Appendix - II (B)

COCHIN UNIVERSITY OF SCIENCE & TECHNOLOGY

CURRICULUM & SYLLABUS
(I to VIII Semesters)

B. TECH. PROGRAMME
in
COMPUTER SCIENCE AND ENGINEERING

(2023 Admission onwards)

B.TECH. DEGREE PROGRAMME IN COMPUTER SCIENCE AND ENGINEERING

VISION

To be a global centre for learning and dissemination in computing andautomation.

MISSION

To mould students as competent and industry leading technologists with social commitment guided by professional ethics and national ethos

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PE01: To equip students with deep insight into the theory and practice of computer science and engineering.

PE02: To guide the students to apply the subject knowledge to offer solutions to societal problems, Inter disciplinary in nature.

PEO3: To empower students to pursue excellence in career and acquisition of higher levels of knowledge through lifelong learning.

PEO4: To impart team spirit, leadership skills, entrepreneurial skills through innovative thinking and high level of professional ethics to students.

PROGRAMME OUTCOMES (POs)

A graduate of this major should be able to:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: 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

PO6: 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

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and needfor sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: 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)

PS01: Design and analyze algorithms and data representations for solving problems efficiently

PS02: Engineer automation systems integrating software and hardware.

PS03: Handle a broad range of programming languages, advanced computer architectures and computer networking.

PS04: Develop systems replicating human intelligence using logical reasoning, heuristicsand data analytics.

Program Articulation Matrix

Mission Statement	**PEO1**	**PEO2**	**PEO3**	**PEO4**
To mould students as competent and industry leading technologists with social commitment guided by professional ethics and national ethos	**3**	**2**	**3**	**3**

1- Slightly; 2- Moderately; 3- Substantially

Categories of Courses with the Breakup of Credits

Sl. No	Category of Courses	Credit breakup for Computer Science and Engineering
1	Humanities and Social Sciences including Management Courses	7
2	Basic Science courses	29
3	Engineering Science Courses including workshop, drawing, basics of electronics/electrical/mechanical/computer etc.,	14
4	Professional Courses	81
5	Professional elective courses relevant to chosen specialization/discipline	18
6	Open subjects-Electives from other technical and /or emerging subjects	6
7	Project work, seminar and internship in industry or elsewhere	15
8	Mandatory courses [Environmental Sciences, Induction Program, IndianConstitution, Essence of Indian Knowledge Tradition]	(non-credit)
	Total	170

Stream B: Computer Science and Engineering, Electrical and Electronics Engineering, Electronics and Communication Engineering & Information Technology.

SEMESTER I (STREAM B)

Code No.	Subject	L H/W	T H/W	P/D H/W	C	Marks		Total
						C A	SEE	
23-200-0101B	Calculus	3	1	0	4	50	50	100
23-200-0102B	Engineering Physics	3	0	1	3	50	50	100
23-200-0103B	Introduction to Electronics Devices &Circuits	3	1	0	4	50	50	100
23-200-0104B	Introduction to Electrical Engineering	3	0	0	3	50	50	100
23-200-0105B	Computer Programming	3	1	0	3	50	50	100
23-200-0106B	Soft Skills Development	2	0	0	2	50	-	50
23-200-0107B	Computer Programming Laboratory	0	0	3	1	25	25	50
23-200-0108B	Basic Electrical Lab	0	0	3	1	25	25	50
23-200-0109B	Language Laboratory	0	0	2	1	25	25	50
23-200-0110B	NSS/Nature Conservation Activities/Yoga	0	0	1	0	-	-	-
	TOTAL	**17**	**3**	**10**	**22**			

CA – Continuous Assessment SEE – Semester End Examination

SEMESTER II (STREAM B)

Code No.	Subject	L H/W	T H/W	P/D H/W	C	Marks		Total
						CA	SEE	
23-200-0201B	Linear Algebra & Transform Techniques	3	1	0	4	50	50	100
23-200-0202B	Engineering Chemistry	3	0	1	3	50	50	100
23-200-0203B	Digital Electronics	3	1	0	3	50	50	100
23-200-0204B	Object Oriented Programming in C++	3	1	1	4	50	50	100
23-200-0205B	Introduction to Cyber Physical Systems	3	1	0	3	50	50	100
23-200-0206B	Environmental and Life Sciences	3	0	0	3	50	50	100
23-200-0207B	Digital Electronics Lab	0	0	3	1	25	25	50
23-200-0208B	Basic Electronics Lab	0	0	3	1	25	25	50
	TOTAL	**18**	**4**	**8**	**22**			

CA – Continuous Assessment, SEE – Semester End Examination

SEMESTER III

Code No.	Subject	L H/ W	T H/ W	P/ D H/ W	C	Marks		Total
						CA	SEE	
23-200-0301B*	Differential Equation and Complex Variables	3	1	0	3	50	50	100
23-202 -0302	Computer Architecture and Organization	3	1	0	3	50	50	100
23-202 -0303**	Discrete Computational Structures	3	1	0	3	50	50	100
23-202 -0304	Data Structures and Algorithms	3	1	0	3	50	50	100
23-202 -0305	Principles of Programming Languages	3	1	0	3	50	50	100
23-202 -0306	Automata Languages and Computations	3	1	0	3	50	50	100
23-202 -0307	Data Structures Laboratory	0	0	3	1	25	25	50
23-202 -0308	Object Oriented Programming Laboratory	0	0	3	1	25	25	50
23-202 -0309	Internship-1	0	0	0	1	50		50
	TOTAL	**18**	**6**	**6**	**21**			
Minor in Machine Learning								
23-202-0310	Introduction to Python Programming	3	1	0	3	50	50	100

*Common for CS/EEE/ECE/IT
** Common for CS/IT

Internship-1 of a minimum duration of two weeks (10 working days) after second semester and the evaluation will take place during the III semester. For lateral Entry students a mini project carried out can be considered equivalent to Internship-1

SEMESTER IV

Code No.	Subject	L H/ W	T H/ W	P/ D H/ W	C	Marks		Total
						CA	SE E	
23-200-0401B*	Numerical and Statistical Techniques	3	1	0	3	50	50	100
23-202 -0402	Operating Systems	3	1	0	3	50	50	100
23-202 -0403	Database Management Systems	3	1	0	3	50	50	100
23-202 -0404	Data and Computer Communication	3	0	0	3	50	50	100
23-202 -0405	Object Oriented SoftwareEngineering	3	0	0	3	50	50	100
23-202 -0406	Microprocessors	3	0	0	3	50	50	100
23-200-0407**	Universal Human Values	2	1	0	3	25	25	50
23-202 -0408	Database Management Systems Laboratory	0	0	3	1	25	25	50
23-202 -0409	Operating System Laboratory	0	0	3	1	25	25	50
	TOTAL	**20**	**4**	**6**	**23**			
Minor in Machine Learning								
23-202-0410	Foundation for Machine Learning	3	1	0	3	50	50	100
Honours in Computer Science and Engineering								
23-202-0411	Python for Machine Learning	3	1	0	3	50	50	100

*Common for CS/EE/EC/IT

**Common for all braches.

SEMESTER V

CodeNo.	Subject	L H/ W	TH / W	P/ D H/ W	C	Marks		Total
						CA	SEE	
23-202 -0501	Mathematical Foundations for Machine Learning	3	1	0	3	50	50	100
23-202 -0502	System Programming	3	1	0	3	50	50	100
23-202 -0503	Data Mining	3	1	0	3	50	50	100
23-202 -0504	Computer Graphics	3	1	0	3	50	50	100
23-202 -0505	Advanced Microprocessors and Embedded Systems	3	1	0	3	50	50	100
23-202 -05**	Professional Elective- I(MOOC)	0	0	0	3	-	-	100
23-202 -0510	Computer Graphics Laboratory	0	0	3	1	25	25	50
23-202 -0511	IoT and EmbeddedSystems Laboratory	0	0	3	1	25	25	50
23-202 -0512	Internship-II	0	0	0	1	50	-	50
	TOTAL	**15**	**5**	**6**	**21**			
Minor in Machine Learning								
23-202-0513#	MOOC I Broad Area : Applied Data Science	0	0	0	3	0	0	100
Honours in Computer Science and Engineering								
23-202-0514	Applied Machine Learning	3	1	0	3	50	50	100

Internship-II of a minimum duration of two weeks (10 working days) after fourth semester and the evaluation will take place during the fifth semester.

#Students should take Massive Open Online Courses (MOOCs) approved by the concerned Division/Board of Studies (BoS)

23-202-0506 to 23-202-0509 Professional Elective – I(MOOC)	
Code No.	**Broad Area**
23-202 -0506(IE)	Web Technologies
23-202 -0507	Software Project Management
23-202 -0508	Embedded System Design
23-202 -0509	Fundamentals of Cyber Security

SEMESTER VI

Code No.	Subject	L H/ W	T H/ W	P/ D H/ W	C	Marks		Total
						CA	SEE	
23-202 -0601	Computer Networks	3	1	0	3	50	50	100
23-202 -0602	Compiler Construction	3	1	0	3	50	50	100
23-202 -0603	Analysis and Designof Algorithms	3	1	0	3	50	50	100
23-202 -0604	Artificial Intelligence	3	1	0	3	50	50	100
23-202 -0605	Cryptography and Network Security	3	1	0	3	50	50	100
23-202 -06**	Professional Elective – II	3	1	0	3	50	50	100
23-202 -0610	Networks Laboratory	0	0	3	1	25	25	50
23-202 -0611	Mini Project	0	0	3	1	25	25	50
	TOTAL	**18**	**6**	**6**	**20**			
Minor in Machine Learning								
23-202-0612#	MOOC II Broad area: Neural Networks and Machine Learning	0	0	0	3	0	0	100
Honours in Computer Science and Engineering								
23-202-0613	Optimization Techniques	3	1	0	3	50	50	100
23-202-0614#	MOOC I Broad area: Recommender Systems	0	0	0	3	0	0	100

#Students should take Massive Open Online Courses (MOOCs) approved by the concerned Division/Board of Studies (BoS)

23-202-0606 to 23-202-0609 Professional Elective – II	
Code No.	**Subject**
23-202 -0606(IE)	Neural Networks and Deep Learning
23-202 -0607	Distributed Computing
23-202 -0608	Digital Image Processing
23-202 -0609	Information Retrieval

SEMESTER VII

Code No.	Subject	LH / W	T H / W	P/D H/ W	C	Marks		Total
						CA	SEE	
23-200 -0701*	Principles of Management	3	1	0	3	50	50	100
23-202 -0702	Advanced Architecture and Parallel Processing	3	1	0	3	50	50	100
23-202 -0703	Big Data Analytics	3	1	0	3	50	50	100
23-202 -07**	Professional Elective – III	3	1	0	3	50	50	100
23-202 -07**	Open Elective- I	3	0	0	3	50	50	100
23-202 -0712	Language Processors Laboratory	0	0	3	1	25	25	50
23-202 -0713	Data Analytics Lab	0	0	3	1	25	25	50
23-202 -0714	Entrepreneurship Development	0	0	2	1	50	-	50
23-202 -0715	Project Phase-I	0	0	3	2	50	-	50
23-202 -0716	Internship-III	0	0	0	1	50	-	50
	TOTAL	**15**	**4**	**11**	**21**			
Minor in Machine Learning								
23-202-0717#	MOOC III Broad area: Deep Learning with Python and Keras	0	0	0	3	0	0	100
23-202-0718	Mini Project	0	0	3	3	100	0	100
Honours in Computer Science and Engineering								
23-202-0719#	MOOC II Reinforcement Learning using Python	0	0	0	3	0	0	100

*Common for ECE/EEE/CS

Internship-III of a minimum duration of two weeks (10 working days) after VI semester and the evaluation will take place during the VII semester.

#Students should take Massive Open Online Courses (MOOCs) approved by the concerned Division/Board of Studies (BoS)

23-202-0704 to 23-202-0707 Professional Elective – III	
Code No.	Subject
23-202 -0704(IE)	Block Chain Technologies
23-202 -0705	Internet of Things and Applications
23-202 -0706	Biometric Technologies
23-202 -0707	Cloud Computing

23-202-0708 to 23-202-0711 Open Elective – I	
Code No.	Subject
23-202 -0708	Mobile Application Development
23-202 -0709	System Modeling and Simulation
23-202 -0710	Cyber Law and Ethics
23-202 -0711	Business Intelligence and Analytics

SEMESTER VIII- Regular Track

Code No.	Subject	L H/ W	T H / W	P/D H/ W	C	Marks		Total
						CA	SEE	
23-202 -08**	Professional Elective- IV	3	1	0	3	50	50	100
23-202 -08**	Professional Elective- V	3	1	0	3	50	50	100
23-202 -08**	Professional Elective- VI	3	1	0	3	50	50	100
23-202 - 08**	Open Elective- II	3	0	0	3	50	50	100
23-202 -0818	Seminar	0	0	3	1	50	-	50
23-202-0819	Project Phase- II	0	0	12	6	200	-	200
23-202 -0820	Comprehensive Viva Voce	0	0	0	1	-	50	50
	TOTAL	**12**	**3**	**15**	**20**			
Honours in Computer Science and Engineering								
23-202-0823#	MOOC III Image Analysis using Deep Learning	0	0	0	3	0	0	100

#Students should take Massive Open Online Courses (MOOCs) approved by the concerned Division/Board of Studies (BoS)

SEMESTER VIII- Internship Track*

Code No.	Subject	L H/W	T H/W	P/D H/W	C	Marks		Total
						CA	SEE	
23-202 -08**	Professional Elective- IV	3	1	0	3	50	50	100
23-202 -08**	Elective(Professional /Open)	3	1	0	3	50	50	100
23-202 -0818	Seminar	0	0	3	1	50	-	50
23-202 -0819	Project Phase - II	0	0	12	6	200	-	200
23-202 -0820	Comprehensive Viva Voce	0	0	0	1	-	50	50
23-202 -0821	Internship-IV	0	0	0	6	200		200
	TOTAL	**6**	**2**	**15**	**20**			

23-202 -0801 to 0812 **PROFESSIONAL ELECTIVE

23-202 -0813 to 0817: **OPEN ELECTIVE – II

23-202 -0801 to 23-202-0804 Professional Elective – IV	
Code No.	Subject
23-202 -0801	Randomized Algorithms
23-202 -0802	Augmented Reality
23-202 -0803	Computational Linguistics
23-202 -0804	Advanced Graph Theory

23-202 -0805 to 23-202 -0808 Professional Elective – V	
Code No.	Subject
23-202 -0805	Computer Vision
23-202 -0806	Agent Based Intelligent System
23-202 -0807	Cloud Security
23-202 -0808	Social Network Analysis

23-202 -0809 to 23-202 -0812 Professional Elective – VI	
Code No.	Subject
23-202 -0809	Natural Language Processing
23-202 -0810	Pattern Recognition
23-202 -0811	Real Time Data Analysis
23-202 -0812	Advanced Compiler Design and Optimization

23-202 -0813 to 23-202 -0817 Open Elective – II	
Code No.	Subject
23-202 -0813	Ethical Hacking
23-202 -0814	Cyberspace and Information System Security
23-202 -0815	Soft Computing
23-202 -0816	Internet of Things
23-200 -0817*	Constitutional Law

List of Minor Courses (Machine Learning)

Code No.	Subject	L	T	P/ D	C	Marks		Total Marks	Offering Semester	Mode of learning
						CA	SE E			
23-202-0310	Introduction to Python Programming	3	1	0	3	50	50	100	III	Class room
23-202-0410	Foundation for Machine Learning	3	1	0	3	50	50	100	IV	Class room
23-202-0513	MOOC I Broad area : Applied Data Science	0	0	0	3	0	0	100	V	Online/ Offline
23-202-0612	MOOC II Broad area: Neural Networks and Machine Learning	0	0	0	3	0	0	100	VI	Online/ Offline
23-202-0717	MOOC III Broad area: Deep Learning with Python and Keras	0	0	0	3	0	0	100	VII	Online/ Offline
23-202-0718	Mini Project	0	0	3	3	100	0	100	VII	

List of Courses for Honours

Code No.	Subject	L	T	P/D	C	Marks		Total Marks	Offering semester	Modeof learning
						CA	SEE			
23-202-0411	Python for Machine Learning	3	1	0	3	50	50	100	IV	Classroom
23-202-0514	Applied Machine Learning	3	1	0	3	50	50	100	V	Classroom
23-202-0613	Optimization Techniques	3	1	0	3	50	50	100	VI	Classroom
23-202-0614	MOOC I Recommender Systems	0	0	0	3	0	0	100	VI	Online / Classroom
23-202-0719	MOOC II Reinforcement Learning using Python	0	0	0	3	0	0	100	VII	Online / Classroom
23-202-0823	MOOC III Image Analysis using Deep Learning	0	0	0	3	0	0	100	VIII	Online / Classroom

Industry Based Electives

Industry based Electives are offered in 5th, 6th and 7th Semesters and are listed among the Professional Electives with notation (IE) along with the subject code. A student should opt for at least one Industry-based elective during the B.Tech programme.

Open Electives:

Open Electives are offered in 7th and 8th Semesters. A student should opt for at least one Open Elective offered by any Division other than their branch of study.

MOOC:

Every student shall undergo at least one MOOC of minimum 12 weeks duration during the programme (preferably before the final semester) as per the university regulations for conducting online courses (MOOC).

SEMESTER VIII Internship Track

Students who intend to go for Internship Track should inform the division head concerned before the commencement of the 8th semester. The students will be given the option to change the track within30 days from the commencement of the 8th semester.

Students opting for Internship Track have to do Project Phase – II and appear for the Comprehensive Viva-Voce.

The interns may opt for courses recommended by the division from the list of NPTEL/SWAYAM courses approved by the BoS.

The students opting for divisional courses must fulfill the Continuous Assessment (CA) and Semester End Examination (SEE) requirements.

One elective from the Open Elective pool is mandatory if they have not completed one mandatory Open Elective in the seventh semester.

Project Phase –II is the continuation of Project Phase –I completed in the seventh semester or a separate one if approved by the division.

The Internship -IV of minimum six weeks duration must be done based on a valid MoU or in any government/ organization approved by the division.

The Internship-IV is equivalent to two 3-credit courses for a total 200 marks

The progress of Internship-IV will be evaluated twice during the semester, along with the Continuous Assessment tests and finally after the completion of the internship.

Evaluation Pattern for Theory and Practical courses

1. Theory courses

Type of Questions for Semester End Examination (SEE)

PART - A (5 x 2 = 10 marks)
Question No. I (a) to (e) –Five short answer questions of 2 marks each with at least one question from each of the four modules.

PART - B (4x10 = 40 marks)
Question nos. II and III (from Module I) of 10 marks each with option to answer either IIor III. The question may have sub sections (a) and (b*).*

Question nos. IV and V (from Module II) of 10 marks each with option to answer eitherIV or V. The question may have sub sections (a) and (b).

Question nos. VI and VII (from Module III) of 10 marks each with the option to answer either VI or VII. The question may have sub sections (a) and (b).

Question nos. VIII and IX (from Module IV) of 10 marks each with an option to answer either VIII or IX.The question may have sub sections (a) and (b).

The maximum marks that can be awarded for the Semester EndExamination (SEE) will be only 50.

2. Practical courses

50% marks is earmarked for Continuous Evaluation, and 50% marks for Semester End Examination. The Semester End Examination to be conducted by a minimum of two examiners.

3. Pass Requirements

A candidate has to obtain a minimum of 50% marks for continuous assessment andsemester end examination put together with a minimum of 40% marks in the semester end examination for a pass in theory and laboratory courses.

In the case of theory/laboratory/other courses having only continuous assessment, acandidate has to obtain a minimum of 50% marks in continuous assessment for a pass.

SEMESTER 1

23-200-0101B CALCULUS

Course Outcomes:

On completion of this course the student will be able to:

1. *Solve ordinary differential equations and linear differential equations of higher orders with constant coefficient and apply them in engineering problems*
2. *Determine the maxima and minima of multivariable functions.*
3. *Convert line integrals into surface integrals and surface integrals into volume integrals*
4. *Illustrate the physical meaning and application of gradient, divergence and curl.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2									
CO2	3	2	2									
CO3	3	2										
CO4	3	3	2									

1-Slightly; 2-Moderately;3-Substantially

Module I

Ordinary differential equations:

First order differential equations - exact differential equations, Bernoulli's equations--Methods of solution and Simple applications.

Linear differential equations of higher orders with constant co-efficient- Methods of solution of these equations. Cauchy's linear differential equations. Simultaneous linear differential equations- Simple applications of linear differential equations in engineering problems –Electrical Circuits, Mechanical Systems**.**

Module II

Partial differentiation: Partial differentiation-Concept of partial derivative - Chain rule- Total derivative- Euler's theorem for homogeneous functions, Differentials and their applications in errors and approximations, Jacobians - Maxima minima of functions of two variables (Proof of the result not required)-Simple applications.

Co-ordinate systems: Rectangular co-ordinates-Polar co-ordinates-In plane and in Space-Cylindrical polar co-ordinates-Spherical polar co-ordinates.

Module III

Integral calculus:

Application of definite integrals: Area, Volume, Arc length, Surface area.

Multiple integral: Evaluation of double integrals-Change of order of integration. Evaluation of triple integrals- Change of Variables in integrals.

