11. Random walks are famous stochastic processes that represent a path made from random steps on integers or other mathematical space. This can be something like the prices of fluctuation stocks, the financial situation of a gambler, the molecule's traveled path in gas or liquid form, etc. Implement the random walk example using python.
12. Suppose you are the mouse and the cat is in front of you. If you choose to move one step forward the cat, you will end up being eaten by the cat. That will have an undesirable outcome, so next time, you will choose a different move and choose to go away to the side of the cat. This may not reduce the value of you moving forward when the cat isn't in front of you. It's a simple example but it serves the purpose well. The point of Q learning is to choose the actions which will maximize the rewardand lower the value of those that bring you unsatisfactory results.

<table>
<tr><td>Course Title</td><td colspan="4">Big Data Analytics</td><td colspan="2">Course Type</td><td colspan="2">OE</td></tr>
<tr><td>Course Code</td><td>B22EH0712</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VII Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

This course introduces the concept of big data and provides a practical foundation level exposure that enables students to participate in big data application development. The course provides grounding in basic and advanced methods to big data technology with Apache Spark fundamentals.

COURSE OBJECTIVE (S):
The objectives of this course are to:

1. Explain the concepts of Big Data and its Business Implications.
2. Illustrate the fundamentals of functional programming for Big-Data Analytics.
3. Exemplifying the features of Apache Spark for Data Analytics.
4. Implement Machine Learning in Spark to solve real business problems.

COURSE OUTCOMES (COs)
After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Outline the concepts of Big Data and its Business Implications.	1 to 5,9,10,12	1
CO2	Apply the concept of functional distributed programming to Big Data Analytics applications.	1 to 5, 9,10,12	1,2, 3
CO3	Understand the fundamentals of Apache Spark and Spark Core.	1 to 5, 9,10,12	1, 3
CO4	Design a Data Analytics Framework using Apache Spark with Python.	1 to 5, 9,10,12	1,2,3
CO5	Implement distributed Machine Learning Applications for big data using Spark.	1 to 5, 9,10,12	1,2,3

CO6	Develop real world big data application using Apache Spark with Python programming.	1 to 5, 9,10,12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√					
CO2			√			
CO3		√				
CO4			√			
CO5			√			
CO6			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	3	-	-	-	-	-	-	-	3	1	3
CO2	3	3	3	3	3	-	-	-	3	-	-	2	3	3	3
CO3	3	1	3	1	3	-	-	-	3	3	3	3	3	3	3
CO4	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3
CO5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3
CO6	3	3	3	3	3	1	-	1	3	3	3	3	3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – 1

Introducing Big Data, Hadoop, and Spark: Introduction to Big Data, Distributed Computing, and Hadoop, A Brief History of Big Data and Hadoop, Hadoop Explained; Introduction to Apache Spark: Apache SparkBackground, Uses for Spark, Programming Interfaces to Spark, Submission Types for Spark Programs, Input/Output Types for Spark Applications, The Spark RDD, Spark and Hadoop; Functional Programming Using Python: Data Structures Used in Functional Python Programming, Python Object Serialization, Python Functional Programming Basics;

UNIT – 2

Understanding the Spark Cluster Architecture: Anatomy of a Spark Application:Spark Driver, Spark Workers and Executors, The Spark Master and Cluster Manager; Spark Applications Using the Standalone Scheduler: Spark Applications Running on YARN Deployment; Modes for Spark Applications Running on YARN: Client Mode, Cluster Mode, Local Mode Revisited; Learning Spark Programming Basics: Introduction to RDDs,Loading Data into RDDs, Creating an RDD from a File or Files, Methods for Creating RDDs from a Text File or Files, Creating an RDD from an Object File, Creating an RDD from a Data Source, Creating RDDs from JSON Files, Creating an RDD Programmatically;