Applications of multiple integrals. Plane Area, Surface area & Volumes of solids

Module IV

Vector calculus: scalar and vector point functions, gradient and directional derivative of a scalar point function, divergence and curl of vector point functions, their physical meaning. Evaluation of line integral, surface integral, and volume integrals, Gauss's divergence theorem, Stoke's theorem (No proofs), conservative force fields, scalar potential.

References:

1. Sastry S.S. Engineering Mathematics: Vol1 (Fourth edition). PHI Learning, New Delhi. (2008).
2. Erwin Kreyzig, Advanced Engineering Mathematics (Tenth edition). John Wiley & Sons, Hoboken, NJ.(2011)
3. Veerarajan T. Engineering Mathematics. (Third edition). Tata McGraw-Hill Publishers, New Delhi. (2011)
4. Grewal B.S .Higher Engineering Mathematics.(Forty third Edition). Khanna Publishers, New Delhi (2013).

23-200-0102B ENGINEERING PHYSICS

Course Outcomes:

On completion of this course the student will be able to:

1. *Interpret modern devices and technologies based on lasers and optical fibers.*
2. *Explain the basic principles of crystal physics*
3. *Summarize the characteristics and applications superconducting materials nanomaterials and smart materials*
4. *Illustrate the theory of semiconductors and magnetic materials*
5. *Understand the principle, concept, working and applications of relevant technologies and comparison of results with theoretical calculations.*

Course Articulation Matrix:

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

1-Slightly;2-Moderately;3-Substantially

Module I

Laser- properties- interaction of radiation with matter- absorption, spontaneous and stimulated emission- principle of laser- Einstein coefficients- population inversion- metastable state -Basic components of a laser- construction and working of Ruby laser and He-Ne laser -Applications.

Fiber optics - Basic structure - principle- step index fiber and graded index fiber- single mode and multimode- Numerical aperture (no derivation) -acceptance angle and acceptance cone- propagation- Applications.

Module II

Crystallography – Space lattice- Basis- Unit cell- Bravais lattices- cubic lattices-sc, bcc, and fcc- Number of atoms per unit cell- Coordination number- Atomic radius-Packing factor- Relation between density and crystal lattice constants- Lattice planes and Miller indices-

Xrays- Production, Properties, characteristic and continuous X-rays, Moseley's law; Diffraction of X-rays- Bragg's law (derivation), Bragg's Spectrometer

Module III

Superconductor-transition temperature- Meissner effect-effect of current- isotope effect- Type 1 and type 2 superconductors –BCS theory (basic idea only)- Applications.

Nanomaterials- nanoparticle, nano ring, nano rod, nanoshells, fullerene- surface occupancy- quantum confinement effect- optical, electrical, magnetic and mechanical properties - Applications.

Smart materials-Liquid crystals, Metallic glasses, Shape memory alloys- optical, electrical magnetic and mechanical properties-applications.

Module IV

Magnetic Materials- Magnetic pole strength, magnetic moment, intensity of magnetization, magnetic field, magnetic induction, magnetic susceptibility, magnetic permeability, classification. Hard and soft- Paramagnetic materials-properties, Diamagnetic materials-properties, Ferromagnetic properties- Antiferromagnetic materials, Ferrimagnetic materials- Applications

Semiconductor- Properties- Energy band description- effect of temperature- intrinsic, extrinsic semiconductors- n-type and p-type semiconductors-Majority and minority carriers.

Laboratory Experiments to be conducted in the virtual lab mode

List of Experiments (Minimum six experiments shall be conducted)

1. Transmission grating: To find the wavelength of laser beam
2. Determination of NA of an optical fiber
3. Laser beam divergence and spot size
4. Determination of Grain size and lattice parameter using Bragg's X-ray spectrum
5. Lattice planes from X Y Z intercepts
6. LCR circuits to find the resonance frequency and quality factor.
7. Diode characteristics
8. Ohm's law
9. LED circuits to find cutting voltage.
10. Determination of Energy band gap of a given semiconductor material
11. Magnetic field along the axis of a circular coil carrying current
12. Deflection Magnetometer

References:

1. S. Mani Naidu, A Textbook of Engineering Physics, Pearson. (2010)
2. A.S. Vasudeva, Modern Engineering Physics, S. Chand & Co. (2013)
3. Prabir K. Vasu and Hrishikesh Dhasmana, Engineering Physics, Ane books Pvt. Ltd. (2010)
4. S.O. Pillai and Sivakami, Applied Physics, New Age International (P) Ltd., Second Edition. (2008)
5. G.S. Raghuvanshi, Engineering Physics, Prentice Hall of India. (2008)

Pattern of Continuous Assessment

Test – I for the theory portions: 15 marks Test -II for the theory portions: 15 marks

Assignment from the theory portions: 5 marks

Laboratory record and Viva-voce: 10 marks (5 + 5)

Attendance: 5 marks

The students are required to submit the laboratory record.

23-200-0103B INTRODUCTION TO ELECTRONICS DEVICES & CIRCUITS

Course Outcomes:

On completion of this course the student will be able to:

1. *To understand the working principle of various semiconductor devices*
2. *To apply the acquired knowledge to the use of semiconductor devices in various applications.*
3. *To design simple electronic circuits for a given application.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2									1
CO2	2	2	2									1
CO3	1	3	1	1								1

1-Slightly;2-Moderately;3-Substantially

Module I:

Semiconductor basics. PN junction diode and its characteristics, Diode Models Diode Applications: Rectifiers- Half wave and full wave rectifiers, Capacitive Filter Clipping and clamping circuits, Special purpose diode: Zener Diode, LED, Photo diode; Zener Shunt, Transistor series regulator

Module II:

Bipolar Junction Transistors (BJT): Transistor Structure, Transistor operation, Transistor characteristics (CE & CB only) and alpha & beta Parameters , r parameter model, h parameter Transistor as an amplifier, Transistor bias circuits: DC operating point, load line, stabilization, Voltage divider bias, Thermal runaway. Transistor switch. FET, FET characteristics

Module III:

Amplifiers: classification of amplifiers as Voltage, Current, transconductance & transresistance amplifiers-properties, operation, CB, CC & CE Amplifiers, bypass and coupling capacitor, common emitter Amplifier, Amplifier Frequency Response: Basic concepts, Low frequency and High frequency response cutoff Total Amplifier frequency Response. FET amplifier (CS configuration only), Multistage amplifier (qualitative study).

Module IV:

Feedback in amplifier, benefits of feedback, positive & negative feedback (qualitative study). Oscillator: RC phase shift oscillator, circuit & its working. LC oscillator Multivibrator: astable multi vibrator, circuit & it's working. Bistable multi vibrators, circuit & its working. Bistable as memory.

References:

1. David M. Buchla, Thomas L. Floyd, Electronics Pearson Education Limited, Year: 2014
2. K V Ramanan, Functional Electronics, Tata McGraw-Hill Publishing Company Ltd. (1984).
3. Donald Neamen, Semiconductor Physics and Devices, Tata McGraw-Hill Publishing Company Ltd., 4th edition (2021).
4. Jacob Milman & Christos C Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, McGraw Hill Education, 2 nd edition (2017).

23-200-0104B INTRODUCTION TO ELECTRICAL ENGINEERING

Course Outcomes

On completion of this course the student will be able to:

1. *Apply elementary principles for finding the DC response of Circuits.*
2. *Develop & solve models of basic magnetic & electromagnetic circuits.*
3. *Apply elementary principles for finding the sinusoidal steady state features of Circuits.*
4. *Familiarize with the basic engineering principles of some common electrical systems.*

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2									1
CO2	2	2	2									1
CO3	1	3	1	1		1						1
CO4	2	1	1			2						1

1-Slightly; 2-Moderately; 3-Substantially

Module I:

Elementary Concepts of Electric Circuits Elementary concepts of DC electric circuits: Basic Terminology including voltage, current, power, resistance, emf; concept of linear, non linear, unilateral, bilateral, active& passive circuit elements, independent voltage & current sources, Interconnection of Resistances- series, parallel, series-parallel, star & deltainter connection, Star-delta/ delta-star transformation; Current and Voltage Division Rules; Capacitance: Parallel plate capacitance with single dielectric, V-I relations and energy stored, Capacitance sin series, parallel & series- parallel; Ohm’s Law and Kirchhoff's laws- Problems.

Introduction to Dynamic Circuits: DC Sourced & Source free Response of RC series circuit, Time Constant, Concept of transient & steady state components of response.

Module II:

Elementary Concepts of Magnetic & Electromagnetic Circuits and AC fundamentals

Magnetic Circuits: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits-Series and parallel magnetic circuits with composite materials, numerical problems.

Electromagnetic Induction: Faraday's laws, Lenz's law- statically induced and dynamically induced emfs, conductor moving in a uniform magnetic field, Self-inductance and mutual inductance, coefficient of coupling, V-I relations of self & mutual inductance, Two winding Transformer, Basic Transformer Equation connecting voltages, currents & number of turns, energy stored in a coupled coil system, Series Connection of coupled Inductances.

Alternating Current fundamentals: Representation of sinusoidal waveforms: frequency, period, cycle, phase, Average, RMS values and form factor of waveforms-Numerical Problems.

Module III:
Sinusoidal Steady State Response:
Sinusoidal Steady Response of Basic Elements: Phasor Representation of sinusoidal quantities, Trigonometric, Rectangular, Polar and complex forms, Response of basic R, L and C elements to a sinusoidal voltage or current–Phasor diagrams, Average power and power factor-Numerical Problems.

Series and Parallel AC Circuits: Reactances, Impedance, Admittance, Solution of series, parallel & series-parallel AC circuits, Power in AC circuits: active, reactive & apparent powers-Numerical Problems, Resonance in series and parallel circuits, Frequency dependence of impedance and admittance, frequency & frequency response plots, half power/cut off frequency, bandwidth

Three phase AC systems: Star and delta connected balanced three phase systems, Phasor diagram, relation between line and phase voltages, line and phase currents, active, reactive & apparent powers-Numerical problems

Module IV: Applications

Dynamic Circuits: Use of simple first & second order resonant/non resonant RLC circuits as low pass, high pass, band pass & band stop filters, RC Differentiator & Integrator

Power Circuits of domestic/Daily Use Appliances: Concept of Linear & non linear AC loads, very basic concept of Power Quality, Functional Block Diagram of the power circuit of modern domestic/daily use appliances-LED Lamps & Tubes, BLDC Fans, Mobile & Laptop Chargers, Inverter Air Conditioner & Inverter Refrigerator, Need & methods of galvanic isolation.

Rechargeable Batteries: Basic Terminology, Battery Capacity, SOC, SOE, SOH DOD, C-rate, Cycle Life, Cut off voltage, deep cycle, Charging Profile, self discharge, Energy Density, Power density, Specific Energy, Specific Power, Purpose & Functions of BMS.

UPS: Functional block diagram, Specifications and Applications of online & offline UPS, computation of back up time.

Power Systems: Various levels of Power Transmission/Distribution- Typical Single line diagram

References

1. Edward Hughes. Electrical technology. Pearson Education 8th ed. 2002.
2. Robert L. Boylestad. Introductory circuit analysis. Pearson Education, 14th edition 2022
3. Cotton, H. Electrical technology. CBS Publishers and Distributors, New Delhi. 7th edition
4. Leonard S. Bobrow. Fundamentals of electrical engineering. Oxford University Press. second edition, 1996

23-200-0105B COMPUTER PROGRAMMING

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify main components of a computer system and explain its working.*
2. *Develop flowchart and algorithms for computational problems.*
3. *Write the syntax of various constructs of C language.*
4. *Build efficient programs by choosing appropriate decision-making statements, loops and data structures.*
5. *Design modular programs using functions for larger problems.*

Course Articulation Matrix

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

1-Slightly;2-Moderately;3-Substantially

Module I

Basics of Computer and Information Technology: Digital Computer System (CPU, Memory, I/O devices) - Working of a digital computer-Hardware and Software: Definition - Categories of Software, Application of Computers.

Problem Solving Methodology: Problem statement, Analysis, Design a solution, Implement/Coding the solution, Test the solution, Design tools (Algorithm, Flow-chart, Pseudo-code)- Develop algorithms for simple problems.

Programming Languages: Types of Languages- Compiler– Interpreter- Linker– Loader– Execution of program.

Module II

Basics of C: Character set-Identifier- Keywords- Constants –Data Types- Variables and declaration –Operators and Expressions – Operator precedence and associativity – Expression Evaluation (Simple Examples) – Input and output functions – Simple computational problems involving the above constructs.

Control Statements: Selection, Conditional operator, Iteration (for, while, do-while), Branching (switch, break, continue, go to), Nesting of control statements- Problems using control statements.

Module III

Arrays: One-dimensional array: Declaration, Initializing and Accessing of Array, Operations with Array, Internal Representation of Array, Working with One-dimensional Array(searching and sorting).

Multi-dimensional array: Declaration, Initializing and Accessing of Array, Working with Two-dimensional Arrays with Matrix.

Strings: Declaration, Initialization and Accessing of String, String Functions, Working with One-dimensional character Array and String Functions.

Functions: Concept of Function, Using Function (Declaration, Definition and Calling), Parameter Passing in C, Inline Function, Recursion, Working with Functions.

Module IV

User defined data types: Structure, Union & Enumerated data type- Declaration, Initialization and Accessing of Structure, Union & Enumerated Data types, Structure versus Union, Arrays of Structure, Working with Structures.

Pointers: Declaration, Initialization & Accessing Pointer– Use of Pointers, Pointer Arithmetic, Arrays and Pointers, Structures and Pointers, Working with Pointers (Pointers to Array: One-dimensional arrays and pointers, Passing an array to a function), Dynamic memory allocation. Command line arguments.

References:

1. Pradip Dey and Manas Ghosh, Computer Fundamentals and Programming, Second Edition, Oxford University Press, (2013).
2. Byron Gottfried, Programming with C, Fourth edition, Tata McGraw-Hill, (2018).
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Second Edition, Pearson Education, (2015).
4. R.G. Dromey, How to solve it by Computer, Pearson Education, (2008).
5. Kanetkar Y, Let Us C: Authentic guide to C programming language (18th Edition), BPB Publications, (2021).

23-200-0106B SOFT SKILLS DEVELOPMENT

Course Outcomes:

On completion of this course the student will be able to:

1. *Use English language at the formal and informal levels for daily conversations, presentations, group discussions and debates.*
2. *Demonstrate the ability to read, comprehend and answer questions based on literary, scientific and technological texts.*
3. *Develop self-motivation, raised aspiration, belief in one's own abilities and commitment to achieving one's goal.*
4. *Demonstrate emotional maturity and emotional health.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						1		2	2	3		
CO2						2		2	2	3		
CO3						1		2	2	2		
CO4						1		2	2	2		

1-Slightly; 2-Moderately; 3-Substantially

Module I

Role and importance of verbal communication – Everyday active vocabulary, common words used in transitions, enhancing vocabulary, affixes and changes in pronunciation and grammatical functions, words often confused in pronunciation and usage. Passage comprehension: skimming, scanning techniques, note making, note taking and summarizing. Deciphering meaning from contexts. Types of meaning: literal and contextual. Constructive criticism of speeches and explanations.

Module II

Fundamental grammar – Simple structures, passivizing the active sentences, reported speech, the judicious use of tenses and moods of verbs, forming questions and conversion from questions to statements and vice versa, forming open-ended and close- ended questions. Words and style used for formal and informal communication. Practice converting informal language to formal, the diction and the style of writing. Dealing with the nuances of ambiguous constructions in language. Learning authoritative writing skills, polite writing and good netiquette. Writing for internships and scholarships. Co-ordinate systems: rectangular co-ordinates, polar co-ordinates – in plane and in space, cylindrical polar co-ordinates, spherical polar co-ordinates.

Module III

Communication – Kinesics, proxemics, haptics, and other areas of non-verbal communication, fighting communication barriers, positive grooming and activities on the same. Different types of interviews and presentation: oral, poster, ppt. organizing ideas for group discussions, the difference between GD and debates. Effective listening and seeking to understand others perspectives. Non-violent negotiation and persuasion, communicating across age groups, cultures

or identity groups. Higher order thinking and evaluation, information seeking, research, and independent learning, synthesis, creativity, problem analysis and problem solving. Decision making, self- reflection and learning from experience.

Module IV

Developing positive self – Understanding oneself, realistic awareness of oneself and one's abilities, strengths and potential, self-esteem, self-efficacy, steps for improvement. Intra-personal skills: self-control, emotional regulation and self-discipline, conscientiousness, dutifulness, reliability, truthfulness, honesty and trustworthiness. Goal orientation and initiative. Time management – characterisation work. Interpersonal skills: cross cultural competence and valuing diversity of perspectives, respecting and expressing concern for others. Empathy and ability to notice the effect of one's actions on others, tolerance for disagreement, conflict management and resolution.

References:

1. Duck, Steve and David T. Macmahan. Communication in Everyday Life. 3rd Ed. Sage, (2017).
2. Gamble, Kawl Teri and Michael W. Gamble. The Public Speaking Playbook. Sage, (2017).
3. Meenakshi Raman, and Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, (2015).
4. Daniel Goleman, Emotional intelligence: Why it can matter more than IQ, Random House (2012).
5. Devadas Menon. Stop sleepwalking through life, Yogi Impressions Books Pvt. Ltd, Mumbai (2013).
6. Barun K Mitra. Personality Development and Soft Skills, Oxford University Press (2012).

ASSESSMENT

- 'Soft Skills Development' is a practical and activity-oriented course which has continuous assessment for 50 marks based on classroom interaction, activities, and assignments. The activities may include 'Just a Minute' (JAM) sessions, group discussion, role play, debate, and extempore speech.
- The weightages for the different components shall be as follows:
    - Classroom interaction – 10 marks Activities – 30 marks
    - Assignments (from Modules I and II) – 10 marks
    - Semester End Examination is not envisaged.
- A student should secure a minimum of 50% marks in continuous assessment for a pass in the course.

23-200-0107B COMPUTER PROGRAMMING LABORATORY

Course Outcomes:

On completion of this course the student will be able to:

1. *Write programs using loops and decision making statements in C language.*
2. *Implement different operations on arrays.*
3. *Solve problems using functions and recursion.*
4. *Design and implement C programs using the concepts of structure and pointers.*

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3		2							1
CO2	3	2	1									1
CO3	3	3	3		3	1						2
CO4	3	3	3		2	1						2

1-Slightly; 2-Moderately; 3-Substantially

Cycle I

Application Packages:

Text Editor

1. To create a word document like an advertisement.

Spreadsheet

2. To create a spreadsheet to analyze the marks of the students of a class and also to create appropriate charts.

Presentation Software

3. To create a presentation for the department using MS PowerPoint.

C Programming Basics:

4. To write a program to calculate and display areas of rectangle and triangle.

Decision Making:

6. To write a program for electricity bill preparation.
7. To write a program to find the roots of a quadratic equation.
8. To write a simple menu driven calculator program using switch statements.
9. To write a program to find the sum of digits of a given number.

Cycle II

Looping:

10. To write a program to print all the prime numbers of a given range.
11. To write a program to print the sine and cosine series.
12. To write a program to print Pascal's triangle.

Arrays:

13. To write a program to print the sum and average of elements in an array.
14. To write a program to sort the given numbers using bubble sort.
15. To write a program to perform Matrix addition and matrix multiplication.

String:

16. To write a program to perform string manipulation functions like string concatenations, comparison, find the length and string copy without using library functions.
17. To write a program to arrange names in alphabetical order.

Cycle III

Functions:

18. To write a C program to calculate the mean, variance and standard deviation using functions.
19. To write a C program to perform sequential and binary search using functions.

Recursion:

20. To write a program to print the Fibonacci series using a recursive function.
21. To write a program to print the factorial of the given number using a recursive function.

Structure:

22. To print the mark sheet of N students using structures.

Pointers:

23. To write a program using pointers to access the elements of an array and count the number of occurrences of the given number in the array.

References:

1. Pradip Dey and Manas Ghosh, Computer Fundamentals and Programming in C, Second Edition, Oxford University Press, (2013).
2. Smarajit Ghosh, All of C, PHI Learning Pvt. Ltd, (2009).
3. Byron Gottfried, Programming with C, Fourth edition, Tata McGraw-Hill, (2018).
4. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Second Edition, Pearson Education, (2015).
5. Sukhendu Dey, Debobrata Dutta, Complete Knowledge in C, Narosa PublishingHouse, New Delhi, (2013).
6. R.G. Dromey, How to solve it by Computer, Pearson Education, (2008).
7. Kanetkar Y, Let Us C: Authentic guide to C programming language (18th Edition), BPB Publications, (2021).

23-200-0108B ELECTRICAL ENGINEERING LAB

Course Outcomes

On completion of this course the student will be able to:

1. *Identify & choose appropriate apparatus for ON-OFF Control, protection diagnosis & instrumentation of a typical LV electrical appliance/circuit.*
2. *Familiarize with various types of electric motors and conventional & smart electrical systems.*
3. *Familiarize with the electrical characteristics of common appliances & solar panels.*

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2									1
CO2	2	2	3									
CO3	1	3	2	2					1			

Details of Experiments

1. Familiarization with various electrical apparatus like switches, relays, smart plugs, smart switches, conventional to smart switch converters, AC & DC Voltmeter, AC & DC Ammeter, Multimeter, Wattmeter, Energy meter, fuse, MCB, Isolator, RCB, ELCB, RCBO
2. Verification of Ohm's Law & Kirchoff's Laws for both DC & AC circuits.
3. Domestic Wiring Circuits with one way/two way switches & plug point.
4. Experimental determination of V-I characteristics, MPP & predetermination of operating point of a solar panel for resistive load.
5. Measurement of Current, Power, Power Factor & Energy of :
   a. A single phase circuit with known parameters
   b. Various domestic/daily use appliances like LED Lamps, LED Tubes, Ceiling fans, Laptop, LED Display, PC+LED Display.
6. Experimental/Simulation based study of an RLC series Circuit under resonant & non resonant conditions.
7. Experimental determination of frequency Response of Circuits.
8. Familiarization with various types of Electrical Machines
9. Experiment on Automatic Street Lighting System.
10. Experiments on Home Automation.