UNIT – 3

Operations on RDDs: Key RDD Concepts, Basic RDD Transformations, Basic RDD Actions, Transformations on PairRDDs, MapReduce and Word Count Exercise, Join Transformations, Joining Datasets in Spark, Transformations on Sets, Transformations on Numeric RDDs; Advanced Programming Using the Spark Core API: Shared Variables in Spark: Broadcast Variables, Accumulators, Exercise: Using Broadcast Variables and Accumulators; Partitioning Data in Spark: Partitioning Overview, Controlling Partitions, Repartitioning Functions, Partition-Specific or Partition-Aware API Methods; RDD Storage Options: RDD

Lineage Revisited, RDD Storage Options, RDD Caching, Persisting RDDs, Choosing When to Persist or Cache RDDs, Checkpointing RDDs, Exercise: Checkpointing RDDs;

UNIT – 4

Processing RDDs with External Programs: Data Sampling with Spark; Understanding Spark Application and Cluster Configuration: Spark Environment Variables, Spark Configuration Properties; Optimizing Spark: Filter Early, Filter Often, Optimizing Associative Operations, Understanding the Impact of Functionsand Closures, Considerations for Collecting Data, Configuration Parameters for Tuning and Optimizing Applications, Avoiding Inefficient Partitioning, Diagnosing Application Performance Issues; Machine Learning with Spark: Machine Learning Primer, Machine Learning Using Spark MLlib, Exercise: Implementing a Recommender Using Spark MLlib, Machine Learning Using Spark ML;

TEXT BOOKS:

5. Aven, Jeffrey. Data Analytics with Spark Using Python. Addison-Wesley Professional, 2018.
6. Bengfort, Benjamin, and Jenny Kim. Data analytics with Hadoop: an introduction for data scientists." O'Reilly Media, Inc.", 2016.
7. Sridhar Alla, Big Data Analytics with Hadoop 3, published by Packt Publishing Ltd, May 2018
8. SubhashiniChellappan, DharanitharanGanesan, Practical Apache Spark Using the Scala API, A Press, 2018.

REFERENCE BOOKS:

1. Michael Minelli, Michele chambers, AmbigaDhiraj: Big data, big analytics, Wiley, 2013.
2. P. Tan, M. Steinbach, V. Kumar, Introduction to Data Mining, Addison-Wesley, 2005.
3. J. Han, M. Kamber, Data Mining: Concepts and Techniques, 2nd ed. Morgan Kaufmann, 2005.

JOURNALS/MAGAZINES:

5. IEEE,Introduction to the IEEE Transactions on Big Data
6. Elsevier,Big data research journal Elsevier
7. Springer, Journal on Big Data Springer.
8. ACM DL,The Journal of Machine Learning Research-ACM

SWAYAM/NPTEL/MOOCs:

5. https://nptel.ac.in/courses/106104189
6. https://onlinecourses.nptel.ac.in/noc20_cs92/preview
7. https://iisc.talentsprint.com/cds/?utm_source=googlesearch&utm_medium=tcpa&utm_campaign=ts-googlesearch-iisc-cds-tcpa-similar-audiences-roi&utm_content=data-science-program&utm_term=Analytics%20training%20courses&gclid=Cj0KCQjw8uOWBhDXARIsAOxKJ2HfWKGqqpZ7Gm0dBPDgkwWaj0BqSZBzuWvcqmbF5AOvYvxYSB5lvFcaAlO_EALw_wcB
8. https://www.simplilearn.com/pgp-data-engineering-certification-training-course?utm_source=google&utm_medium=cpc&utm_term=big%20data%20analysis%20online%20course&utm_content=11233548673-137256573987-586850068745&utm_device=c&utm_campaign=Search-DataCluster-PG-BigData-CDE-Purdue-IN-Main-AllDevice-adgroup-SEMR-09Mar2022-BD-Analysis-Course-Phrase&gclid=Cj0KCQjw8uOWBhDXARIsAOxKJ2GINP8K1hXBRF4Qu6cWTaZ714GQYvQR_CL4ff9qM6whNg_Xx2vLFmcaAjMTEALw_wcB

SELF-LEARNING EXERCISES:

3. SQL and NoSQL Programming with Spark
4. Stream Processing and Messaging Using Spark

Open Elective – IV

Course Title	MOOC/COMPETITIVE EXAM			Course Type	OE
Course Code	B22EHO721	Credits	3	Class	VII Semester

<table>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>6</td><td>6</td><td>-</td><td>42</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The MOOC Course is a one semester intensive project-based learning approach to cater with the Industry requirement. It prepares the students to up skill their knowledge base to compete in terms of latest technology and become competent enough to the industry requirment. In this, students will be able to solve complex real-world problems pertaining to the domain chosen and gain confidence. It is an individual course and students have to earn the certificate based on their performances in terms of project assignment and aptitude. Students have to choose one MOOC course.

COURSE OBJECTIVE (S):

1. To allow students to learn skills of their choice required in the current Industry perspective.
2. To encourage building multidisciplinary skill set through the integration of courses learned.
3. To allow students to develop problem solving, analysis, synthesis and evaluation skills.
4. To prepare them to face the interview as professionals by improving communication skills.

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	Pos	PSOs
CO1	Demonstrate in-depth knowledge on the project topic.	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATION MATRIX:

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3
CO10										3			3	3	3
CO11											3		3	3	3
CO12												3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the MOOC EXAM:

- Student should choose one **MOOC** among the available Industry ready courses to cope up with the vast changing software world.
- Student should register for the course having minimum of 42 hours of teaching and should have 100 percent attendance for all the sessions.
- Each student shall be reviewed and evaluated in two reviews through the semester.
- Review 1 shall be on the presentation of the course, assignment completed followed by viva.
- Review 2 shall be on the presentation of their overall skills learned in the course followed by their certification verification.

<table>
<tr><td>Course Title</td><td colspan="4">Cryptography and Network Security</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EH0701</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">VIISemester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>42</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

This course will emphasise on principles and practice of cryptography and network security: classical systems, symmetric block ciphers (DES, AES, other contemporary symmetric ciphers), linear and differential cryptanalysis, perfect secrecy, public-key cryptography algorithms for factoring and discrete logarithms, cryptographic protocols, hash functions, authentication, key management, key exchange, signature schemes and email security, viruses, firewalls, digital right management, and other topics. In this course students will learn as aspects of network security and cryptography.

COURSE OBJECTIVE (S):

The objectives of this course are to:
1. Explain the fundamental concepts of cryptography.
2. Describe public key cryptography and message authentication.
3: Demonstrate the key distribution using Symmetric or Asymmetric encryption.
4. Discuss security applications in the field of Information technology.

COURSE OUTCOMES (COs):

After the completion of the course, the student will be able to:

CO#	Course Outcomes	Pos	PSOs
CO1	Identify the fundamental concepts of cryptography.	1 to 5	1
CO2	Use symmetric and asymmetric key algorithms for cryptography	1 to 5	2
CO3	Apply the key distribution technique using Symmetric or Asymmetric encryption	1 to 5	2,3
CO4	Develop real-world security applications in the field of Information technology.	1 to 5	2,3
CO5	Understanding of Authentication functions the manner in which Message Authentication Codes and Hash Functions works.	1 to 5	1,2

CO6	Apply the System security concepts for real-time secure applications.	1 to 5	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3			√			
CO4						√
CO5		√				
CO6		√				

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1								3		
CO2	3	2	3	1	2									3	
CO3	3	1	2	2	3									3	3
CO4	2	2	2	1	1									3	3
CO5	3	2	3	2	1								3	3	
CO6	2	1	2	2	2									3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

UNIT – I

INTRODUCTION: Security trends, The OSI Security Architecture, Security Attacks, Security Services and Security Mechanisms, A model for Network security.
CLASSICAL ENCRYPTION TECHNIQUES: Overview of Symmetric Cipher Modes, Substitute Techniques, Transposition Techniques, andStenography.
INTRODUCTION TO NUMBER THEORY: Prime Numbers, Fermat's and Euler's Theorem, Testing for Primality, The Chinese Remainder Theorem, Discrete logarithms.
TOOLS DEMONSTRATION: Wireshark, Metasploit, Snort, Nmap, Kali Linux.