23-200-0109B LANGUAGE LABORATORY

Course Outcomes:

On completion of this course the student will be able to:

1. *Test pronunciation skills through stress on word accent, intonation, and rhythm.*
2. *Use the English language effectively for writing business letters, resumes, minutes of meetings and reports.*
3. *Use the English language effectively to face interviews, group discussions, and public speaking*

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									2	3		2
CO2									2	3		2
CO3									2	3		2

1-Slightly; 2-Moderately; 3-Substantially

The following exercises are prescribed for the **Language Laboratory** sessions:

1. Introduction to the Sounds of English- Vowels, Diphthongs & Consonants.
2. Introduction to Stress and Intonation.
3. Preparing business letters
4. Preparing a resume
5. Conducting a meeting and writing the minutes
6. Writing a report
7. Situational Dialogues / Role Play.
8. Oral Presentations- Prepared and Extempore.
9. 'Just A Minute' Sessions (JAM).
10. Describing Objects / Situations / People.
11. Debate
12. Group discussion

23-200-0110B NSS/NATURE CONSERVATION ACTIVITIES/YOGA

NATIONAL SERVICE SCHEME (NSS)

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify the community in which they work*
2. *Utilize their knowledge in finding practical solutions to individual and community problems.*

A student enrolling as a member of NSS will have to complete 10 hours of training / social service.

NATURE CONSERVATION ACTIVITIES

Course Outcomes:

On completion of this course the student will be able to:

1. *Demonstrate the message of sustainable lifestyles.*
2. *Explain the importance of green plants in mitigating global environmental problems.*
3. *Identify suitable waste management practices for the local community.*

A student enrolling as a member of the Nature Conservation Club will have to complete 10 hours of campus cleaning and greening activities.

YOGA

Course Outcomes:

On completion of this course the student will be able to:

1. *Demonstrate the use of yoga for stress management.*
2. *Illustrate the different yogic postures for physical and mental wellbeing.*
3. *Identify suitable methods of strengthening physical, emotional, intellectual aspects of "self" based on the principles and practices of Yoga and positive psychology.*

SEMESTER 2

23-200-0201B LINEAR ALGEBRA & TRANSFORM TECHNIQUES

Course Outcomes:

On completion of this course the student will be able to:

1. *Solve linear systems of equations and to determine Eigen values and vectors of a matrix.*
2. *Exemplify the concept of vector space and subspace.*
3. *Determine Fourier series expansion of functions and transform.*
4. *Solve linear differential equation and integral equation using Laplace transform.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1										
CO2	3	1										
CO3	3	3	3									
CO4	3	3	2									

1-Slightly; 2-Moderately; 3-Substantially

Module I

Linear Algebra 1: Rank of a matrix, solution of linear system of equations- existence, uniqueness, general form-Eigen values and Eigen vectors- properties of Eigen values - Diagonalization of a matrix - Cayley Hamilton theorem (without proof) Verification-Finding inverse and power of a matrix using it-Quadratic form-orthogonal reduction of quadratic form to Canonical form.

Module II

Linear Algebra 2: Vector space-subspace-Linear dependence and independence-Spanning of a subspace- Basis and Dimension. Inner product- Inner product spaces - Orthogonal and Orthonormal basis – Gram- Schmidt Orthogonalization process. Linear Transformation.

Module III

Fourier Analysis: Periodic function, Fourier series, Functions of arbitrary period, Even and odd functions, Half Range Expansion, Harmonic analysis, Complex Fourier Series, Fourier Integrals, Fourier Cosine and Sine Transform, Fourier Transform.

Module IV

Laplace Transforms: Gamma functions and Beta function-Definition and properties, Laplace transforms. Inverse Laplace Transform, Shifting theorem, Transform of Derivative and Integrals, Solution of differential equation and integral equation using Laplace transform, Convolution, Unit step function, Second Shifting theorem, Laplace transform of periodic function.

References:

1. Erwin Kreyzig. (2010). Advanced engineering mathematics. (Tenth edition). John Wiley & Sons, Hoboken, N.J
2. Grewal, B.S. (2013). Higher engineering mathematics. (Forty third edition). Khanna Publishers, New Delhi.
3. Hsiung,C.Y and Mao, G. Y. (1999). Linear algebra. World Scientific, New Jersey.
4. Hoffman, K. and Kunze, R. (1971). Linear algebra. Prentice Hall of India, New Delhi.
5. Venkataraman, M. K. (1999). Linear algebra. The National Publishing Co, Chennai.

23-200-0202B ENGINEERING CHEMISTRY

Course Outcomes:

On completion of this course the student will be able to:

1. *Explain the basic concepts of chemical thermodynamics, and quantum chemistry.*
2. *Illustrate the spectroscopic methods in characterizing materials.*
3. *Develop electrochemical methods to protect different metals from corrosion.*
4. *Interpret the chemistry of a few important engineering materials and their industrial applications.*
5. *Understand the principle, concept, working and applications of relevant technologies and comparison of results with theoretical calculations.*

Course Articulation Matrix:

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

1-Slightly; 2-Moderately; 3-Substantially

Module I

Chemical Thermodynamics: Fundamentals. First law of thermodynamics, Molecular interpretation of internal energy, enthalpy and entropy. Heat of reaction. Kirchoff's equations. Dependence on pressure and temperature. Gibbs-Helmholtz equation. Free energy changes and equilibrium constant. Chemical potential and fugacity. Thermodynamics of biochemical reactions.

Phase Rule: Terms involved in phase rule and examples, Application of phase rule to one component water system, Application of phase rule to two-component systems. (Simple eutectic systems).

Module II

Quantum Chemistry: Schrodinger wave equation – significance of Ψ, well behaved functions, Postulates of quantum mechanics, Application of quantum mechanics to simple systems - particle in 1 D box, normalization of wave function, Forms of hydrogen atom wave functions and the plots of these functions to explore their spatial variations, Quantum numbers.

Module III

Spectroscopy: Principles of spectroscopy and selection rules. Electronic spectroscopy. Vibrational and rotational spectroscopy of diatomic molecules. Applications.

^{1}H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting - coupling constant - applications of NMR- MRI.

Module IV

Electrochemistry: Cell EMF- its measurement and applications. Nernst Equation and application, relation of e.m.f. with thermodynamic functions (ΔH, ΔF and ΔS). Lead storage battery. Corrosion; causes, effects and its prevention.

Polymers- Classifications- Thermoplastics and thermosetting plastics- A brief account of conducting polymers (polypyrrole and polythiophene) and their applications.

Lubricants- Introduction solid and liquid lubricants- Properties of lubricants-Viscosity index-flash and fire point- cloud and pour point- aniline value.

Refractories: Classifications – Properties of refractories.

Laboratory Experiments to be conducted in the virtual lab mode

List of Experiments (Minimum six experiments shall be conducted)

1. Determination of the partition coefficient of a solute in two immiscible liquids.
2. Phase diagram of two component System (Naphthalene-diphenylamine)
3. Conductometric titration of **S**trong acids with Strong base.
4. Potentiometric titration: Fe^{2+} vs $KMNO_4$
5. Heat of neutralization
6. Verification of Beer-Lambert's law
7. Determination of rate constant of a reaction.
8. Determination of total hardness of water by EDTA method.
9. Determination of COD of water sample.
10. Determination of alkalinity of water.
11. Determination of chloride content of water by Mohr's method.
12. Determination of dissolved oxygen in a given water sample.
13. Determination of acidity of water sample.
14. Determination of adsorption of acetic acid by charcoal.
15. Determination of acidity of water sample

References:

1. B. H. Mahan and R. J. Meyers. University Chemistry, 4th Edition, Pearson publishers. (2009).
2. Peter W. Atkins, Julio de Paula, and James Keele. Physical Chemistry, 11th Edition, Oxford publishers. (2018).
3. M. J. Sienko and R. A. Plane. Chemistry: Principles and Applications, 3rd Edition, McGraw-Hill Publishers. (1980).
4. C. N. Banwell. Fundamentals of Molecular Spectroscopy, 5th Edition, McGraw-Hill Publishers. (2013).
5. B.L. Tembe, M.S. Krishnan and Kamaluddin. Engineering Chemistry (NPTEL Web Course).

6. Shashi Chawla. A Textbook of Engineering Chemistry. Dhanpat Rai & Co, New Delhi.(2013).

Pattern of Continuous Assessment

Test – I for the theory portions: 15 marks

Test -II for the theory portions: 15 marks

Assignment from the theory portions: 5 marks

Laboratory record and Viva -voce: 10 marks (5 + 5) Attendance: 5 marks

The students are required to submit the laboratory record.

23-200-0203B DIGITAL ELECTRONICS

Course Outcomes:

On successful completion of teaching-learning and evaluation activities, a student would able to:

1. *Understand the fundamental Boolean functions and basic building blocks of Digital systems*
2. *Design Optimal digital circuits using basic building blocks*
3. *Analyze Basic digital circuits*
4. *Understand HDL models of simple circuits*

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1									1
CO2	2	2	3									
CO3	1	3	1	2								
CO4	1	1	1	1	3				1			2

1-Slightly; 2-Moderately; 3-Substantially

Module I

Digital Concepts and Techniques: Binary arithmetic, Binary coded Decimal, Excess - 3 code, Gray Code. Boolean algebra-Standard Sum of products, Standard Product of sums. Logic gates. Minimization of Boolean function: Karnaugh Map (up to 5 variables) and Quine - McClusky methods. Variable entered mapping. Design of optimal logic function from a given problem statement.

HDL: Basic concepts and modelling of simple circuits.

Module II

Combinational circuits: Half adder, Full adder, Subtractor, Ripple Carry adder, Carry look ahead adder, BCD adder, multiplexer, demultiplexer, Basic decoder and encoder circuits, Binary Multiplication.

Sequential circuits: Flip-flops – (RS /JK / MS/T / D)

Serial Adder-Difference between Parallel Adder and Serial Adder

HDL: Models of simple combinational circuits.

Module III

Shift Registers: various types - Counters : Asynchronous and synchronous counters, Up-Down counter, Shift Register Counters - Sequence generators

HDL: Models of simple sequential circuits

Module IV

Implementation of logic functions using PLA, PROM. Error Detection and Correction: Parity, (7,4) Hamming code. Practical design considerations: Logic families- Standard logic levels- Current And Voltage Parameters- fan in and fan out-Propagation delay, Noise margin, Speed power product, setup time, hold time.

TTL family NAND gate working principle, Totem pole configuration- Transfer characteristics, Tri-state logic gate.

Note: HDL portion of each module to be evaluated based on assignments ONLY, as part of Continuous Evaluation, subject to a maximum weightage of 50% of marks allocated for assignments

References:

1. Floyd, Thomas L. Digital fundamentals, 11/e. Pearson Education India, 2017. 978-9332584600
2. Kumar, A. Anand. Fundamentals of digital circuits.4/e PHI Learning, 2016. 978-8120352681
3. Stephan Brown & Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, 2/e, McGraw-Hill, 2007, ISBN-13 : 978-0077211646
4. Taub, Herbert, and Donald L. Schilling. Digital integrated electronics. McGraw Hill, India, 2016 978-0070265080
5. Roth Jr, Charles H., Larry L. Kinney, and Eugene B. John. Fundamentals of logic design. Cengage Learning, 2020. 978-9353502645

23-200-0204B OBJECT ORIENTED PROGRAMMING IN C++

Course Outcomes:

On completion of this course the student will be able to:

1. *Understand the basic concepts of Object-Oriented Programming.*
2. *Describe the object-oriented paradigm with concepts of streams, classes, functions, data and objects.*
3. *Implement object-oriented programming constructs like encapsulation, inheritance and polymorphism.*
4. *Understand dynamic memory management techniques using pointers, constructors, destructors, etc.*
5. *Identify classes including data, methods and the relationship among the classes from a given problem statement and solve the problem using object oriented constructs in C++.*

Course Articulation Matrix

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

1-Slightly; 2-Moderately; 3-Substantially

Module I

Procedure oriented programming, Object oriented programming paradigm, Basic concepts of object oriented programming, Benefits of OOP, Introduction to C++ programming, data types, variables, control statements (if, if else, switch), iteration (for, while, do...while). Console I/O operations - formatted and unformatted –managing output with manipulators. Functions in C++, call and return by reference, inline functions, default arguments, const arguments.

Module II

Classes and objects, Specifying a class, Defining member functions, Memory allocation for objects Static data members, Static member functions, Arrays of objects, const member functions Constructors and Destructors, Constructors: default, parameterized, with default arguments, copy constructor, destructors, Friend functions.

Introduction to pointers, new and delete operators, Pointers to objects, this pointer.

Module III

Inheritance: Defining derived classes, Single inheritance, multilevel inheritance, multiple inheritance, Hierarchical inheritance, Hybrid inheritance, Virtual base classes, Abstract classes, Constructors in derived classes.

Polymorphism: Function overloading, operator overloading: overloading unary operators, overloading binary operators, overloading binary operators using friends, manipulation of strings using operators, Type conversions: basic to class, class to basic, class to class.

Module IV

Pointers to derived classes, virtual functions, pure virtual functions.

Working with files: classes for fstream operations, opening and closing of file, detecting end of file, file modes, file pointers and manipulators, sequential input and output operations, random access, Templates, Exception handling.

List of programs to practice:

1. Implementation of classes and objects.
2. Implementation of constructors and constructor overloading.
3. Implementation of methods and method overloading.
4. Implementation of different types of inheritance: Single Inheritance, Multilevel Inheritance, Hierarchical Inheritance, Multiple Inheritance, Hybrid Inheritance.
5. Implementation of polymorphism.
6. Implementation of File handling
7. **Assignment:** Design any real time application using object oriented concepts and develop the solution using the C++programming language. For this the students can form a project team with a maximum 4 members per team. The team can select a socially relevant problem from various domains such as health, safety, education, agriculture, legal etc. At the end of the semester, the team has to demonstrate their product and submit a report. The team will be assessed through rubrics.

Pattern of Continuous Assessment (50 marks)

Test – I for the theory portions: 15 marks
Test -II for the theory portions: 15 marks
Assignment from the Theory: 5 marks
Assignment from the Practice: 10 marks
Attendance: 5 marks
The students are required to submit the practice record.

References:

1. Balagurusamy, E. (2020). Object oriented programming with C++ (8th ed.).Tata McGraw Hill. New Delhi.
2. Lafore, R., & Lafore, R. (2002). Object oriented programming in C++ (4th ed.).Sams Pub.Indianapolis, Indiana.
3. Stroustrup, B. (2013). The C++ programming language (4th ed.). Reading, Mass.: Addison Wesley.
4. Kamthane, A. (2003). Object oriented programming with ANSI and Turbo C++.Pearson Education.Delhi, India.
5. Schildt, H. (2012). C++ the complete reference (5th ed.). Osborne McGraw Hill. Berkeley.

23-200-0205B INTRODUCTION TO CYBER PHYSICAL SYSTEMS

Course Outcomes:

On completion of this course the student will be able to:

1. *Understand the features & components of Cyber Physical Systems*
2. *Understand the elementary constructs of Arduino Software*
3. *Develop optimal programs & circuits for interfacing various sensors with Arduino*
4. *Apply Arduino IDE for developing suitable programs for interfacing sensors & actuators with Arduino & Node MCU*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2									1
CO2	1	2	2									
CO3	1	2	2	2								1
CO4	1	1	1	1	2							1

1-Slightly; 2-Moderately; 3-Substantially

Module-I

Introduction to CPS, Key features of CPS-reactive computation, concurrency, Feedback Control of the Physical World, real time computation, safety critical applications, general structure of a CPS, Examples of CPS.

IoT- Characteristics of IoT, Enabling Technologies, Concept of Transducers/sensors- Primary & Secondary, active & passive, analog & digital, Concept about actuators- thermal, electric & mechanical, IoT stack, Levels of IoT.

Module-II

Arduino Basics: Development Boards-Arduino Uno, Node MCU, Arduino IDE, General Program Structure, Basic data types, variables & constants, Operators, control statements, loops, functions, time functions, arrays.

Module-III

Arduino-I/O functions, Arduino PWM, Arduino Communication, LED Interfacing-Sinking & Sourcing methods of LED Connection, LED blinking, fading, Analog read, LED bar graph display, Seven Segment LED Display, interfacing sensors with arduino-humidity, temperature, water detector, PIR, ultrasonic sensor, LDR, Interfacing Push Button Switch-Pull Up & Pull Down Connection.

Module-IV

Arduino for motor control- Control of DC Motor, Servo motor & Stepper Motor.

Introduction to NodeMCU/ESP32, Overview of NodeMCU and its features, Programming Node mcu via arduino IDE, Interfacing LED, Gas Sensor, Introduction to Wifi Connectivity with Node MCU

References

1. Rajeev Alur Principles of Cyber-Physical Systems, MIT Press 2015
2. Edward Ashford Lee, Sanjit Arunkumar Seshia Introduction to Embedded Systems-A Cyber-Physical Systems Approach-MIT Press 2017
3. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram Internet of Things, WILEY 2020
4. Srinivasa K.G, Siddesh G.M, Hanumantha Raju R Internet of Things, CENGAGE 2018
5. Arduino-Tutorialspoint

23-200-0206B ENVIRONMENTAL AND LIFE SCIENCES

Course Outcomes

On completion of this course the student will be able to:

1. *Identify the global environmental issues*
2. *Examine the types of pollution in society along with their sources*
3. *Elucidate the basic biological concepts via relevant industrial applications and case studies.*
4. *Evaluate the principles of design and development, for exploring novel bioengineering projects.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2				3	3					
CO2	2	2				2	3					
CO3	2	2				2	2					
CO4	2	2				2	2					

1-Slightly; 2-Moderately; 3-Substantially

Module -I

Environment, Ecosystems and Biodiversity: Definition, scope and importance of environment - need for public awareness - concept of an ecosystem - structure and function of an ecosystem - producers, consumers and decomposers - energy flow in the ecosystem - ecological succession - food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) - Introduction to biodiversity definition: genetic, species and ecosystem diversity - biogeographical classification of India - value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels - India as a mega-diversity nation - hot-spots of biodiversity - threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - endangered and endemic species of India - conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems - pond, river, hill slopes, etc.

Module -II

Natural Resources: Forest resources: Use and over-exploitation, deforestation, case studies-timber extraction, mining, dams and their effects on forests and tribal people - Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies - Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies - Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and

desertification role of an individual in conservation of natural resources. The concept of sustainable development.

Environmental Pollution: Definition - causes, effects and control measures of: (a) Air pollution (b) Water pollution and (c) Soil pollution (d) Noise pollution. Management of e-waste.

Module – III

Biomolecules and their Applications (Qualitative): Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics - DNA fingerprinting), Proteins (Proteins as food - whey protein and meat analogs, Plant based proteins), Lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching).

Nature-Bioinspired Materials and Mechanisms (Qualitative): Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swimsuits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).

Module -IV

Human Organ Systems and Bio Designs (Qualitative): Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye). Heart as a pump system (architecture, electrical signalling – ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). Lungs as purification systems (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine). Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis).

Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods.