UNIT – II

SYMMETRIC KEY CRYPTOGRAPHY: Block Cipher Principles, Data Encryption Standards, Advanced Encryption Standards, Block Cipher Modes of Operation, Stream Cipher and RC4.
PUBLIC KEY CRYPTOGRAPHY: Principles Public key crypto Systems, RSA algorithm, Key Management, Diffie Hellman Key Exchange, Overview of Elliptic Curve Cryptography.

UNIT – III

MESSAGE AUTHENTICATION AND HASH FUNCTIONS: Authentication Requirement, Authentication Function, Message Authentication Code, List of Hash Function, Secure Hash Algorithm, HMAC, CMAC, an overview of Digital Signature.
AUTHENTICATION APPLICATION: Kerberos, X.509 Authentication Service, Public Key Infrastructure.

UNIT – IV

EMAIL SECURITY: Pretty Good Privacy (PGP) and S/MIME**.**
IP SECURITY: Overview, IP Security Architecture.
SYSTEM SECURITY: Intrusion Detection, Overview of Packet Sniffing, Penetration testing, Database testing, DoS attacks. Password Management, Virus and threats, Virus Counter measures.
FIREWALLS: The Need for Firewalls, Firewall Characteristics, Types of Firewalls.

SELF-LEARNING EXERCISES:

The student is expected to study more about the following topics: IoT complexity leads to security issues and further DDoS attacks, Malware, Cloud security, Roles of AI and machine learning in cyber security.

TEXT BOOKS:

1. William Stallings, “Cryptography and Network Security Principles and Practice”, Pearson, Sixth edition, 2013
2. Behrouz A. Forouzan, “Cryptography and Network Security”, McGraw Hill, 2007.

REFERENCE BOOKS:

1. William Stallings, “Network Security Essentials Applications and Standards”, Fourth edition, Prentice Hall, 2011.
2. Joseph MiggaKizza,” Guide to Computer Security, Springer Science & Media Inc., Third edition, 2015
3. Andrew S.Tanenbaum, “Computer Networks”, Pearson, Fifth edition, 2015.
4. AtulKahate, “Cryptography and Network Security”, McGraw Hill, 2013.

JOURNALS/MAGAZINES:

1. Springer Journal of Cryptographic Engineering, ISSN 2190-8508
2. ACM, ACM- International Journal of Applied Cryptography, ISSN:1753-0563
3. IEEE, IEEE Transactions on Information Forensics and Security.
4. Elsevier, Journal of Information Security and Applications.

SWAYAM/NPTEL/MOOCs:

1. Foundations of Cryptography: https://nptel.ac.in/courses/106/106/106106221/
2. Cryptography and Network Security: https://nptel.ac.in/courses/106/105/106105162/

Course Title	**Skill Development Course – 4(MOOC)**				**Course Type**		**SDC**	
Course Code	**B22EH0702**	**Credits**	**2**		**Class**		**VII Semester**	
Course Structure	**LTP**	**Credits**	**Contact Hours**	**Work Load**	**Total Number of Classes Per Semester**		**Assessment in Weightage**	
	Lecture	**1**						
	Tutorial	**-**			**Theory**	**Practical**	**CIE**	**SEE**
	Practical	**1**						

	Total	**2**			**-**	**56**	**50%**	**50%**

COURSE OUTCOMES:

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES:

	Bloom's Level					
CO#	**Remember (L1)**	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√

CO11		√		√		
CO12			√			

COURSE ARTICULATION MATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3
CO10										3			3	3	3
CO11											3		3	3	3
CO12												3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Skill development-4:

Students will be offered training and certifications on the trending technologies from the industry experts.