References:

1. Rajagopalan, R. Environmental Studies: From Crisis to Cure. Oxford University Press, New Delhi, (2015).
2. Erach Bharucha, Textbook of Environmental Studies and Ethics. Universities Press (India), Hyderabad, (2013).
3. Thyagarajan S, Velmurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and JagannathanM.K. Biology for Engineers, Tata McGraw-Hill, New Delhi, (2012).
4. Arthur T. Johnson. Biology for Engineers, CRC Press, Taylorand Francis,(2019).
5. Sohini Singhand Tanu Allen. Biology for Engineers,Vayu Education of India, New Delhi,(2020).
6. Ibrahim Ozbolat.3D Bioprinting: Fundamentals ,Principles and Applications, Academic Press

23-200-0207B DIGITAL ELECTRONICS LAB

Course Outcomes:

On completion of this course the student will be able to:

1. *To understand working of gates, flip flops MUX, DeMUX, Shift registers ,counters etc*
2. *To design digital circuits using appropriate ICs*
3. *To understand the timing diagrams*
4. *To develop teamwork skills*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1									1
CO2	2	2	3									
CO3	1	3	1	2								
CO4	1	1	1	1	3				1			2

1-Slightly; 2-Moderately; 3-Substantially

Experiments:

Introduction to Data sheet of various digital ICs and their familiarization to be given before the hands on sessions

1. Half adder and full adder using standard logic gates / NANDgates.
2. Code converters - Binary to Gray and gray to Binary with mode control
3. Binary addition and subtraction (a) 1's complement (b) 2's complement(using7483)
4. BCD adder using7483.
5. Study of MUX, DeMUX & Decoder Circuits and ICs
6. Set up R-S JK & JK Master slave flip flops using NAND/NORGates
7. Asynchronous UP / DOWN counter using JK Flipflops
8. Design and realization of sequence generators.
9. Study of shift registers and Implementation of Johnson and Ring counters using them .
10. Study of counter ICs 7490, 7492, 7493.
11. Study of seven segment display and decoder driver (7447)- virtual lab

Handson wiring experiments may be supplemented by simulation using CAD tools / virtual labs etc At least 8 experiments must be mandatorily completed by every student and recorded.Students are required to submit a simple project fully conceived, designed and developed by them at the end of the semester

References:

1. Herbert Taub,Donald Schilling, *Digital Integrated Electronics,* Tata McGrawHill, 1/e, (2008), ISBN:9780070265080

23-200-0208B BASIC ELECTRONICS LAB

Course Outcomes:

On completion of this course the student will be able to:

1. *To design and implement simple hardware circuits using electronic devices and digital ICs and to test the performance and its applications.*
2. *To use the basic logic gates and various reduction techniques of digital logic circuit in detail.*
3. *To design simple circuits and mini projects (groups) using sensors and electronic components.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1									1
CO2	1	2	1									
CO3	1	3	1	2					1			

1-Slightly; 2-Moderately; 3-Substantially

Experiments:

1. Familiarization of electronic components and Electronic instruments – Power Supply, Function Generator, CRO, Multimeter.
2. VI characteristics of PN junction diode.
3. Clipping and clamping circuits
4. Design Rectifying circuits: (with and without filter)
   i. Half Wave Rectifier
   ii. Full Wave Rectifier
5. Characterization of Passive Integrator and Differentiator Circuits.
6. Characterization of Transistor CE Configuration.
7. Design CE Amplifier for a particular Gain.
8. Electronic Systems Hardware Familiarization.
9. Introduction to PCB design

References:

1. Jacob Milman & Christos C Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, McGraw Hill Education, 2 nd edition (2017).
2. David M. Buchla, Thomas L. Floyd, Electronics Pearson Education Limited, Year: 2014

SEMESTER 3

23-200-0301B- DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES

Course Outcomes:

On completion of this course, the student will be able to:

1. *Apply complex analysis principles in engineering scenarios, understanding key concepts like analytic functions, Cauchy's theorem, and contour integration.*
2. *Employ linear algebra techniques, such as eigen values and linear transformations, to solve engineering problems and model real-world systems effectively.*
3. *Solve partial differential equations using various methods and apply the solutions to analyze phenomena in engineering, machine learning, and computational biology.*
4. *Utilize advanced differential equations, including wave and heat equations, Alembert's solution, and Fourier series, for modelling and analyzing complex engineering problems.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1		2							1	2	2	2	1
CO2	3	2	2		2							1	2	2	2	2
CO3	3	2	3		2							1	2	2	2	1
CO4	3	2	3	2	2								2	2	2	2

1-Slightly;2-Moderately;3-Substantially

Module I

Analytic Function: Analytic function, Cauchy-Riemann equation (Cartesian and polar), Harmonic function, Construction of analytic function given real or imaginary parts, Conformal mapping of standard elementary function and bilinear transformation. Applications of Analytic Functions in Signal Processing and Image Analysis.

Module II

Complex Analysis: Cauchy's integral theorem, Cauchy's integral formula and for derivatives, Taylor's and Laurent's expansion (without proof), Singularities, Residues, Cauchy's Residues theorem, Contour integration involving unit circle. Advanced Applications of Complex Analysis in Quantum Mechanics and Electrical Engineering.

Module III

Partial Differential Equations: Formation of partial differential equation eliminating arbitrary constants and function, Solution of the first-order equation, Four standard types, Lagrange's equation, Linear homogeneous partial differential equation with constant coefficient. Applications of Partial Differential Equations in Machine Learning and Computational Biology.

Module IV

Advanced Topics in Differential Equations: One-dimensional wave equation, Alembert's solution and one-dimensional heat flow equation, Solution by the method of separation of variables, Application of Fourier series solution, Solution of Laplace's equation over a rectangular region by

the method of separation of variables, Recent Topics: Modern Applications of Wave and Heat Equations in Signal Processing and Materials Science.

The students should be introduced to Computer Algebra Systems (CAS) such as Matlab/Python (utilizing NumPy, SymPy, and SciPy) for both symbolic and numerical calculations. Homework and assignments should be given with the integration of CAS.

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 11th Edition, John Wiley & Sons, (2022).
2. Grewal, B. S., Higher Engineering Mathematics, 45th Edition, Khanna Publishers, (2023).
3. Churchill, R.V. and Brown, J.W., Complex Variables and Applications, 10th Edition, McGraw Hill, (2021).
4. Stroud, K.A. and Booth, D.J., Advanced Engineering Mathematics, 6th Edition, Palgrave Macmillan, (2019).

Case studies for assignment	
Matlab	**Python**
1. Study of Complex functions and operations 2. Differential Equations – Ordinary and Partial 3. Solving Ordinary Differential Equations 4. Solving system of Ordinary Differential Equations 5. Solving Partial Differential Equations	1. Complex Numbers Arithmetic 2. Python Complex Numbers as 2D vectors 3. Solving first-order linear differential equations 4. Plotting Characteristic curves 5. Modeling Infectious disease

23-202-0302 COMPUTER ARCHITECTURE AND ORGANISATION

Course Outcomes:

On completion of this course, the student will be able to:

1. *Acquire knowledge about the structure, functions and characteristics of computer systems.*
2. *Identify the addressing modes used in instructions.*
3. *Determine the set of control signals generated and their timing sequence, given an instruction.*
4. *Demonstrate how addition, multiplication and division operations are implemented inside a computer system.*
5. *Explain each level of memory hierarchy.*
6. *Show how cache mapping affects the data's location and the replacement policies.*
7. *Map a virtual address to a physical address.*
8. *Identify and compare different methods for computer I/O.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1	1							1	3	3	3	2
CO2	3	2	1	1								1	2	2		2
CO3	3	2	1	1	1							1	3	3		2
CO4	3	2	1		1							1	2	3	3	2
CO5	3	2	1	1	1							1	2	3		2
CO6	3	2	1	1	1							1	3	3		2
CO7	3	2	1	1								1	2	3	3	2
CO8	3	2	1	1	1							1	2	3		2

1-Slightly; 2-Moderately; 3-Substantially

Module I

Organisation and Architecture - A Brief History of Computers-The Evolution of the Intel x86 Architecture- Embedded Systems - ARM architecture. Concept of cloud computing. Functions and interconnections: Computer components and functions-Interconnection Structures-Bus Interconnection-Point-to-Point Interconnection - PCI Express.

Module II

Computer Memory System Overview- Characteristics of Memory Systems. The Memory Hierarch Internal Memory: Semiconductor Main Memory Organization - DRAM and SRAM - Types of ROM-Chip Logic

Chip Packaging- Module Organization- Interleaved Memory. DDR SDRAM. Flash Memory-Non-volatile Solid- State Memory Technologies.

External Memory: Magnetic Disk- RAID- Solid State Drives-Optical Memory-Magnet Tape.

Cache Memory: Principles- Cache Addresses - Cache Size - Mapping Function - Replacement Algorithms - Write Policy - Line Size - Number of Caches.

Module III

Input/Output Organisation: External Devices- I/O Modules- Programmed I/O Interrupt- Driven I/O - Direct Memory Access - Direct Cache Access - I/O Channels and Processors - External Interconnection Standard.

Operating System Support: Operating System Overview – Scheduling - Memory Management: Swapping – Partitioning – Paging - Virtual Memory - Translation Lookaside Buffer – Segmentation - Intel x86 and ARM Memory Management

Computer Arithmetic- Arithmetic and Logic Unit - Integer Representation and Arithmetic - Addition and Subtraction – Multiplication - Fast multiplication - Booth's algorithm - Division. Floating Point Representation and Arithmetic - IEEE Standard for Binary Floating-Point Arithmetic.

Module IV

Instruction sets: Representation-Types-Design- Types of operations- Addressing modes- Instruction Formats- x86 and ARM Data types, Addressing Modes and Instruction Formats.

Processor Organization- Register Organization- Instruction Cycle- Instruction Pipelining.

RISC: Instruction Execution Characteristics- Use of a Large Register File- CISC vs RISC Characteristics.

Control Unit: Micro-Operations- Control of the Processor -Hardwired Control Unit.

Microprogrammed Control Unit- Microinstruction Sequencing- Microinstruction Execution.

References:

1. William Stallings, Computer Organization and Architecture Designing for Performance Tenth Edition, 11th Edition, Pearson Education, ISBN: 978-9356061590.
2. Carl Hamacher, Naraig Manjikian, Safwat G. Zaky, Zvonko G. Vranesic, Computer Organization and Embedded Systems, 6th Edition,McGraw Hill Education (India) Private Limited. ISBN: 9780071089005.
3. John P. Hayes, Computer Organization and Architecture, 4th Edition, McGraw Hill, 2003, ISBN-13: 978-0072320886.
4. David A. Patterson and John L. Hennessy, Computer Organization and Design, The Hardware / Software Interface, 5th Edition, Morgan Kaufmann, 2013, ISBN: 978-0-12- 407726-3.

23-202 -0303- DISCRETE COMPUTATIONAL STRUCTURES

Course Outcomes:

On completion of this course the student will be able to:

1. *Apply mathematical logic and prove assertions using different proof techniques.*
2. *Model computational problems using concepts of sets, relations and functions.*
3. *Solve counting and enumeration problems using techniques like pigeonhole principle, recurrence relations.*
4. *Represent discrete computational structures using graphs and trees, and analyze their properties.*
5. *Apply algorithms like Fleury's over graphs to solve problems.*
6. *Explain the structural characteristics of algebraic structures like groups, rings, lattices.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2								1	3			
CO2	3	3	1	1								1	3			
CO3	3	3	1	2								1	2			
CO4	3	3	1	2								1	2			
CO5	2	1	1	2									1			
CO6	3	3	1	1								2	2			

1-Slightly; 2-Moderately; 3-Substantially

Module I

Mathematical Logic: Propositions, Connectives, Equivalences of Proposition, Algebra of Propositions, Quantifiers, Proofs: Direct, Contraposition, Contradiction, Resolution, Mathematical Induction, Sets, Relations: Properties, Representation, Composition of Relations, Equivalence Relation, Functions: Types, Composition of Functions.

Module II

Counting techniques: Counting Principle, The Pigeonhole Principle, Recurrence Relations, Order of Recurrence Relation, Linear Recurrence Relation with Constant Coefficients, Linear Homogeneous Recurrence Relation with Constant Coefficients.

Module III

Graphs: Definition and terminology, Representation of graphs, Multigraphs, Bipartite graphs, Planar graphs-Properties of planar graphs, connectivity, matching, graph coloring, Isomorphism of graphs, Euler and Hamiltonian paths and graphs, Fleury's Algorithm. Trees: Introduction to Trees, Binary Trees, and Spanning Trees.

Module IV

Algebraic Structures: Semigroups and Monoids, groups, subgroups, homomorphisms, Isomorphisms, Rings, Field. Posets, Hasse Diagrams, Maximal-Minimal Element, Least Upper

Bound (LUB), Greatest Lower Bound (GLB), Lattice: Bounded Lattice, Sublattices, Isomorphic Lattices, Distributive Lattice.

References:

1. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", McGraw-Hill Education, 8th Edition)
2. Eric Lehman, F. Thomson Leighton and Albert R. Meyer, "Mathematics for Computer Science", CreateSpace Independent Publishing Platform, 2017.
3. Ralph P. Grimaldi.(2014), Discrete and Combinatorial Mathematics: An applied introduction, Pearson Education Limited
4. Veerarajan, T., Discrete Mathematics with Graph Theory and Combinatorics, McGraw-Hill Education.

23-202 -0304- DATA STRUCTURES AND ALGORITHMS

Course Outcomes

On completion of this course the student will be able to:

1. *Explain the important features of data structures like arrays, linked lists, trees and graphs.*
2. *Define advanced data structures such as balanced search trees, hash tables, skip lists etc.*
3. *Develop applications using the data structures.*
4. *Describe and compare the performance of various sorting algorithms.*
5. *Describe algorithms on trees and graphs such as traversals, shortest path and minimum spanning tree.*
6. *Understand the searching using hashing.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3							2					3		2	
CO2	3		3	3				2				3	3		3	
CO3	2	3	3		1			2					3		3	
CO4			3	3				2				3	3		2	
CO5			3	3	1			2				2	3		2	
CO6		3	2	3				2				2	3		2	

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to Data structures – Arrays- one dimensional and two dimensional- - representation. Linked lists- singly, doubly and circular- Applications of linked lists. Implementation of Stacks using arrays and linked lists-Conversions between infix, prefix and postfix. Evaluation of postfix expression. Queues-linear and circular- implementation-priority queues.

Module II

Binary trees –Definition and mathematical properties. Representation – sequential, linked
Binary Search trees. Binary tree traversals – pre-order, in-order & post-order, Expression trees. Threaded binary trees. Balanced BST-AVL trees- Heap- Minimum and maximum heap-Tree based indexing B trees and B+ trees.

Module III

Graphs – Graph representation using adjacency matrices and lists – Graph traversals – DFS, BFS - shortest path – Dijkstra's algorithm, Minimum spanning tree – Kruskal Algorithm, Prims algorithm

Module IV

Hashing- Hash tables, Hashing functions, Collision resolution techniques. Sorting- Insertion, Quick, Merge, Heap, Topological sorting. Skip lists-Associative arrays.

References:

1. Robert Lafore, Data structures and algorithms in JAVA, 2 nd Edition, Pearson, ISBN: 978-8131718124.

2. Michael T. Goodrich, Roberto Tamassia, Data structures and Algorithms in Java, 4th Edition, John Wiley & Sons, Inc.
3. Aaron M. Tanenbaum, Moshe J. Augenstein, Yedidyah Langsam, Data Structures using Java, Pearson Education, 2003, ISBN 13: 9780130477217.
4. Narasimha Karumanchi, Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles" July 2023, ISBN 978-8193245286
5. Jean Paul Tremblay and Paul G Sorenson, An introduction to Data Structures with Applications, McGraw-Hill Education, 2017. ISBN 978-0074624715
6. Clifford A. Shaffer, Data structures and Algorithm analysis in Java, Third Edition, Dover Publications, 2012, ISBN 97804864858127.

23-202 -0305- PRINCIPLES OF PROGRAMMING LANGUAGES

Course Outcomes:

On completion of this course the student will be able to:

1. *Summarize the evaluation criteria for programming languages.*
2. *Familiarise notations to describe syntax and semantics of programming languages.*
3. *Compare different programming paradigms – imperative, object oriented, functional and logical Programming and choose the appropriate one for problem solving.*
4. *Analyze and explain behaviour of imperative languages using concepts like binding, scope and lifetime, referencing environment, subprograms and parameter passing mechanisms.*
5. *Explain the concepts of object oriented, functional and logic programming for solving problems.*
6. *Explain the design issues involved in various constructs of programming languages.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1									1		1			3	
CO2	2											2			3	
CO3	2	3	3	3						1		2	3		3	
CO4	3	3	3	3									3		3	
CO5	3	3	3	3									3		3	
CO6	3	2	3	3											3	

1-Slightly; 2-Moderately; 3-Substantially

Module I

Programming domains, Language Evaluation Programming paradigms - Imperative programming, Functional programming, Object oriented programming, Logic programming. Formal methods of describing syntax and semantics - Backus Naur Form, Attribute grammars. Describing semantics - Denotational semantics.

Module II

Data types, Names, Variables, Bindings, Scope and lifetime, Referencing Environments-Named Constants-Variable Initialization-Subprograms-Parameter Passing – Co routines.

Module III

Data abstraction and encapsulation, Polymorphism and inheritance, Features of object-oriented languages - Smalltalk, C++ and Java, Design and implementation issues, Exception handling.

Module IV

Functional programming languages - Lambda calculus - Introduction to pure LISP, Application of functional programming languages, Logic programming languages - a brief introduction to predicate calculus – Horn clauses - Logic programming, Introduction to Prolog, Applications of Logic programming.

References:

1. Robert W. Sebesta, Concepts of Programming Languages, 10th Edition, Addison Wesley.

2. Ravi Sethi, Programming Languages - concepts and constructs, 2nd Edition, Addison Wesley.
3. Michael L. Scott, Programming Language Pragmatics – 3rd Edition, Morgan Kaufmann.
4. Kenneth C. Louden, Programming Languages: Principles and Practices, 3rd Edition, Thomson Learning.
5. Terence W. Pratt, Programming Languages, 4th Edition, Prentice Hall.
6. Bjarne Stroustrup, Design and Evolution of C++, Addison Wesley.

23-202 -0306-AUTOMATA LANGUAGES AND COMPUTATIONS

Course Outcomes:

On completion of this course the student will be able to:

1. *Design a minimized Deterministic Finite Automata.*
2. *Analyse and generate regular expressions for any structure.*
3. *Demonstrate that a given language is regular or not.*
4. *Design new context free grammar.*
5. *Design Push Down Automata for any context free grammar.*
6. *Analyse and design turing machines for any problem.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2													
CO2	1	2	2													
CO3	1															
CO4	2	2	2													
CO5	2	2	3													1
CO6	2	2	3													1

1-Slightly; 2-Moderately; 3-Substantially

Module I

Finite state systems: NFA, DFA, Definitions. Equivalence of NFA and DFA, NFA to DFA conversion, NFA with epsilon transitions, Elimination of epsilon transitions, Minimization of Finite Automata, Finite Automata with output. Designing Moore and Mealy machines.

Module II

Regular Expressions: Definitions, Equivalence of regular expression and finite automata, Conversion between regular expression and DFA, Arden's Theorem, Pumping Lemma of regular languages and its application, closure properties of Regular sets, Applications of regular expressions: Expressions in UNIX, lexical analysis. Regular grammars: equivalence of regular grammar and FA, converting regular grammar to Finite Automata, Converting Finite Automata to regular grammar.

Module III

Context Free grammars (CFG): Definition, Derivations, parse trees, ambiguity, Simplification of CFG, Conversion to Normal Forms: Chomsky, Greibach. Pumping lemma for Context free languages, application of pumping lemma, Closure Properties of CFL, decision algorithms for CFL. Pushdown Automata: Definition, Design examples, Equivalence of acceptance by final state and empty stack, Equivalence of PDA and CFG.

Module IV

Turing machine (TM): Model of TM, Design examples, Techniques for construction of TM: storage in the state, multiple tracks ,subroutines, multi-tape .Church's Thesis, Universal TM Recursive and recursively enumerable languages, halting problem of TM, Decidable and Undecidable problems. Problem reduction. Introduction to Linear Bound Automata and Context Sensitive Grammars, Chomsky Hierarchy.

References:

1. Hopcroft J. E., Motwani,R. and Ullman J. D., Introduction to Automata Theory, Languages, and Computation, 3rd Edition, ISBN : 978-03-214-5536-9.
2. Padma Reddy, A.M., Finite Automata and Formal Languages, 1st Edition, Pearson Education,ISBN 978-81-317-6047-5.
3. Mishra, K.L.P. and Chandrasekaran, N., Theory of Computer Science, Automata, Languages and Computation, 3 rd Edition, PHI, 2014, ISBN 978-81-203-2968-3.
4. Peter Linz, An Introduction to Formal Languages and Automata, 4th Edition, Narosa Publishing Co., ISBN 978-81-7319-781-9
5. Sivadandam S. N., Janaki Meena, M., Theory of Computation, I. K. International Publishing House, 1 st Edition, ISBN 978-93-80026-20-6.
6. John.C. Martin, Introduction to Languages and the theory of computation, 3rd Edition, Tata McGraw-Hill, ISBN 978-0-07-066048-9.

23-202 -0307-DATA STRUCTURES LABORATORY

Course Outcomes

On completion of this course the student will be able to:

1. *Write the syntax of Java language constructs.*
2. *Write a Java program.*
3. *Implement data structures like arrays, stacks, queues, linked lists, trees and graphs.*
4. *Implement various searching & sorting algorithms like quick sort, merge sort and binary search.*
5. *Design a data structure and algorithm for a problem for maximum efficiency.*

Course Articulation Matrix:

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

1-Slightly; 2-Moderately; 3-Substantially

Cycle-I

1. Simple programming exercises in Java.
2. Implementation in Java for Stacks – various applications.
3. Implementation in Java for Queues-Linear and circular.
4. Implementation in Java for Dequeue.

Cycle-II

1. Implementation in Java for Linked Lists- Singly linked and doubly linked.
2. Implementation in Java for Trees –Binary search tree and threaded binary trees.

Cycle-III

1. Implementation in Java programming language for Graphs- Traversals, Minimum spanning trees.

Cycle- IV

1. Implementation in Java for Searching and Sorting algorithms.

References:

1. Robert Lafore, Data structures and algorithms in JAVA-Second edition, Pearson, ISBN: 978-8131718124.
2. Herbert Schildt, Java The complete reference, 10 th edition, Mc Graw-Hill, 2017, ISBN: 9789387432291.
3. Balaguruswamy, Programming with JAVA, a primer, 7 th Edition, McGraw-Hill, 2023 ISBN: 978- 9355325891.

23-202 -0308- OBJECT ORIENTED PROGRAMMING LABORATORY

Course Outcomes

On completion of this course the student will be able to:

1. *Familiarise with the language environment.*
2. *Develop object oriented programming style and compare that with structured style of programming.*
3. *Plan and decide appropriate oops features for the problems in hand.*
4. *Create a complete class definition with constructors and methods and to instantiate it.*
5. *Design efficient programs by incorporating oops features like operator overloading, virtual functions, different ways of inheritance structures etc.*
6. *Develop programs that can read and write data to and from secondary storage.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2		1										1	2	2	
CO2	2	2											1			
CO3	2	1												2	2	
CO4	2	2											1	2		
CO5	2	3	2		2								3			
CO6	2	2											1	2		

1-Slightly; 2-Moderately; 3-Substantially

Cycle-I

1. Programs to differentiate between struct and class.
2. Programs to implement data abstraction, data encapsulation and information hiding.
3. Programs to demonstrate parameter passing techniques.

Cycle-II

1. Programs to implement different Inheritance structures - Single, multiple, multilevel, and hierarchical.
2. Programs to implement Operator overloading and function overloading.
3. Programs to implement conversions- basic to class, class to basic, class to class.

Cycle-III

1. Programs to implement virtual functions and dynamic binding.
2. Programs to implement Files.

References:

1. Balagurusamy, E., Object Oriented Programming with C++, 8 th Edition, 2020, Tata McGraw Hill.,ISBN: 978-9389949186
2. Robert Lafore, Object Oriented Programming in Turbo C++, 4 th Edition, Galgotia, ISBN-13: 978-8185623221.
3. Bjarne Stroustrup, The C++ Programming Language, 4 th Edition, Addison Wesley. ISBN-13: 978-0275967307.

23-202 -0309 – INTERNSHIP-1

Course Outcomes:

On completion of this course the student will be able to:

1. *Understand the real time technical/managerial skills required and relevant to the subject area of internship.*
2. *Initiate a habit of proper daily diary writing with adequacy and quality of information recorded, drawing, sketches and data, thought process and the proper organization of the information gained during the internship.*
3. *Conceive the pros and cons of working in a real time industrial / incubation/ innovation /entrepreneurship/lab environment and the wonderful results which could evolve through team-work.*
4. *Present and defend self-prepared and corrected internship report (with the help of internship guide) of a self-created work to a peer audience.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	1	1			2	1		2	2	2	1	2
CO2	2	3	1	2	2	1			2	2	1	1	2	2		1
CO3	2	2	3	2	2	1			2	2	1	1	2	2		2
CO4	2	2	2	3	2	1			2	2	1	1	2	2		1

1-Slightly;2-Moderately;3-Substantially

Internship Guidelines

During the summer vacations, after the 2nd Semester, students are required to be involved in Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the University; contribution at incubation/ innovation /entrepreneurship cell of the University; participation in conferences/ workshops/ competitions etc.; Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop; Working for consultancy/ research project within the institutes and Participation in all the activities of Institute's Innovation Council for eg: IPR workshop/Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.

A committee consisting of the Internship Coordinator (nominated by the Head of the Department/Division), faculty mentor, and at least one senior faculty member at the level of Associate Professor or above will carry out the final review. Training Certificate from the Inter/ Intra Institutional Activities from the concerned department/lab as mentioned above for the prescribed period shall be submitted at the end of the internship which can be considered as evidence for the Internship-1.

Guidelines for evaluation:

1. Regularity and progress of work 10
2. Work knowledge and Involvement 10

3.	Semester End presentation and oral examination	10
4.	Level of completion of internship	10
5.	Internship Report – Presentation style and content	10
Total		**50** Marks

SEMESTER IV

23-200-0401B - NUMERICAL AND STATISTICAL TECHNIQUES

Course Outcomes:

On completion of this course, the student will be able to:

1. *Comprehend foundational concepts in numerical analysis, statistical methods, and machine learning, including understanding the importance of numerical methods and statistical techniques in problem-solving.*
2. *Apply various numerical methods and statistical tests to solve algebraic and transcendental equations, analyze data, and draw inferences about populations and samples.*
3. *Evaluate and compare the efficiency of numerical techniques in solving engineering problems, demonstrating analytical skills in differentiation, integration, and solving ordinary differential equations.*
4. *Apply advanced statistical and machine learning techniques using Pandas for data exploration and processing, showcasing proficiency in descriptive statistics, regression analysis, and the implementation of basic machine learning models.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	1	1						1	2	2	1	
CO2	2	3	1	2	2	1						1	2	2		
CO3	2	2	3	2	2	1						1	2	2		
CO4	2	2	2	3	2	1						1	2	2		

1-Slightly; 2-Moderately; 3-Substantially

Module I

Fundamentals of Numerical Analysis: Understanding Numerical Methods, Importance in Problem Solving, Error Analysis and Approximations. Numerical solution of algebraic and transcendental equations: Bisection, Newton-Raphson, Secant and Successive Iteration Method. System of Equations: Gauss-Seidel Iteration (Convergence without proof). Interpolation and Approximation: Polynomial, Lagrange, Newton's Forward/Backward/Divided-Difference, and Least Squares. Taylor's Theorem: Taylor series expansion, Taylor Polynomial and Maclaurin Series.

Module II

Numerical Differentiation at Tabulated Points: Forward, Backward, Central Differences. Numerical Integration: Trapezoidal, Simpson's, Gaussian Quadrature. Ordinary Differential Equations (ODEs): Initial Value Problems- Euler's Method, Runge- Kutta (2nd & 4th Order), Boundary Value Problems-Finite Difference Method (First & Second Order BVPs).

Module III

Statistical Concepts and Tests: Random Variables, Expectation, Mean, Variance. Probability Distributions: Binomial, Poisson, Normal. Statistical Inference: Population, Sample, Sampling Distributions (Mean & Variance). Hypothesis Testing: Level of Significance, Z-Test, Chi-Square Tests (Variance & Goodness of Fit), F-Test.

Module IV

Descriptive Statistics and Regression Analysis. Overview of Descriptive Statistics. Regression Analysis of Numerical Data. Regression Analysis of Categorical Data. Visualization of Data Trends. Basic Concepts of Machine Learning: Introduction to Supervised Learning, Overview of Classification and Regression, Introduction to Unsupervised Learning: Clustering. Utilize Pandas for data exploration and processing.

The students should be introduced to Computer Algebra Systems (CAS) such as Matlab/Python (utilizing NumPy, SymPy, and SciPy) for both symbolic and numerical calculations. Homework and assignments should be given with the integration of CAS.

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 11th Edition, John Wiley & Sons, (2022).
2. Grewal, B. S., Higher Engineering Mathematics, 45th Edition, Khanna Publishers, (2023).
3. R.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 7th Edition, New Age International Publishers, (2022).
4. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 10th Edition, Cengage Learning, (2023).
5. Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 3rd Edition, O'Reilly Media, (2022).
6. Andreas C. Muller, Sarah Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists, 2nd Edition, O'Reilly Media, (2021).

Case studies for assignment	
Matlab	**Python**
1. Determination of roots of a polynomial 2. Determination of polynomial using Least-square method 3. Finding Taylor and Maclaurin Series Expansion 4. Solution of differential equation using Euler method 5. Solution of differential equation using 4^{th} order Runge- Kutta method	1. Finding roots of functions 2. Numerical differentiation 3. Numerical Integration 4. Probability distributions 5. Regression Analysis

23-202 -0402 - OPERATING SYSTEMS

Course Outcomes:

On completion of this course the student will be able to:

1. *Familiarize with the basic concepts of operating systems.*
2. *Analyze various scheduling algorithms and process synchronization.*
3. *Gain knowledge about memory management and virtual memory concepts.*
4. *Explain the functionality of file systems, I/O systems, Security and Protection mechanisms.*
5. *Visualize the problems related with deadlocks, deadlock prevention and deadlock handling.*
6. *Compare different types of operating systems.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1										3				
CO2	2	1	3										3	2		1
CO3		3	2	1									3			1
CO4		2	3		1								1			
CO5		3	2	1								2	2			
CO6	1	3	2									2				

1-Slightly;2-Moderately;3-Substantially

Module I

Introduction to Operating Systems. Operating system concepts – System calls – Operating System Structure. Processes - Interposes Communication – Race Conditions - Critical Sections – Mutual Exclusion - Busy Waiting - Sleep And Wake Up -Semaphores - Monitors - Message Passing. Process Scheduling – First come First Served - Shortest Job First - Priority scheduling - Round Robin Scheduling - Multiple queues scheduling – Guaranteed scheduling - Two- level scheduling.

Module II

Memory management. Multiprogramming and memory usage - Swapping - multiprogramming with fixed and variable partitions - Memory management with bitmaps, linked lists, Buddy system - Allocation of swap space. Virtual memory - paging and page tables, Associative memory - Inverted page tables. Page replacement algorithms – Segmentation.

Module III

File systems and Input/output. Files - Directories - File system implementation - Security and Protection mechanisms. Principles of I/O hardware - I/O devices - Device controllers - DMA. Principles of I/O software - Interrupt handlers - Device drivers - Disk scheduling - Clocks and terminals. I/O Buffering - RAID- Disk Cache.

Module IV

Deadlocks - Conditions for deadlock. Deadlock detection and recovery. Deadlock avoidance - resource trajectories - safe and unsafe states – Banker's algorithm. Deadlock prevention. Two phase locking – Non-resource deadlocks - Starvation. Case Study: Mobile Operating System: iOS and Android.

References:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, “Operating Systems Concepts”, Tenth Edition, John Wiley & Sons, 2021, ISBN-13: 978-1119800361.
2. Andrew S Tanenbaum, Herbert Bos “Modern Operating Systems” , Fifth Edition, Pearson Education India, 2022. ISBN-13: 978-0137618880.
3. William Stallings, “Operating Systems: Internals and Design Principles”, Ninth Edition, Pearson Education, 2018, ISBN-13: 978-0137516742.
4. Garry Nutt, Nabendu Chaki, Sarmistha Neogy, “Operating Systems”, Third Edition, Pearson Education, 2012.
5. D.M.Dhamdhere, “Operating Systems: A Concept Based Approach”, 3rd Edition, Tata McGraw Hill, 2017, ISBN-13: 978-1259005589, 13: 978-0070702035.

23-202 -0403 – DATABASE MANAGEMENT SYSTEMS

Course Outcomes:

On completion of this course the student will be able to:

1. *Outline the characteristics and features of database systems.*
2. *Represent the components and relations through an ER diagram and convert that to relational model.*
3. *Familiarise with the storage structures, accessing methods and indexing techniques.*
4. *Formulate relational algebra queries and SQL query and refine it with procedures, cursors etc.*
5. *Improve the database design by applying normalisation techniques.*
6. *Discover the basic issues of transactions and concurrency control of them.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	3	1												2
CO2	3	2	3	1												3
CO3	3	3	3	3												3
CO4	3	3	2	3												3
CO5	3	3	2	3												3
CO6	3	2	2	3												3

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction: Characteristics of the Database approach - Data models, schemas and instances - DBMS architecture - Data modelling using Entity - Relationship (ER), Entity sets, attributes and keys - Relationships, Relationship types, roles and structural constraints - Weak Entity types - Enhanced Entity - Relationship (EER) and object modelling. Sub classes, super classes and inheritance - Specialization and generalization.

Module II

Record storage and file organizations: Fixed length and variable length records- Spanned Vs Unspanned records - Heap files, Sorted files. Hashing Techniques: Internal, External. Indexed structures for files - single level ordered index, multi- level indexes.

Module III

The Relational model: Concepts-Relational model constraints - The Relational Algebra. Functional Dependencies - Basic definition - Trivial and Nontrivial dependencies - First, Second and Third normal forms - Boyce - code normal form. SQL - Commands - Group By & Order By - Cursor - Procedure & Function - Trigger - Views.

Module IV

Transaction Management - introduction, problems and failures in transaction, Desirable properties of transaction - characterizing schedules based on recoverability and serializability - Concurrency Control with two phase locking methods - Concurrency Control with Time Stamping - Database Recovery Management: Deferred update-immediate update-shadow paging- Aries recovery

algorithm

Next Generation Databases: Distributed Relational Databases – Nonrelational Distributed Databases - MongoDB Sharding and Replication - Hbase - Cassandra – CAP Theorem.

References:

1. Elmasri and Navathe, Fundamentals of Database Systems, 5th Edition, Addison - Wesley, 2011.
2. Peter Rob Carlos Coronel, Database Systems, Design, Implementation & Management, 5th Edition, Thomson Course Technology.
3. Silberschatz, A., Korth, H.F. and Sudarshan, S., Database System Concepts, 4th Edition, Tata McGraw Hill, 2002.
4. Thomas Connoly, Carolyn Begg, Database Systems, 3rd Edition, Pearson Education.
5. Date C.J, An Introduction to Database Systems, Addison - Wesley.
6. Margaret H. Dunham, Data Mining - Introductory and advanced topics, Pearson Education, 2003.

23-202 -0404 – DATA AND COMPUTER COMMUNICATION

Course Outcomes:

On completion of this course the student will be able to:

1. *Explain and calculate digital transmission over different types of communication media.*
2. *Describe the principles of access control to shared media and carry out performance calculations.*
3. *Solve issues in networking by referring to problem solving steps through relevant information by choosing suitable techniques.*
4. *Explain the role of protocols in networking.*
5. *Analyse the services and features of various communication devices.*

Course Articulation Matrix:

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

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to Data Communications and Computer Networks, The Internet, Protocols and Standards, Network Models, Layered Tasks, The OSI Model, Layers in the OSI Model, TCP/IP Protocol suit. Addressing. Data and Signals: Analog and Digital, Periodic Analog Signals, Digital Signals, Noise, Transmission impairments, Data Rate Limits - Nyquist's and Shannon's capacity equations, Performance, Digital Transmission: Digital data over Digital channel, Analog data over Digital channel, Analog Transmission: Analog data over Analog channel, Digital data over Analog channel.

Module II

Bandwidth utilization: Multiplexing and Spreading, Multiplexing, Spread Spectrum, Transmission Media: Guided Media, Unguided Media: Wireless, Switching, Circuit - Switched Networks, Datagram Networks, Packet Switching Virtual - Circuit Networks, Structure of a Switch, Using Telephone and Cable Networks for Data Transmission, Telephone Networks, Dial-up Modems and modem standards, Digital Subscriber Line - different DSL technologies, Cable TV Networks, Cable TV for Data Transfer -FTTH.

Module III

Data link Control: Error Detection and Correction: Block Coding, Linear Block Codes, Hamming distance, Cyclic Codes, Checksum – CRC - capabilities of CRC, FEC: Hamming code, constant ratio code, convolutional code-threshold decoding, Sequential decoding, Viterbi decoding. Error and flow control methods: Framing-Piggybacking- ARQ implementations - Stop and wait, Go-back-n, Selective repeat-Link utilisation and efficiency of ARQ methods.

Data Compression: Simple coding schemes, Frequency-based coding - Huffman coding, Relative encoding, Run-length encoding, LZW compression - Image and video compression standards. Framing- bit- oriented and character-oriented- Data link Control Protocols- HDLC -PPP.

Module IV

Media Access Control (MAC) -ALOHA-CSMA-CSMA/CD-CSMA/CA. Controlled Access-Reservation- Polling-Token Passing-Channelization-FDMA-TDMA-CDMA. Network Topologies - Mesh, Star, Tree, Ring, Bus, Hybrid. Connecting devices: Passive hubs, Repeaters, Active hubs, Bridges, Two-layer and Three-layer switches, Routers, Gateway. IEEE Ethernet Standards, Standard Ethernet, Changes in the Standard, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet - IEEE 802.11, Bluetooth.

References:

1. Behrouz A. Forouzan, Data Communications And Networking With TCP/IP Protocol Suite, 6th Edition, McGraw Hill, 2022.ISBN: 978-1-260-59782-0
2. Andrew S. Tanenbaum and David J. Wetherall, Computer Networks, 5th edition, Prentice Hall, ISBN-13 978-0-13-212695-3.
3. William Stallings, Data and Computer Communication, 10th Edition, Pearson Education, 2006. 978-0133506488.
4. Fred Halsall, Data Communication Computer Network and Open Systems, 4th Edition, Pearson Education.
5. William Stalling, Wireless Communication and Networks, 2nd Edition, Pearson Education, 2004ISBN: 978-0-13-191835-1.
6. William A. Shay, Understanding Data Communication & Networks, 2nd Edition, Thomson Learning, 2003, ISBN: 978-0-53-420244-6

23-202 -0405 - OBJECT ORIENTED SOFTWARE ENGINEERING

Course Outcomes:

On completion of this course the student will be able to:

1. Compare and classify various software process / life cycle models.
2. Analyze structured vs object oriented modelling.
3. Illustrate various techniques in software quality assurance.
4. Analyze various principles of software project management.
5. Compare and classify the new trends in life cycle models in industry.
6. Analyze and make use of any one testing tool used in the industry.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3		2	2		2			3		2			
CO2	2	3	3		3			2			3		2	2		
CO3	2	1	2		3			2	3	3	3	2		3		
CO4	3	3	2		3	2		3	3	3	3	2		3		
CO5	2	3	3		2	2		2			3	2		3		
CO6	2	1	2	3	3			2			3			3		

Module I

Software Life Cycle - Waterfall model – Prototyping – Spiral model - Agile development - pros and cons of each model. Requirements Analysis - SRS – Introduction to Structured analysis and design techniques - Introduction to Object oriented analysis and design techniques.

Module II

Software Design: High level Vs Low Level design- Types of design-Data, Architecture, interface and Component designs-Design Heuristics – Cohesion and Coupling. Concepts of user interface design best practices-Trends in UI/UX development- Low code/No code development- Architectural styles - Use case analysis - Introduction to UML diagrams - case studies - ATM system design using object oriented analysis techniques.

Module III

Introduction to Software Quality Management - SQA-SQM-SCM-Software Testing - Objectives of testing– Black Box and white box testing – Test Plan - Unit testing – Integration tests – System testing – Test reporting-Testing object oriented programs - Quality standards ISO and CMM - Software quality metrics. Familiarization with testing tools- Automation of the testing design process-Trends in testing

Module IV

Software Project Management - Brief study of various phases of Project Management – Planning – Organizing – Staffing – Directing and Controlling-Case studies and activities.

Software Project Cost Estimation – COCOMO model – Software Project Scheduling - Work Breakdown Structure - CASE tools- Life cycle, classification and different types-Introduction to DevOps- Docker- Kubernetes.

References:

1. Roger S. Pressman, Software Engineering – 6th illustrated edition, McGraw Hill,2005.
2. Booch et.al, The UML Reference Manual- Pearson Education, 2005.
3. Jacobs et.al, Object Oriented Software Engineering: A Use case driven approach, Pearson Education, 7th edition, 2009.
4. Frank Tsui, Managing Software Projects - Illustrated Edition, Jones and Barlett learning, 2011.
5. David Gustafson, Software Engineering-, 1st Edition, Schaum's outline series, 2002.
6. Richard Thayer et.al, Software Engineering Project Management – 2nd Illustrated Edition, IEEE Computer Society, 2006.
7. Verona, J. (2016). Practical DevOps. United Kingdom:Packt Publishing.

23-202 -0406- MICROPROCESSORS

Course Outcomes:

On completion of this course the student will be able to:

1. *Explain the architecture, instruction set and interfacing of 8085 and 8086 microprocessors.*
2. *Write assembly language programs for the 8085 and 8086 using addressing modes, procedures, interrupts and timers.*
3. *Interface memory and peripheral devices like RAM, ROM, DMA, interrupt controllers, keyboards etc. with 8086 microprocessor.*
4. *Design microprocessor-based systems using 8255, 8254, 8259 and 8279 programmable devices and 8087 coprocessor.*
5. *Analyze the functional and timing requirements for memory and I/O interfacing with 8086 in minimum and maximum mode configurations.*
6. *Evaluate the performance of microprocessor-based implementations in terms of memory organization, interrupts handling and real-time response.*
7. *Design and implement basic microprocessor-based applications involving data acquisition, display, instrumentation etc.*

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3			2									2		
CO2	2	2	2	2	3								2	2		
CO3	3	2	3	2	3									3		
CO4	3	2	3	2	3								2	3		
CO5	3	3	2	2	3									2		
CO6	2	3	2	3	3									2		
CO7	2	2	3	3	3								2	3		

1-Slightly; 2-Moderately; 3-Substantially

Module 1 - 8085 Microprocessor

Architecture and pin diagram, Addressing modes, Instruction set and assembly language programming, Timing diagrams and machine cycles, Interfacing memory and I/O devices, Stack, subroutines, and interrupts.

Module 2 - Introduction to 8086 Microprocessor

Architecture, registers, memory segmentation, Pin diagram and signals, Addressing modes, Instruction set and assembly language programming, Assembler directives, Interrupts and exception handling, Hardware and software interrupts, Vectored and non-vectored interrupts, interrupt priorities, Interrupt procedures, Exception handling, Timing diagrams and machine cycles, Comparison of 8086 and 8088.

Module 3 - Advanced 8086 Architecture and Interfacing

Minimum and maximum mode 8086 systems, Memory interfacing, Dynamic RAM interfacing, Static RAM interfacing, EPROM and flash memory interfacing, Direct Memory Access (DMA),

DMA transfer, Interfacing 8257 DMA controller, Numeric coprocessor 8087, Architecture, Instruction set, Interface with 8086, Interrupt controllers 8259, Modes of operation, Interrupt handling, Cascading controllers, Interfacing with 8086.