The students are evaluated and certified after the training programs.

<table>
<tr><td>Course Title</td><td colspan="4">Internship</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EH0703</td><td>Credits</td><td colspan="2">2</td><td colspan="2">Class</td><td colspan="2">VII Semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="3">Total Number of Classes Per Semester</td><td colspan="2" rowspan="3">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Tutorial</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td></td><td></td><td></td><td></td><td></td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

An internship can present students with new skills and opportunities. Interns not only gain technical knowledge within the industry of their choice, but they also learn how to interact with professionals in a workplace setting, and develop essential soft skills like time management, organization, adaptability, problem-solving and teamwork.

COURSE OBJECTIVES:

1. To allow students to develop problem solving, analysis, synthesis and evaluation skills.
2. To encourage team work.
3. To help students to gain exposure into industries.
4. To improve students' communication skills by asking them to produce both a professional report and to give an oral presentation.

COURSE OUTCOMES:

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	**Bloom's Level**					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				

CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATIONMATRIX

CO#/ Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**												**3**	**3**	**3**
CO2		**3**											**3**	**3**	**3**
CO3			**3**										**3**	**3**	**3**
CO4				**3**									**3**	**3**	**3**
CO5					**3**								**3**	**3**	**3**
C06						**3**							**3**	**3**	**3**
CO7							**3**						**3**	**3**	**3**
CO8								**3**					**3**	**3**	**3**
CO9									**3**				**3**	**3**	**3**
CO10										**3**			**3**	**3**	**3**
CO11											**3**		**3**	**3**	**3**
CO12												**3**	**3**	**3**	**3**

Note: 1-Low,2-Medium,3-High

The students are informed to follow the following instructions to complete the Internship:

1. The internship should be paid internship in IT industry.
2. The internship should be for minimum of three months.
3. The project title must be submitted in form a document (synopsis) that contains the proposed title of the project, an abstract, Introduction and their roles and responsibilities in company.
4. Each student shall be reviewed and evaluated in two reviews through the semester.
5. Review 1 shall be on the presentation of the synopsis.
6. Review 2 shall be on the presentation on the roles and responsibilities carried out with module completion results (as applicable).

Course Title	**Project Phase-1 / Start- up**	**Course Type**	**HC**

<table>
<tr><td>Course Code</td><td>B22EH0704/5</td><td>Credits</td><td colspan="2">1</td><td colspan="2">Class</td><td colspan="2">VII Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Practical</td><td>3</td><td>6</td><td>6</td></tr>
<tr><td>Total</td><td>3</td><td>6</td><td>6</td><td>-</td><td>84</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The major project is a two semester-long practical project with the main objective that students show their ability to apply theoretical concepts learned in lectures to solve (complex) practical problems. The results are to be presented in a project report and as an oral presentation. The major project must be completed as a team project. Team projects are limited to a minimum of two students to a maximum number of four students.

COURSE OBJECTIVE (S):

1. To allow students to demonstrate a wide range of the skills learned during theircourse of study by asking them to deliver a product that has passed through the design, analysis, testing and evaluation.
2. To encourage multidisciplinary research through the integration learned in a number of courses.
3. To allow students to develop problem solving, analysis, synthesis and evaluation skills.
4. To encourage teamwork.
5. To improve students' communication skills by asking them to produce both a professional report and to give an oral presentation.