Module 4 - Peripheral interfacing

Programmable peripheral interface 8255, Modes of operation, Control words, Interfacing with 8086, Keyboard/display controller 8279, Programming and interfacing with 8086, Programmable interval timer 8254, Modes of operation, interfacing with 8086.

References:

1. Ramesh S. Gaonkar, Microprocessor – Architecture, Programming and Applications with the 8085 Penram International Publisher, 6th Edition 2013.
2. Nilesh B. Bahadure, Microprocessors - The 8086/8088, 80186/80286, 80386/80486 and the Pentium Family. 2010, PHI Learning, ISBN-978-81-203-3943-2
3. Douglas V. Hall, Microprocessors and Interfacing, Tata McGraw Hill publications, ISBN-978-1259006159 3rd Edition, 2017
4. Yu-Cheng Liu, Glenn A. Gibson, Microcomputer Systems: The 8086/8088 Family: Architecture, Programming, and Design, Prentice-Hall, ISBN: 9780135818510
5. Barry B Brey, The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64 -bit Extensions, Pearson/ Prentice Hall, 8/e, (2009), ISBN 0135026458/ 9780135026458.

23-200-0407- UNIVERSAL HUMAN VALUES

Course Outcomes:
On completion of this course the student will be able to:

1. *Recognize needs, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity.*
2. *Understand human being as the co-existence of two realities, self and body and harmony in the individual level.*
3. *Verify the possibility of ensuring within the naturally acceptable feelings and express those to the others with an expectation of mutual happiness and mutual prosperity.*
4. *Identify the harmony in society, nature and existence and ensuring them through the effort to fulfill the human goal.*
5. *Apply the understanding of ethical human conduct to formulate strategies for ethical life and profession.*

Course Articulation Matrix

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

1-Slightly; 2-Moderately; 3-Substantially

Module I: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education.
Purpose and motivation for the course, recapitulation from Universal Human Values-I.
Self-Exploration–what is it? – Its content and process; 'Natural Acceptance' and experiential Validation- as the process for self-exploration.
Continuous Happiness and Prosperity – A look at basic Human Aspirations.
Right understanding, Relationship and Physical Facility – the basic requirements for the fulfillment of aspirations of every human being with their priority.
Understanding Happiness and Prosperity rightly- A critical appraisal of the current Scenario.
Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human beings as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than arbitrariness in choice based on liking-disliking.

Module II: Understanding Harmony in the Human Being - Harmony in Myself.
Understanding human beings as a co-existence of the sentient 'I' and the material 'Body'.
Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
Understanding the characteristics and activities of 'I' and harmony in 'I'.

Understanding the harmony of I with the Body: Self-regulation (*Sanyam)* and Health; correct appraisal of Physical needs, the meaning of Prosperity in detail.
Programs to ensure Self-regulation (*Sanyam)* and Health.

Include practice sessions to discuss the role others have played in making material goods available to one self, identifying from own life. Differentiate between prosperity and accumulation. Discuss a program for ensuring health vs dealing with a disease.

Module III: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship.
Understanding values in a human-human relationship; the meaning of Justice (nine universal values in relationships) and the program for its fulfillment 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, the difference between respect and differentiation; the other salient values in a relationship.
Understanding the harmony in the society (society being an extension of the family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.
Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real-life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Module IV: Understanding Harmony in Nature and Existence – Whole existence as Coexistence.
Understanding the Harmony in Nature.
Interconnectedness and mutual fulfillment 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 beings as the cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Implications of the above Holistic Understanding of Harmony on Professional Ethics:
Natural acceptance of human values, Definitiveness of Ethical Human Conduct.
Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.
Competence in professional ethics: a. Ability to utilize professional competence for augmenting universal human order, b. Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for the above production systems.
Case studies of typical holistic technologies, management models and production systems.
Strategy for the transition from the present state to Universal Human Order: a. At the level of the individual: as socially and ecologically responsible engineers, technologists and managers, b. At the level of society: as mutually enriching institutions and organizations.
Sum up.
Include practice exercises and case studies to discuss the conduct as an engineer or scientist etc.

References:

1. Human Values and Professional Ethics (3rd revised edition) by R. R. Gaur, R Asthana, G P Bageria, Excel Books, New Delhi, 2022.
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 3rd Edition, (2022).
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 5th Edition, (2022).

23-202-0408 DATABASE MANAGEMENT SYSTEMS LABORATORY

Course Outcomes:

On completion of this course, the student will be able to:
1. Design and manipulate database tables using MySQL and PostgreSQL queries.
2. Apply set operations on database tables.
3. Design and develop applications using PHP/Python with Databses.
4. Design procedures and functions to manipulate database tables.
5. Implement Triggers and cursors.
6. Mange dbs using NoSQL/MongoDB.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3							1	3	1	3	1
CO2	3	2	2	2	3							1	3	1	3	1
CO3	3	2	2	2	3							1	3	3	3	2
CO4	3	3	2	2	3							1	3	1		1
CO5	3	3	3	3	3							1	3	1	3	1
CO6	3	2	2	2	3							1	3	1	3	1

1-Slightly; 2-Moderately; 3-Substantially

Cycle-I

1. Installation of Mysql / MariaDB
2. Installation of PostgreSQL.
3. User management.
4. Implementation of DDL and DML queries and set operations.

Cycle- II

1. Implementation of views, Procedures and Functions.
2. Implementation of Triggers and Cursors.

Cycle-III

1. Database Administration- Managing database, creation backups, distributed database. Synchronising distributed database.
2. Database management with NoSQL /MongoDB.

Cycle-IV

1. Develop web applications using PHP-MySQL/PostgreSQL
2. Develop web applications using Python-MySQL/PostgreSQL

References:

1. Seyed, M. M. et.al, Learning MySQL: Get a handle on your data, O'Reillypublishers.
2. Andreas Meier, Michael Kaufmann, SQL & NoSQL Databases: Models, Languages, Consistency Options and Architectures for Big Data Management, Springer Vieweg, ISBN: 978-3658245481.

3. Gianni Ciolli, Boriss Mejías, Jimmy Angelakos, Vibhor Kumar, Simon Riggs, "PostgreSQL 16 Administration Cookbook", Packt Publishing Limited, ISBN : 978-1835460580
4. Robin Nixon, Learning PHP, MySQL and JavaScript, 5th Edition, O'Reilly publishers.
5. Peter Rob, Carlos Coronel, Database Systems, Design, Implementation &Management, 8th Edition, Thomson Course Technology.
6. Elmasri and Navathe, Fundamentals of Database Systems, 7th Edition, Pearson Education.
7. Johannes Ernesti, Peter Kaiser, "Python 3: The Comprehensive Guide to Hands-On Python Programming", Rheinwerk Computing, ISBN: 978-1493223022

23-202 -0409 - OPERATING SYSTEM LABORATORY

Course Outcomes:

On completion of this course the student will be able to:

1. *Develop shell scripts.*
2. *Implement scheduling algorithms.*
3. *Write programs using system calls.*
4. *Write programs to implement inter process communication.*
5. *Write system level programs.*

Course Articulation Matrix

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

1-Slightly; 2-Moderately; 3-Substantially

Cycle-I

1. Study of different system calls.
2. Programs using the system calls of linux operating system fork, exec, getpid, exit, wait, close, stat, opendir, readdir.
3. Programs using the I/O system calls of Linux operating systems.
4. Programs to simulate Linux commands like ls, grep etc

Cycle- II

1. Programs to study and analyze various scheduling policies.
2. Programs to study the uses of semaphore.
3. Programs to implement various page replacement algorithms.
4. Programs to implement deadlock prevention and avoidance.

Cycle-III

1. Programs to implement IPC using shared memory, pipes, and message queues.
2. Linux shell programming.
3. Kernel programming--Linux Kernel configuration, compilation and rebooting from the newly compiled kernel.
4. Kernel space programming: Implement and add a loadable kernel module to Linux Kernel, demonstrate using insmod, lsmod and rmmod commands.
5. Developing device drivers.
6. Creating Linux distributions from debian source.

References:

1. W. Richard Stevens, Bill Fenner, Andrew M Rudoff, “UNIX Network Programming: The Sockets Networking API”, Volume 1, Third Edition, Prentice Hall, 2017, ISBN-13: 978-9332549746.
2. Peter Jay Salzman, Michael Burian, Ori Pomerantz, “The Linux Kernel Module Programming

Guide". http://www.tldp.org/LDP/lkmpg/2.6/lkmpg.pdf.
3. Robert Love, "Linux Kernel Development", 3rd Edition Addison-Wesley Professional, 2010, ISBN-13: 978- 0672329463.
4. Mark G. Sobell, Matthew Helmke, "Practical Guide to Linux Commands, Editors, and Shell Programming", 4th Edition, Prentice Hall, 2017, ISBN-13: 978-0134774602.

SEMESTER-V

23-202 -0501- MATHEMATICAL FOUNDATIONS FOR MACHINE LEARNING

Course Outcomes:

On completion of this course the student will be able to:

1. Explain the basics of machine learning and Central Machine Learning Problems.
2. Explain the basics of Linear Regression with problems.
3. Describe Dimensionality Reduction with Principal Component Analysis.
4. Discuss Density Estimation with Gaussian Mixture Models.
5. Discuss Classification with Support Vector Machines.

Course Articulation Matrix

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

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to machine learning: How machines learn - Data storage, Abstraction, Generalization, Evaluation, Machine learning in practice - Types of machine learning algorithms. Central Machine Learning Problems-Data, Models, and Learning, Data as Vectors, Models as Functions ,Models as Probability Distributions, Empirical Risk Minimization, Hypothesis Class of Functions ,Regularization to Reduce Over fitting, Parameter Estimation, Maximum Likelihood Estimation, Probabilistic Modeling and Inference, Directed Graphical Models, Model Selection.

Module II

Linear Regression -Problem Formulation, Parameter Estimation, Maximum Likelihood Estimation, Maximum A Posteriori Estimation, Bayesian Linear Regression, Maximum Likelihood as Orthogonal Projection

Module III

Dimensionality Reduction with Principal Component Analysis-Maximum Variance Perspective. Density Estimation with Gaussian Mixture Models- Gaussian Mixture Model, EM Algorithm, Latent-Variable Perspective.

Module IV

Classification with Support Vector Machine- Separating Hyperplanes, Primal Support Vector Machine -Concept of the Margin, Traditional Derivation of the Margin, Soft Margin SVM : Geometric View Dual Support Vector Machine, Kernels.

References:

1. Marc Peter Deisenroth A. Aldo Faisal Cheng Soon Ong, Mathematics for Machine Learning, 2019.

2. Michael Steinbach, Pang-Ning Tan, and Vipin Kumar, Introduction to Data Mining, Pearson 2016.
3. Jiawei Han, Micheline Kamber and Jian Pei, Data mining Concepts and techniques, Morgan Kaufmann Publishers 2012.
4. Peter Harrington, Machine Learning in action, Dreamtech publishers 2012.
5. Dr M Gopal, Applied Machine learning, McGraw Hill Education Private Limited.
6. E.Alpayidin, Introduction to Machine Learning, Prentice Hall of India (2005).
7. T. Hastie, RT Ibrashiran and J. Friedman, The Elements of Statistical Learning, Springer 2001

23-202 -0502 - SYSTEM PROGRAMMING

Course Outcomes:

On completion of this course the student will be able to:

1. *Familiarise the basics of system programs like assemblers, macro processors, linkers, loaders and operating systems.*
2. *Design, analyze and implement one pass, two or multi pass assembler.*
3. *Design and implement macro processors, linkers and loaders.*
4. *Compare different types of operating systems.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	3	2									2		
CO2		3	3		3								2			
CO3	2	3	3	3	3									2		
CO4	3	3	2	2	3									2		

1-Slightly; 2-Moderately; 3-Substantially

Module I

Assemblers: Overview of the assembly process- Machine dependent assembler features-Machine independent assembler features - Design of two pass assembler - single pass assembler.

Module II

Linker and Loader :Basic Loader functions - Design of absolute loader, Simple bootstrap Loader, Machine dependent loader features- Relocation, Program Linking, Algorithm and data structures of two pass Linking Loader, Overview of linkage editing - linking loader - Dynamic linking - Design of the linkage editor.

Module III

Basic Macro Processor Functions - Macro Definitions and Expansion, Macro Processor Algorithm and Data Structures, Machine- Independent Macro Processor Features - Concatenation of Macro Parameters, Generation of Unique Labels, Conditional Macro Expansion, Keyword Macro Parameters, Macro Processor Design Options - Recursive Macro Expansion, General-Purpose Macro Processors, Design of a Macro assembler.

Module IV

Device drivers - Anatomy of a device driver, Character and block device drivers,

General design of device drivers. Text Editors- Overview of Editing, User Interface, Editor structure. Debuggers - Debugging Functions and Capabilities, Relationship with other parts of the system, Debugging Methods- By Induction, Deduction and Backtracking

References:

1. Leland L. Beck,System Software-An Introduction to System Programming, 3rd Edition,Addison Wesley.
2. John J. Donovan, Systems Programming, McGraw-Hill, 2009.
3. D.M. Dhamdhere, Systems Programming and Operating Systems, Second Revised Edition, Tata McGraw-Hill.

4. J Nithyashri, System Software, Second Edition, Tata McGraw Hill.
5. Srimanta Pal, System Programming, OXFORD Publication.
6. John R. Levine,Linkers & Loaders – Harcourt India Pvt. Ltd., Morgan Kaufmann Publishers, 2000.

23-202 -0503 - DATA MINING

Course Outcomes:

On completion of this course the student will be able to:

1. *Analyze various types of data, its collection and cleaning.*
2. *Illustrate and analyze various applications of data mining.*
3. *Analyze and compare various classification models in data mining.*
4. *Understand developments in big data technologies.*
5. *Familiarize the concepts of machine learning using R/Python.*
6. *Analyze and make use of deep learning using R/Python.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3			2	2	3			2		3			
CO2	3		3	2		2	2	2	2	2	2	2		2	2	
CO3	3	3	2	2				3			1		3	3		2
CO4		2	3	2	3			3	2	2	2	2	3	3	3	3
CO5					3			3			2				2	2
CO6					3			3			2				2	2

1-Slightly; 2-Moderately; 3-Substantially

Module I

Data Mining-Purpose-Various phases of data mining - supervised vs. unsupervised - learning - Data Warehouses - OLAP - Multidimensional databases - Data Pre-processing-Case studies in data pre- processing-Different applications of data mining.

Module II

Association Rules mining- Apriori algorithm-Examples-Improvements for apriori algorithm-Classification concepts, mathematical notions and case studies-Decision trees, Neural networks, Naïve Bayes classifier, KNN, Support vector machines.

Module III

Cluster Analysis-K-Means algorithm-Example and suggestions for improvements- A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods (DBSCAN), Time series mining, Graph Mining-Case studies-Introduction to Spatial data mining-Ubiquitous data mining

Module IV

Introduction to cloud computing-Services from a cloud- Big Data-definition-data bases for the big data platform-Introduction to Hadoop its architecture and ecosystem. MapReduce-basic concepts-Introduction to Spark-Deep learning-Concepts-CNN and RNN- Object detection techniques-Typical use cases

References:

1. Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques – 3rd Edition, Elsevier, 2011.

2. Richard Royger, Data mining – 1st Edition, CRC Press, 2nd Edition, 2017.
3. Tom White, Hadoop: The definitive guide, 3rd edition, OReilly Publishers, 2012.
4. Karau. H. et.al, Learning Spark: lightning-fast big data analysis, OReilly Publishers, 2015 hadoop, tom white.
5. Ian H.Witten et.al, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kofman publishers. 4th edition, 2016.
6. Ian Good fellow et.al, Deep learning, First edition, MIT Press, 2016.
7. Gupta G K, Introduction to Data Mining with Case Studies, 3rd edition, PHI Learning, ISBN: 9788120350021
8. Sudheep Elayidom. M, "Data Mining and Warehousing", Cengage learning, 2015 ISBN: 978-81-315-2586-9

23-202 -0504 - COMPUTER GRAPHICS

Course Outcomes:

On completion of this course the student will be able to:

1. *Explain the organization of an interactive computer graphics system.*
2. *Design and create 2D and 3D geometrical objects and their transformations.*
3. *Fill polygons and clip lines, polygons and text against rectangular boundary*
4. *Generate different types of curves.*
5. *Apply projections and rendering for 3D objects.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1												3				
CO2	3		3									3				
CO3	3		3									3				
CO4	3		3									3				
CO5	3		3									3				

1-Slightly; 2-Moderately; 3-Substantially

Module I

Graphic hardware: Raster scan and random scan displays, color CRTs, Hard copy output devices, interactive input devices, Output primitives –points and lines. Line drawing algorithms –DDA-Bresenham, parametric and nonparametric forms of circle, midpoint algorithms for circle polygon filling algorithms – boundary fill, flood fill and scan line fill, Antialiasing. Graphical user interface – Logical classification of input devices.

Module II

Two dimensional transformations: Representation of points - Transformations and matrices-transformation of points- Transformations of lines – Rotation - Reflection- Scaling – Combined transformations - Homogeneous coordinates. Viewing transformations: Viewing pipeline, window to viewport transformation. Clipping: Interior and exterior clipping- Point clipping- Line clipping – Cohen Sutherland - Liang Barsky- Sutherland Hodgeman Polygon clipping- Curve clipping – Text clipping. Curves: Curve representation- Geometric and Parametric Continuity – Natural Cubic Splines– Hermite spline - Bezier curves - B-spline curves.

Module III

Polygon meshes, sweep representations, Bezier surfaces, B-spline surfaces. Three Dimensional Transformations: Three dimensional scaling, shearing, rotation, reflection, translations - Rotation about arbitrary axis Parallel to coordinate axis- Rotation about arbitrary axis in space.

Projections: Orthographic projections – Oblique projections-perspective projections and Vanishing points. Visible surfaces: classification of visible surface detection algorithms, Back Face detection method - Depth buffer method(z-Buffer algorithm)- A-Buffer method-Screen subdivision method-Painter's algorithm - Scan line algorithms- octree hidden surface elimination.

Module IV

Rendering: Illumination models-diffuse reflection – specular reflection-Determining surface normal and reflection vector- Polygon rendering – Gouraud shading- Phong Shading -Ray tracing-Texture mapping. Color models: Color- Chromacity - Tristimulus theory of color – RGB color system -CMY color system -HSV color system. Modeling techniques: Hierarchical modeling, Fractals. Animation: Computer assisted animation.

References:

1. Donald Hearn, Pauline Baker, M., Computer Graphics with OpenGL, 3 rd Edition, Pearson Education, 2004, ISBN: 978-0-13-015390-6.
2. David F. Rogers, Procedural Elements for Computer Graphics, 2 nd Edition, Tata McGraw Hill,2001, ISBN-13:978-0-07-047371-3, ISBN-10:0-07-047371-4.
3. James D. Foley et.al. Introduction to Computer Graphics, Addison Wesley Publishing Company, 1994, ISBN: 0-201-60921-5.
4. David F. Rogers, Mathematical Elements for Computer Graphics, 2 nd Edition, Tata McGraw Hill,2001,ISBN-13:978-0-07-048677-5,ISBN-10:0-07-048677-8.
5. James D. Foley, Andries Van Dam, Steven K. Feiner, John F. Hughes, Computer Graphics

23-202 -0505 - ADVANCED MICROPROCESSORS AND EMBEDDED SYSTEMS

Course Outcomes:

On completion of this course the student will be able to:

1. *Understand the architecture, registers, descriptors, and operating modes (Real, Protected, and Virtual 8086) of the Intel 80386 microprocessor, including paging and segmentation mechanisms.*
2. *Gain knowledge of advanced microprocessor features such as RISC and CISC architectures, superscalar architecture, instruction pipelining, branch prediction techniques, and floating-point units (FPU).*
3. *Develop an understanding of 64-bit processors, including their execution environment, memory organization, extended physical addressing in protected mode, basic program execution registers, and operand addressing.*
4. *Explore multicore architectures and power reduction techniques employed in modern processors.*
5. *Acquire knowledge of embedded systems, their characteristics, quality attributes, applications, and domain-specific design considerations.*
6. *Gain hands-on experience in programming and designing embedded systems using 8-bit microcontrollers, specifically the 8051 microcontrollers.*
7. *Understand the concepts of embedded hardware design and development, including firmware design approaches and programming languages for embedded systems.*
8. *Develop proficiency in programming embedded systems using Embedded C language.*
9. *Understand the concepts and techniques related to embedded firmware design and development, including firmware design approaches and programming languages.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3			3									2	3	
CO2	3	3			3									2	3	
CO3	3	3			3										3	
CO4	3	2			3		2								3	
CO5	3	3			3									2	3	
CO6			3	3	3				2	2				2	2	
CO7	3	3			3			2					2	2	3	
CO8					3				2	2			2	2	3	
CO9	3	3			3								2	2	3	

1-Slightly; 2-Moderately; 3-Substantially

Module I:

Intel 80386 Microprocessor: Architecture - Registers – Descriptors - Real Mode - Protected mode -Virtual 8086 mode - Paging and Segmentation - Comparison with 80486 Microprocessor. Pentiumclass of processors: RISC and CISC architectures - Superscalar Architecture and instruction pipelining - Branch Prediction techniques – FPU

Module II

Intel 64 bit processors-: Overview of 64 bit processor execution environment – Memory organization –IA-32 memory models – Memory organization in 64-bit mode – Extended physical addressing in protected mode - Basic program execution registers – Operand addressing. Multicore Architectures: Concepts – Power reduction techniques in processors.

Module III

Introduction to Embedded System, Typical Embedded System, Characteristics and Quality Attributes of Embedded System, Embedded System- Application and Domain-specific, Designing Embedded System with 8-bit Microcontrollers, Programming with 8051 Microcontrollers.

Module IV

Embedded Hardware Design and Development, Embedded Firmware Design and Development: Embedded Firmware Design approaches, Embedded Firmware development languages, Programming in Embedded C

References

1. Intel x86 processors programmer's reference manuals.
2. Lyla B. Das, The x86 Microprocessors: 8086 to Pentium, Multicores, Atom and the 8051Microcontroller, 2/e, Pearson Education. ISBN-13**:** 978-9332536821.
3. Barry B. Brey, The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486,Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bitExtensions : Architecture, Programming, and Interfacing, Pearson Education India,ISBN:9788131726228.A.K. Ray, Microprocessor Architecture, McGraw Hill Education (India) Pvt.Ltd, ISBN-9780070482889, 5th edition published in 2004
4. Shibu K.V, Introduction to Embedded Systems, Tata McGraw Hill, (2009)
5. Simone, Embedded Systems Dreamtech Press, 2nd Edition – ISBN 978-9390386565
6. Robert Oshana, Design Patterns for Embedded Systems in C, Elsevier Science & Technology, Paperback ISBN 978-143232381

23-202 -0510 - COMPUTER GRAPHICS LABORATORY

Course Outcomes:

On completion of this course the student will be able to:

1. *Understand and explain the mathematical and theoretical principles of computer graphics and openGL.*
2. *Familiarize generation and transformations for 2D geometrical objects, filling and clipping operations.*
3. *Design algorithms for different geometric shapes line, circle and ellipse.*
4. *Implement various algorithms to scan, convert the basic geometrical primitives, transformations, Area filling, clipping.*
5. *Understand the practical implementation of modelling, rendering, viewing of objects in 2D, 3D etc. and describe the importance of viewing and projections.*

Note: All programs should be done using python with openGL libraries.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3				3							3				
CO2	3		3		3							3				
CO3	3		3		3							3				
CO4	3		3		3							3				
CO5	3		3		3							3				

1-Slightly; 2-Moderately; 3-Substantially

Cycle-I

1. Introduction: Study of graphical input devices and display devices and different display standards. Study of OpenGL libraries and programming techniques using python.
2. Implementation of algorithms for drawing 2D Primitives.
    a. Line – DDA, Bresenham's
    b. Circle- Bresenham's, Midpoint

Cycle- II

1. 2D Filling Algorithms:
    a. Seed filling algorithms (recursive and non-recursive methods)
        - Flood fill
        - Boundary fill
    b. Scanline filling-
    Filling a given polygon using the scan line polygon fill algorithm.
2. 2D Geometric Transformations:
    a. Translation
    b. Rotation

c. Scaling
d. Reflection
e. Sheer
f. Window to Viewport
g. Composite Transformations.

Cycle-III

1. 2D Clipping Algorithms:
    a. Line clipping (Cohen Sutherland, Liang-Barsky)
    b. Polygon clipping (Sutherland–Hodgman, Weiler–Atherton)

2. 3D Transformations:
    a. Translation
    b. Rotation
    c. Scaling
3. 3D Projections
    a. Orthographic
    b. Perspective.

Cycle-IV

1. Programs for generating Splines.
    a. Interpolation curves.
    b. B-Spline
    c. Bezier Spline
2. Generating fractal images
3. 3D rendering
4. Simple animation programs using python animation libraries.

References:

1. Donald Hearn, Pauline Baker, M., Computer Graphics with OpenGL, 3rd Edition, Pearson Education, 2004, ISBN: 978-0-13-015390-6.
2. Dave Shreiner, Bill The Khronos OpenGL ARB Working Group, OpenGL Programming Guide: The Official Guide to Learning OpenGL, Versions 3.0 and 3.1, Pearson Education, 2009.ISBN: 9780321669278.
3. David F. Rogers, Procedural Elements for Computer Graphics, 2nd Edition, Tata McGraw-Hill, 2001, ISBN- 13:978-0-07-047371-3, ISBN-10:0-07-047371-4.
4. David F. Rogers, Mathematical elements for computer graphics', McGraw Hill Education; 2nd edition, 2017.ISBN: 978-0070486775.
5. PyopenGL libraries and documents, http://pyopengl.sourceforge.net/.
6. Python Tutorial, http://soe.cusat.ac.in/tutorials/python/.

23-202 -0511 - IOT AND EMBEDDED SYSTEMS LABORATORY

Course Outcomes:

On completion of this course the student will be able to:

1. *Develop proficiency in x86 assembly language programming, including understanding assembler directives, addressing modes, memory models, and working with interrupts and functions.*
2. *Gain hands-on experience in interfacing the 8086 microprocessor with peripheral devices such as 8255 PPI, 8279 keyboard/display controller, stepper motors, ADC/DAC, hex keyboard, and LCD displays.*
3. *Acquire skills in programming and interfacing microcontrollers, such as 8051 or AVR, for tasks like LED blinking, traffic light control, 7-segment display interfacing, LCD and keypad interfacing, analog-to-digital conversion with temperature sensors, and stepper motor control.*
4. *Explore the realm of Internet of Things (IoT) by implementing home automation projects using ESP8266 and integrating with cloud platforms.*
5. *Develop proficiency in writing assembly language programs for various tasks, including arithmetic operations, array manipulations, keyboard and display management, disk operations, and reading/setting system parameters.*
6. *Apply theoretical knowledge to practical experiments and projects, fostering hands-on skills in embedded systems and IoT.*
7. *Gain experience in working with various development tools, such as assemblers, microcontroller development boards, and IoT platforms.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2		3					2			3	2	3	
CO2	3	2	3	2	3				2	2			3	3	2	
CO3	3	2	3	2	3				2	2			3	3	2	
CO4		2	3	2	3				2	2			2	3	2	2
CO5	2	2	2		3					2			3	2	3	
CO6	2	2	3	3	3				2	2			2	3	2	
CO7	2	2	2	2	3				2	2			1	3	2	

1-Slightly; 2-Moderately; 3-Substantially

Cycle-I

x86 Assembly language programming using TASM/MASM/NASM.

- Familiarize assembler directives, addressing modes and memory models.
- Interrupts and functions.
- Arithmetic operation using keyboard inputs and display on the screen (Signed and Unsigned)
- Programs on array manipulation using Indirect, indexed and based indexed addressing modes.
- Programs using keyboard interrupts - manipulate key functions.
- Programs using display interrupts - managing texts and drawings.

- Programs using disk interrupts - formatting, partitioning, file management.
- Programs using interrupts to read and set system parameters-date, time, resolution, BIOS etc.
- Programs to test Memory resident programs.

Cycle- II

Design and implementation of basic interface circuits (Any two)

- Interfacing 8086 with 8255
- Interfacing 8086 with 8279
- Stepper motor
- ADC/DAC
- Hex keyboard
- LCD

Cycle-III

Embedded System Experiments: (Any two)

- LED blinking and traffic light controller using 8051/AVR microcontroller
- 7-segment display interfacing with 8051 to display count/data
- Interfacing LCD display and keypad with 8051 microcontroller.
- Interfacing ADC with 8051 and temperature sensor LM35
- Stepper motor control using 8051.

Cycle-IV

IoT Experiments

- Home automation using ESP8266 and cloud integration.

Reference:

1. Bhurchandi and Ray, Advanced Microprocessors and Peripherals, Third Edition McGraw-Hill.
2. A. NagoorKani, Microprocessors and Microcontrollers, Second Edition, Tata McGraw-Hill
3. Kenneth Ayala, The 8051 Microcontroller,3rd Edition, Thomson Learning / Cengage Learning publishing, 2004, ISBN-13: 978-1401835227
4. Prasad N.S, Getting Started with IoT, Packet Publishing, 2018, ISBN-13: 978-1788996049

23-202 -0512 -INTERNSHIP-II

Course Outcomes:

On completion of this course the student will be able to:

1. *Understand the real time technical/managerial skills required and relevant to the subject area of internship*
2. *Initiate a habit of proper daily diary writing with adequacy and quality of information recorded, drawing, sketches and data, thought process and the proper organisation of the information gained during the internship.*
3. *Conceive the pros and cons of working in a real time industrial environment and the wonderful results which could evolve through team-work.*
4. *Present and defend self-prepared and corrected internship report (with the help of internship guide/industry mentors) of a self-created work to a peer audience.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	1	1			2	1		2	2	2	1	2
CO2	2	3	1	2	2	1			2	2	1	1	2	2		1
CO3	2	2	3	2	2	1			2	2	1	1	2	2		2
CO4	2	2	2	3	2	1			2	2	1	1	2	2		1

1-Slightly; 2-Moderately; 3-Substantially

Internship Guidelines

- An internship plan has to be prepared by the interns incorporating the job description/internship duties, name of the project, if any and internship schedule and expected learning outcomes in consultation with industry supervisor/mentor and institute faculty.
- A detailed training report in the prescribed format shall be submitted at the end of the internship.
- Training Certificate from the industry for the prescribed period shall be submitted at the end of the internship.
- The work shall be reviewed and evaluated periodically.
- Orientation of interns, resource requirement of interns, monitoring of interns progress on a daily basis shall be carried out by the industry offering internship in addition to ensuring safety and welfare of the interns.

A committee consisting of the Internship Coordinator (nominated by the Head of the Department/Division), faculty mentor, and at least one senior faculty member at the level of Associate Professor or above will carry out the final review.

Guidelines for evaluation:		
1.	Regularity and progress of work	10
2.	Work knowledge and Involvement	10
3.	Semester End presentation and oral examination	10
4.	Level of completion of internship	10
5.	Internship Report – Presentation style and content	10
Total		**50** Marks

23-202-0506 TO 23-202-0509 PROFESSIONAL ELECTIVE – I

23-202 -0506(IE) - WEB TECHNOLOGIES

Course Outcomes:

On completion of this course the student will be able to:

1. *Write programs in PHP language for server side scripting.*
2. *Understand XML and processing of XML Data with Java.*
3. *Develop server side programming using JSP.*
4. *Use client side scripting using Javascript.*
5. *Use AJAX with PHP and Mysql.*

Course Articulation Matrix:

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

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to PHP: Variables, data types, numbers, date, arrays, strings. Operators, Expressions, Control structures, Functions, Handling POST and GET methods, connecting to database (MySQL or Postgres), executing queries and handling results, managing sessions and cookies, PHP file handling: open, read, write and closing files. PHP errors and exception handling.

Module II

Introduction of XML- Features of XML, Anatomy of XML document, The XML Declaration, Defining XML tags, their attributes and values, Document Type Definition, XML Schemas, Document Object Model, XHTML Parsing XML Data. XMLHttpRequest- Introduction, XMLHttpRequest, The XMLHttpRequest Object, Events for the XMLHttpRequest Object, Request Object for XMLHttpRequest, Response Object for XMLHttpRequest.

Module III

JavaServer Pages (JSP): Introduction, JSP Processing, Declarations, Directives, Expressions, Code Snippets, implicit objects, Standard Actions, Directives, Custom Tag Libraries, Using Cookies and session for session tracking, connecting to database in JSP.

Module IV

Java Script : Client side scripting with JavaScript , variables, functions, conditions, event handlers, loops and repetition, Pop up boxes, Form validation, Advance JavaScript: Javascript and objects,

JavaScript own objects, the DOM and web browser environment. AJAX: Introduction, AJAX Components, Handling Dynamic HTML with Ajax. AJAX Database, Working of AJAX with PHP, Ajax PHP Database Form, AJAX PHP MySQL query.

References:

1. Kogent Learning Solutions Inc. Web Technologies, HTML, JAVASCRIPT, PHP, JAVA, JSP, ASP.NET, XML AND AJAX Black Book, Dreamtech Press**,** Wiley India Pvt.Ltd.,2009. ISBH: 978-8177229974.
2. Uttam Kumar Roy, Web Technologies, Oxford University Press.2010. ISBN: 978-0198066224.
3. Alan Forbes,The Joy of PHP: A Beginner's Guide to Programming Interactive Web Applications with PHP and MySQL, CreateSpace Independent Publishing Platform, 2012. ISBN: 978-1522792147.
4. Hans Bergsten, Java Server Pages, 3rd Edition, O'Reilly Media ,2009. ISBN: 978-0596005634.
5. David Flanagan, JavaScript:The Definitive Guide, 6th edition, O'Reilly Media,ISBN:978-059680552.

23-202 -0507 - SOFTWARE PROJECT MANAGEMENT

Course Outcomes:

On completion of this course the student will be able to:

1. *Gain knowledge on the issues and challenges to be faced while managing a software project.*
2. *Familiarize with various project scheduling techniques, project control and monitoring.*
3. *Identify factors that influence the performance of team members in a project environment.*
4. *Explain the role of continuous training, improve team working and select appropriate leadership styles.*
5. *Understand the new trends in project management*
6. *Importance of AI and data analysis in project management*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1									3							
CO2	2	2	2						3	3	3		2			
CO3				2					3	3	2					
CO4				2					3							
CO5	2		2	2	3				3		2		2	2	3	2
CO6	2		3		3	3	2	2	3				2		2	3

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction And Software Project Planning: Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management spectrum, SPM Framework, Software Project Planning, Planning Objectives, Project Plan, Types of Project plan, Structure of a Software Project Management Plan, software project estimation, Estimation methods, Estimation models, Decision process

Module II

Project Organization And Scheduling: Project Elements, Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, scheduling terminology and techniques, Network Diagrams: PERT, CPM, Bar Charts, Milestone charts, Gantt Charts.

Risk Management – Nature Of Risk – Types Of Risk – Managing Risk – Hazard Identification – Hazard Analysis – Risk Planning And Control.

Module III

Monitoring And Control: Creating Framework – Collecting the Data – Visualizing Progress – Cost Monitoring – Earned Value – Prioritizing Monitoring – Getting Project Back To Target – Change control –Managing contracts – Introduction – Types of Contract – Stages in Contract Placement – Typical Terms of a Contract – Contract Management – Acceptance-Latest trends in SPM-Using AI and data analysis in project management .

Module IV

Managing People and Organizing Teams: Introduction – Understanding Behavior – Organizational Behaviour: A Background – Selecting the Right Person For The Job – Instruction in the Best Methods–Motivation – The Oldman – Hackman Job Characteristics Model – Working in Groups – Becoming a Team –Decision Making – Leadership – Organizational Structures – Stress – Health and Safety –l-Case Studies.

Project management in the agile way-Remote project management in the context of work from home mode

References:

1. Jalote, software Project Management in Practice, First edition, Pearson Education, ISBN: 978-7-30-210682-1.
2. Bob Hughes, Mike cotterell, Software Project Management, Third Edition, Tata McGraw-Hill, ISBN: 978-0-07-070653-8.
3. Ramesh, Gopalaswamy, Managing Global Projects, First edition, Tata McGraw Hill, ISBN: 978-0-07-059897-3.
4. Royce, Software Project Management, 1st Edition, Pearson Education, ISBN: 978-0-2-0130958-4.
5. John C. Goodpasture ·, Project management the agile way, J Ross publishing, ISBN: 9781604271157
6. Gren Gale, The remote project manager, Amazon digital services ISBN: 9781099908071

23-202-0508 EMBEDDED SYSTEM DESIGN

Course Outcomes:

On completion of this course the student will be able to:

1. *Demonstrate the architecture of Embedded Systems.*
2. *Summarise the characteristics of Embedded Systems.*
3. *Illustrate the features of Embedded Operating Systems.*
4. *Apply the concepts of scheduling algorithms to solve scheduling problems in Embedded Systems.*
5. *Demonstrate the design procedure and analysis of Embedded Systems.*
6. *Develop solutions to simple computation problems using ARM instructions.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3							1	2	3	3	1
CO2	3	2	2	2	3							1	2	3	3	
CO3	3	2	2	2	3							1	2	3	3	1
CO4	3	3	2	2	3							1		2	2	2
CO5	3	3	3	3	3							1	3	3	3	2
CO6	3	2	2	2	3								3	2	3	2

1-Slightly; 2-Moderately; 3-Substantially

Module I

Concepts of control system: Definitions-open loop system-closed loop system, embedded computing- characteristics of embedded computing applications- challenges in embedded computing system design -embedded system design process. Instruction set– ARM Processor and Memory Organizations- Data Operations.

Module II

CPU- Programming input and output-supervisor mode-exceptions and trap-co-processors-CPU performance-CPU power consumption. Computing platforms -basic computing platforms- Platform hardware components- Platform software components- The CPU bus- Bus organisation and protocol- DMA- System Bus Configuration.

Module III

Program Design and analysis- components for embedded programs- models of program- Assembly, linking and loading-Compilation techniques- compiler optimizations. Software performance optimization -program validation and testing.

Module IV

Processes and OS- multiple tasks and multiple processes- Multirate systems- Preemption real-time OS- priority based scheduling- Rate monotonic scheduling- Earliest deadline first scheduling- Interprocess communication mechanisms. Network and multiprocessors- categories of multiprocessors- MPSoCs and shared memory multiprocessors.

References:

1. Marilyn Wolf, Computers as Components, 5th Edition, Morgan Kaufmann Publishers, ISBN: 9780323851282
2. Raj Kamal, Embedded System, Architecture programming and Design, 3rd Edition, ISBN: 9789332901490
3. Jack Ganssle The Art of Designing Embedded Systems, Second Edition, Newnes, ISBN: 9780080568799.
4. Tammy Noergaard, Embedded Systems Architecture, Newnes, ISBN: 978-81-8147-997-6.
5. Arun Ghosh, Introduction To Control Systems, 2nd Edition, PHI Learning Pvt.Ltd., ISBN-13:9788120348202.

23-202 -0509 - FUNDAMENTALS OF CYBER SECURITY

Course outcomes

On completion of this course the student will be able to:

1. *Famialize the various threats in the cyber world and various methods used in authentication of users.*
2. *Familiarise various attacks in website and email communication.*
3. *Familiarise threats in network communications and wireless communications.*
4. *Analyse the security in a computer network and take countermeasures in case of any threat.*
5. *Familiarise the security issues in the cloud and take measures for secure online transactions.*
6. *Familiarise with the steps taken in handling risk and unforseen disasters*.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1														
CO2	1	2														
CO3	1	2														
CO4	1	2	3										1			
CO5	1	2	2										1			
CO6	1	1														

1-Slightly; 2-Moderately; 3-Substantially

Module 1

Introduction to cyber security – Threats – Harm – vulnerabilities – controls. Methods of authentication and access control – unintentional programming oversights – types of malicious code – counter measures.

Module 2

Web security – browser attacks – web attacks – email attacks. Security in operating systems – Design of secure operating systems – Rootkit. Network security – threats to network communications – wireless network security – denial of service – distributed DoS

Module 3

Security countermeasures – cryptography in network security – firewalls (definition, types, comparison). Intrusion detection and prevention systems (goals, strengths, limitations), security requirements of databases.

Module 4

Security in cloud: cloud computing concepts – risk analysis -cloud provider assessment - cloud as a security control – data protection in the cloud - Privacy on the web: payments on the web - site and portal registrations- spyware – shopping on the internet. Email security: interception – monitoring – spoofing and spamming. Management and incidents: security planning – handling incidents - risk analysis – dealing with disaster.

References:

1. Security in computing by Charles P. Pfleeger, Shari Lawrence Pfleeger, and Jnathan Marguilies, Prentice Hall, 5th Edition

2. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt. Ltd. , 2011

3. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithms, Applications, and Perspectives, CRC Press, 2018.

4. George K.Kostopoulos, Cyber Space and Cyber Security, CRC Press, 2013.

SEMESTER – VI

23-202-0601-COMPUTER NETWORKS

Course Outcomes:

On completion of this course the student will be able to:

1. *Familiarize with fundamental underlying principles of computer networking.*
2. *Explain the details and functionality of layered network architecture.*
3. *Apply mathematical foundations to solve computational problems in computer networking.*
4. *Acquire knowledge in ethical, legal, security and social issues related to computer networking.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	2							1	2	1	3	1
CO2	3	2	2	2	3							1	2	1	3	1
CO3	3	3	2	3	3							1	3	1	2	2
CO4	2	2	2	2	2							1	1	1	1	2

1-Slightly; 2-Moderately; 3-Substantially

Module I

TCP/IP Protocol stack - Application Layer: Application layer Protocols: - WWW and HTTP, FTP, DNS, SMTP, P2P File sharing, Domain Name System (DNS), Video Streaming and Content Distribution Networks-Internet Video- HTTP Streaming and DASH -Content Distribution Networks , Case Studies: Netflix and YouTube. Socket Programming.

Module II

Transport layer: Transport Layer Services, Relationship with Network Layer, Relationship with Application Layer, Multiplexing and Demultiplexing, UDP, TCP: Header, Segment Structure, Services, Connection establishment and termination, Flow control and window size advertising, TCP timeout and retransmission, Congestion Control, TCP Fairness.