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM’S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom’s Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATIONMATRIX

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	3
CO2		3											3	3	3
CO3			3										3	3	3
CO4				3									3	3	3
CO5					3								3	3	3
C06						3							3	3	3
CO7							3						3	3	3
CO8								3					3	3	3
CO9									3				3	3	3
CO10										3			3	3	3
CO11											3		3	3	3

CO12													3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Project Phase-1:

1. Student should carry out project work in a group which is formed in the VII semester. Student must select group members from the same section as they belong to and select a faculty member from department of CSE as aninternal project guide based on research domain and expertise. Student may optionally also select external guide bearing domain expertise from different departments within University and Industry to carry out multidisciplinary project.
2. Student group must propose a project title, after consultation with guides and after carrying out a literature survey. The proposed title must be submitted in form a document (synopsis) that contains the proposed title of the project, an abstract, Introduction, Survey, Feasibility, and cost estimation to carry out the project.
3. Further with the help of respective guide, each student group have to the literature review based on the literature survey, identify the research gaps in the selected research/project domain, and then finalize the problem statement and objectives for the project.
4. Each student groups shall be reviewed and evaluated in two reviews through the semester.
5. Review 1 shall be on the presentation of the synopsis and justification of the title and feasibility of the project
6. Review 2 shall be on the presentation on the literature survey carried out.

Finally, the Project Phase-1 shall conclude with each project group apply for idea patent or copyright and publish a survey paper in SCOPUS indexed journals, write research proposals for fundings from various governmental organizations or industries

VIII SEMESTER

VIII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE/ MC/SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	B22EH0801	Project Phase 2 / Start-up	HC	0	0	12	12	24	50	50	100	PCC
Total				0	0	12	12	24	50	50	100	
TOTAL SEMESTER CREDITS					**12**							
TOTAL CUMULATIVE CREDITS					**168**							
TOTAL CONTACT HOURS					**24**							
TOTAL MARKS					**100**							

<table>
<tr><td>Course Title</td><td colspan="4">Project Phase-2</td><td colspan="2">Course Type</td><td colspan="2">HC</td></tr>
<tr><td>Course Code</td><td>B22EH0801</td><td>Credits</td><td colspan="2">12</td><td colspan="2">Class</td><td colspan="2">VIII Semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>LTP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="3">Total Number of Classes Per Semester</td><td colspan="2" rowspan="3">Assessment in Weightage</td></tr>
<tr><td>Lecture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Practical</td><td>6</td><td>12</td><td>12</td><td>Theory</td><td>Practical</td><td>CIE</td><td>SEE</td></tr>
<tr><td>Total</td><td>6</td><td>12</td><td>12</td><td>-</td><td>182</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

Project Phase-2 is continuation of Project Phase-1 from semester VII.

COURSE OBJECTIVE (S):

1. To allow students to demonstrate a wide range of the skills learned during their course of study by asking them to deliver a product that has passed through the design, analysis, testing and evaluation.
2. To encourage multidisciplinary research through the integration learned in a number of courses.
3. To allow students to develop problem solving, analysis, synthesis and evaluation skills.
4. To encourage teamwork.
5. To improve students' communication skills by asking them to produce both a professional report and to give an oral presentation

COURSE OUTCOMES (CO'S):

On successful completion of this course, the student shall be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3

CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3
CO12	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	12	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level					
CO#	**Remember (L1)**	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		
CO12			√			

COURSE ARTICULATIONMATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**

CO1	3											3	3	3
CO2		3										3	3	3
CO3			3									3	3	3
CO4				3								3	3	3
CO5					3							3	3	3
C06						3						3	3	3
CO7							3					3	3	3
CO8								3				3	3	3
CO9									3			3	3	3
CO10										3		3	3	3
CO11											3	3	3	3
CO12												3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Project Phase-2:

- Each student group shall, conduct the required experiment to implement the proposed project with the consultation of respective guides.
- Each student groups shall be reviewed and evaluated in two reviews through the semester and finally each group shall demonstrate the completed project to a team of examiners.
- Review 1 shall be on the presentation of the methodology employed and model created.
- Review 2 shall be on the presentation on the functional project.
- Finally, the Capstone-Project Phase-2 shall conclude with each project group apply for patent or copyright and publish a paper in SCOPUS indexed journals.
- In Semester end examination, each student in groups shall be evaluated, based on the course outcomes.