Module III

Network Layer: Network layer Services, Datagram and Virtual circuit services, IP datagram format and Types of Services, The Original Classful Addressing Scheme Dotted Decimal Notation – Subnet and Classless Extensions - Router architectures. IP Multicast Addresses. ARP Protocol. IPv6. Datagram encapsulation and Fragmentation, Reassembly and fragmentation

Module IV

Routing algorithm- LS and DV, Intra-AS Routing in the Internet: OSPF-Routing Among the ISPs: BGP. SDN control plane. ICMP, SNMP.

Data link layer services, Multiple Access Protocols. Switching, VLANs, MPLS, Data centre networking, Software-defined networking.

References:

1. James F. Kurose and Keith W. Ross, Computer Networking – A Top-Down Approach 7th Edition, Pearson Education, ISBN: 978-1292153599.
2. Andrew S. Tanenbaum and David J. Wetherall, Computer Networks, 5th Edition, Pearson Education, 2013, ISBN: 978- 9332518742.
3. Peterson and Davie, "Computer Networks, A Systems Approach", 5th ed., Elsevier,, ISBN:978-0123850591
4. Douglas E. Comer, Computer Networks and Internet, 6th Edition, Pearson Education, ISBN: 978-9352869152.
5. William Stallings, Data and Computer Communication, 10th Edition, Pearson Education, 2006.978-0133506488.
6. Behrouz A. Fourouzan, Firouz Mosharraf, Computer Networks - A Top Down Approach, Tata McGraw Hill, ISBN: 13978-1-25-900156-7.

23-202 -0602 - COMPILER CONSTRUCTION

Course Outcomes:

On completion of this course the student will be able to:

1. *Summarize the functionality of each phase involved in compilation process.*
2. *Develop scanner and parser using lex and yacc tools.*
3. *Design top down parsers including recursive descent parser and non-recursive predictive parser for CFGs.*
4. *Design bottom up parsers including shift reduce, operator precedence and LR parsers (SLR,CLR and LALR).*
5. *Explain Syntax directed translation using S-attributed definition and L-attributed definition.*
6. *Familiarize specification for a type checker and run time environment.*
7. *Comprehend different representations of intermediate code.*
8. *Describe various code optimization techniques to improve the performance of a program and learn code generation techniques.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3													2		
CO2	3		3										3	3	3	
CO3	3	3	3										3	3		
CO4	3	3	3										3	3		
CO5	3															
CO6	3															
CO7	3															
CO8	3															

1-Slightly; 2-Moderately; 3-Substantially

Module I

Compiler: Introduction – Analysis of the source program – phases of a compiler – Lexical analysis –Role of the lexical analyser – Input Buffering -- Specification of tokens – Recognition of tokens –Lexical analyser generators.

Module II

Syntax Analysis – Role of the parser – Context free grammars – Top-down parsing – Bottom-up parsing –Operator precedence parsing – LR parsers (SLR, Canonical LR, LALR) – Parser generators.

Module III

Syntax-directed translation – Syntax-directed definitions – S-attributed definitions –L-attributed definition – Top-down and bottom-up translation – Type checking – Type systems – Specification of a type checker. Run time environment – Source language issues – Storage organization – Storage allocation strategies – Access to nonlocal names – Symbol tables.

Module IV

Intermediate code generation – Intermediate languages – Declarations – Assignment Statement – Boolean Expression – Procedure calls - Code optimization – Introduction – Sources of optimization – Introduction to data flow analysis. Code generator – Issues in the design of a code generator, the target machine, A simple code generator.

References:

1. Alfred V. Aho, Ravi Sethi & Jeffrey D. Ullman, Compilers Principles, Techniques & Tools, Pearson.
2. Kenneth C. Louden, Compiler Construction: Principles and Practice, Thomson Learning, India.
3. Keith D. Cooper & Linda Torczon, Engineering a Compiler, 2nd Edition, Elsevier
4. Muchnick, S.S., Harcourt Asra, Advanced Compiler Design implementation, Morgan Kaufman.
5. Alan Holub, Compiler Design in C, PHI.

23-202 -0603 - ANALYSIS AND DESIGN OF ALGORITHMS

Course Outcomes:

On completion of this course the student will be able to:

1. *Analyse a given algorithm and express its worst, best and average time and space complexities in asymptotic notations and Solve recurrence equations.*
2. *Analyse different searching, sorting algorithms and complex data structures.*
3. *Understand the greedy and dynamic programming paradigm and its algorithmic design solutions.*
4. *Design efficient algorithms using Backtracking and Branch and Bound Techniques for solving problems.*
5. *Classify computational problems into P, NP, NP-Hard and NP-Complete complexity classes.*

Course Articulation Matrix:

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

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to algorithm analysis-Time and Space Complexity-Classifying functions by their asymptotic growth rate-Best, Worst and Average case complexities-Complexity Calculation of simple algorithms (sequential and iterative algorithms).Recurrence Equations: Solution of Recurrence Equations –Iteration Method and Recursion Tree Methods, Masters Theorem-divide and conquer and decrease and conquer.

Module II

Analysis of searching Algorithms and Sorting Algorithms- Linear Search and Binary Search. Sorting- Quick Sort, Merge Sort and Heap Sort - Comparison of sorting Algorithms. Analysis of complex Data Structures- Binomial Heap, Fibonacci Heap, Red Black Tree.

Module III

Greedy Strategy- The control Abstraction- Spanning Tree, Minimal Cost Spanning Tree Computation- Prim’s and Kruskal Algorithm-Complexity. Dynamic Programming- The control Abstraction-The Optimality Principle- Optimal matrix multiplication, Bellman-Ford Algorithm.

Back Tracking: -The Control Abstraction – The N Queen's Problem, 0/1 Knapsack Problem. Branch and Bound- Travelling Salesman Problem.

Module IV

Introduction to Complexity Theory- Tractable and Intractable Problems- P and NP, Polynomial Reductions, NP-Hard and NP Complete Complexity Classes. NP Complete Problems- Bin Packing, Graph Colouring, Travelling salesman problem.

References:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Computer Algorithms, Universities Press, 2007.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, MIT Press, 2009.
3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, The Design and Analysis of Computer Algorithms, Pearson Education, 1999.
4. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Pearson, 3rd Edition, 2011.
5. Gilles Brassard, Paul Bratley, Fundamentals of Algorithmics, Pearson Education, 1995.
6. Richard E. Neapolitan, Kumarss Naimipour, Foundations of Algorithms using C++ Psuedocode, Second Edition, 1997.

23-202 -0604 - ARTIFICIAL INTELLIGENCE

Course Outcomes:

On completion of this course the student will be able to:

1. *Explain the characteristics of software agents and java framework for implementing agents.*
2. *Explain production system model and state space search.*
3. *Describe important search techniques and apply to suitable problems.*
4. *Define and apply knowledge representation and deduction methods.*
5. *Explain nonmonotonic reasoning methods*
6. *Describe the important phases in natural language processing.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3	3	3	3	3		2					3	3		3
CO2		3	3	3	3	3		2					3	3		3
CO3		3	3	3	3	3		2					3	3		3
CO4		3	3	3	3	3		2					3	3		3
CO5		3	3	3	3	3		2					3	3		3
CO6		3	3	3	3	3		2					3	3		3

1-Slightly; 2-Moderately; 3-Substantially

Module I

Software agents – agent characteristics, agent topology, and agent oriented programming, Java implementation of intelligent agents. AI domains-Problem Characteristics – Problem spaces-search: DFS, BFS - Production systems- Swarm intelligence- genetic algorithm.

Module II

Heuristic search techniques: Generate and Test - Hill climbing -Best first - A* algorithm.
Problem reduction –AO*algorithm, constraint satisfaction - Means Ends analysis. Game playing: Minimax – Alpha-beta cut-off.

Module III

Logic and Deduction: Introduction to symbolic logic - Propositional logic - Well Formed Formula- Predicate Logic - predicates variables and constants - First order logic, Quantifiers-Forward and backward chaining-Resolution by refutation- Unification- Goal trees.

Module IV

Representing Knowledge: Procedural versus Declarative. PROLOG programming Reasoning under uncertainty: Non Monotonic reasoning –support lists and dependency directed backtracking - Statistical reasoning: Bayes theorem. Bayesian networks. Fuzzy Logic, Semantic Nets, Frames, Conceptual Dependency, Scripts, CYC. Natural Language Processing. – machine translation,-Morphology and Finite State Transducers--Word Classes and Part-of-Speech Tagging and chunking-HMM Taggers - Learning: Types of learning- supervised and unsupervised.

References:

1. Elaine Rich and Kevin Knight, Artificial Intelligence, Tata McGraw-Hill, Third Edition, ISBN: 13:978-0-07-008770-5, 2010.
2. Jeffrey M. Bradshaw, Software Agents, AAAI Press/ The MIT Press (1997) (Module 1), ISBN: 0-262-52234-9.
3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hall India Ltd., 2009, ISBN: 81-203-0777-1 (modules 2,3and 4).
4. Stuart Russell and Peter Norvig, Artificial Intelligence – A Modern Approach. 3rd Edition, Prentice Hall, 2009.
5. Padhy, N.P., Artificial intelligence and intelligent systems, 2010, 0-19-567154-6.
6. Jurafsky D., Martin J.H., Speech and natural language processing, Second Edition, Prentice Hall, 2008, ISBN 10: 0131873210.

23-202 -0605 - CRYPTOGRAPHY AND NETWORK SECURITY

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify various security attacks in the network that are related to the security goals.*
2. *Familiarise the elementary algorithms based on substitution and transportation.*
3. *Familiarise cryptographic algorithms using symmetric and asymmetric keys.*
4. *Familiarise how key exchange (private and public keys) is performed between the sender and receiver.*
5. *Understand how user authentication and message authentication is achieved in a computer network.*
6. *Familiarise with network security protocols used to protect the network against threats.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1															
CO2	2	1	3										2			
CO3	2	1	3										2			
CO4	3	2	3										1			
CO5	2	2	2													
CO6	1	2	2													

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to cryptography, security goals, attacks related to security goals. Mathematics of cryptography: euclidean algorithm, congruence, modular arithmetic, multiplicative inverse. Substitution cipher: caesar, monoalphabetic, playfair, hill cipher, affine ciphers. Transportation cipher, stream and block ciphers.

Module II

Symmetric key encryption: Feistel cipher structure , DES, AES, modes of operations of block cipher, avalanche effect. Public Key Encryption: Primality testing- Miller-Rabin Algorithm, RSA cryptosystem.

Module III

Key Management: symmetric key distribution, KDC, Diffie -Hellman protocol, public key distribution, certificate authority, X.509, PKI. Cryptographic hash functions: message authentication, digital signature, SHA-512, MAC

Module IV

User authentication: one way, mutual authentication, Kerberos. Network security: secure email, PGP, SSL architecture- protocols. IP Security: modes, protocols. Intruders, Malicious programs, worms, viruses. Firewall architectures.

References:

1. Cryptography and Network Security – Principles and Practice: William Stallings, Pearson Education, 6th Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition.
3. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition.
4. Introduction to Network Security: Neal Krawetz, CENGAGE Learning.
5. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.

23-202 -0610 - NETWORKS LABORATORY

Course Outcomes:

On completion of this course the student will be able to:

1. *Familiarise network components and structured cabling.*
2. *Write programs for various communication algorithms.*
3. *Familiarise configuration of various servers and firewalls.*
4. *Do simulations of various network protocols using a network simulator such as ns3.*
5. *Design of communication system using embedded boards.*

Course Articulation Matrix:

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

1-Slightly; 2-Moderately; 3-Substantially

Cycle-I

1. Familiarizing computer network components–
   a) Cables
   b) Connector
   c) Switches and Hub
   d) Router
   e) Network Cards etc.
2. Structured cabling, Creating VLAN using switches and routers, Experiments on subnetting and supernetting.
3. Packet capture and analysis using WireShark.
4. Socket programming–Implement TCP and UDP in UNIX domain, Single chatting program, Multi Chat program using Multithread, Applet chatting.

Cycle- II

1. Program to test error detection and correction codes.
2. Program to test various data compression algorithms.
3. Program to test public key and symmetric key cryptography methods.
4. Program to test various message digest algorithms.

Cycle - lll

1. Simulations of CSMA / CD, Aloha and Slotted Aloha protocols.

2. Simulations to test ARP and RARP.
3. Simulation to test CSMA/CA.
4. Simulations to test congestion and flow control methods in TCP and UDP.
5. Simulations to test various routing protocols.
6. Programs using pcap libraries to packet capture and analysis.
7. Install and configure various servers- file server, ssh server, web server, database server etc.
8. ACL, firewall and use of "iptables".
9. Design of communication system using GSM, 3G,GPS and RFID modules using Raspberrypi, Arduino or Edison Board .

References:

1. Richard Stevens,W., Unix network programming, The Sockets Networking API,Vol.1,3rd edition, Addison-Wesley Professional ISBN:9780131411555.
2. James F. Kurose and Keith W. Ross, Computer Networking – A Top-Down Approach 7 th Edition, Pearson Education, ISBN: 978-1292153599.
3. Douglas E. Comer, Hands-on Networking with Internet Technologies, Pearson Education.
4. Todd Lammle, CCNA: Cisco Certified Network Associate Study Guide,John Wiley and Sons, ISBN:9780470410486.
5. Emad Aboelela, Network Simulation Experiments Manual, The Morgan Kaufmann Series in Networking, Elsevier. ISBN: 9780123852113.
6. Jack L. Burbank, An Introduction to Network Simulator 3(ns3), Wiley-Blackwell. ISBN: 978111815899.

23-202 -0611 - MINI PROJECT

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify project topic of current relevance.*
2. *Explain software development cycle with emphasis on different processes - requirements, design and implementation phases.*
3. *Develop confidence at having conceptualized, designed and implemented a working, medium sized project.*
4. *Learn how to work as a team and to do a working project on time with each student taking responsibility for their part in the project.*
5. *Familiarize document and report preparation.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	2	3	3	3	3				1	2		1	3	3		
CO2	2	1	1		3				1	2		1	3	3		
CO3	2	3	3	3	3				1	2		1	3	3		
CO4	2	1	1		3				1	2		1	3	3		
CO5									1			1		1		

1-Slightly; 2-Moderately; 3-Substantially

The students are expected to develop an application in the field of embedded system / mobile application / any other current relevant topic. They have to do a proper system study and prepare SRS and design documents.

Each batch comprising of 3 to 5 students. Each student shall submit a project report at the end of the semester. The project report should contain the design and engineering documentation and test results. Product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations and aesthetics / ergonomic aspects taken care of in the project shall be given due weight.

Guidelines for evaluation:

i) Attendance and Regularity		5
ii) Work knowledge and Involvement		15
iii) End-Semester presentation & Oral examination		10
iv) Level of completion and demonstration of functionality/specifications		10
v) Project Report		10
	Total	50 marks

Note: External projects and R&D projects need not be encouraged at this level. Points (i) & (ii) to be evaluated by the project guide & coordinator and the rest by the final evaluation team comprising of 3 teachers including the project guide.

23-202-0606 TO 23-202-0609 PROFESSIONAL ELECTIVE – II
23-202 -0606(IE) - NEURAL NETWORKS AND DEEP LEARNING

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify the basic concepts of deep learning.*
2. *Analyse the deep learning architectures which are appropriate for various types of learning tasks in different domains.*
3. *Illustrate use of TensorFlow libraries to implement deep neural networks.*
4. *Apply TensorFlow in NLP applications.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2															1
CO2	3	2	2										1			3
CO3	2	2	3	2									1			1
CO4	2	2	3	2									1			2

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to neural networks: Artificial neural networks, Biological neural networks, Basic Models of Artificial Neural Networks: Connections, Learning, Activation functions, Important terminologies of Artificial Neural Networks, McCulloch–Pitts neuron. Perceptron: architecture, algorithm, perceptron learning rule convergence theorem.

Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation.

Module II

Convolutional Neural Networks: Architectures, convolution / pooling layers.

TensorFlow: Introduction, tensors, tensor properties, basic tensor methods.

CNN in TensorFlow: Applying convolution in TensorFlow, applying pool operations in TensorFlow, Applying Dropout operation in Tensor Flow, Implementation of CNN in TensorFlow.

Module III

Recurrent Neural Networks: Back propagation through time, Bidirectional RNNs, Long Short-Term Memory, Gated Recurrent Units, Bidirectional LSTMs. RNN in TensorFlow: TensorFlow LSTM useful classes and methods, Implementation of RNN in TensorFlow.

Module IV

Applications of Deep Learning to NLP: Introduction, working with bag of words, Implementing TF-IDF, Working with skip-gram embeddings, CBOW embeddings, making predictions with word2vec, using doc2vec for sentiment analysis.

References:

1. Laurene Fausett, Fundamentals of Neural Networks, Prentice Hall, New Jersey, 2007.
2. Ian Goodfellow,Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.
3. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media,2019
4. Rodolfo Bonnin, Building Machine Learning Projects with TensorFlow, Packt Publishing, 2016.
5. Nick McClure, Tensorflow Machine Learning Cookbook, Packt Publishing, 2017.
6. Principles of Soft Computing, S N Sivanandam, S N Deepa.

23-202 -0607 - DISTRIBUTED COMPUTING

Course Outcomes

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

1. Distinguish the theoretical and conceptual foundations of distributed computing.

2. Design client server model and peer to peer model for communication.

3. Recognise issues and challenges in the distributed system design.

4. Identify the problems in developing distributed applications.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2									3	3			
CO2	3	3	3	2								3		3		
CO3	3	2	3									2		2		
CO4	3	3	2									2				

1-Slightly; 2-Moderately; 3-Substantially

Module-I

Characterization of Distributed systems – Introduction – Challenges , System Models, Interprocess communication, Indirect communication, Distributed Objects and Remote Invocation –Case Study - Java RMI.

Module-II

Operating System Support- The Operating system layer – Protection- Processes and Threads- Operating System architecture. Distributed file Systems- Introduction-File Service architecture– Case study Sun NFS. Name services

Module-III

Time and coordination. Synchronizing physical clocks -logical time and logical clocks. Distributed coordination –distributed mutual exclusion – elections. Replication – basic architectural model – consistency and request ordering.

Module-IV

Distributed DBMS Architecture- Distributed Database Design –Query Decomposition and Data Localization-Distributed transactions – concurrency control in distributed transactions– distributed deadlocks –transaction recovery.

References

1. George Coulouris, Jean Dollimore, Tim Kindberg, Distributed Systems – Concepts and design, Fourth Edition, Pearson Education, 2011. ISBN 978-81-317-1840-7

2. Sunita Mahajan, Seema Shah, Distributed Computing, Oxford University Press, 2010. ISBN: 0-19-806186-2.
3. Andrew S. Tanenbaum, Distributed Operating Systems, Pearson Education, 2011. ISBN: 978-81-7758-179-9.
4. Randy Chow, Theodore Johnson, Distributed Operating Systems and Algorithm Analysis, Pearson Education, 2011. ISBN: 978-81-317-2859-8.
5. TamerOzsu, M., Patrick Valduriez, Principles of Distributed Database Systems, Second Edition, Pearson Education.

23-202 -0608 - DIGITAL IMAGE PROCESSING

Course Outcomes:

On completion of this course the student will be able to:

1. *Outline the basics of image processing.*
2. *Interpret image enhancement techniques.*
3. *Illustrate image restoration and segmentation techniques.*
4. *Infer image compression techniques.*
5. *Identify current technologies and applications of image processing.*
6. *Have a general awareness of DIP use cases in medical domain*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2									3			3			
CO2	2	3	3							2			2	2		
CO3	2	2	2	2						3			3	3		
CO4		3	3	3	3				3			3		2		
CO5				3	3	2	2	2	3		1	3			2	2
CO6					3	2	2	2	3		1	3			2	2

1-Slightly;2-Moderately;3-Substantially

Module I

Introduction-Digital image representation, Fundamental steps in image processing, Components of image processing system. Digital image fundamentals- Sampling and quantization, relationship between pixels. Image transforms-2D DFT, DCT, Walsh-Hadamard transform, Haar Transform, Wavelet Transform.

Module II

Image enhancement-Spatial domain methods-Basic Gray Level Transformations, Histogram Processing. Basics of Spatial Filtering-Smoothing, Sharpening. Frequency Domain Methods-low pass filters, high pass filters, homomorphic filters.

Module III

Image restoration- Degradation model, Inverse filtering, Wiener filter, constrained least squares filtering. Morphological Image Processing- Dilation and Erosion, Opening and Closing. Fundamentals of color image processing- Color models-RGB, CMY, CMYK, and HSI. Pseudocolor Image processing- Intensity slicing, gray level to color transformation.

Module IV

Image Segmentation-Detection of Discontinuities, edge linking and boundary detection, thresholding, region based segmentation, use of motion in segmentation.

Image compression-Error-free Compression-variable length coding, LZW coding, bit plane coding, lossless predictive coding, Lossy compression- lossy predictive coding, transform coding, wavelet coding, Image compression standards. Use cases in medical image processing such as cancer detection, disease diagnosis and so on.

References:

1. Rafael C., Gonzalez & Woods R.E., Digital Image Processing, 3rd edition, Pearson Education, 2008.
2. Anil K Jain, Fundamentals of Digital Image Processing, Prentice Hall India, 2010.
3. William K Pratt, Digital Image Processing, 4th Edition, John Wiley and Sons, 2007.
4. Ioannis Pittas, Digital Image Processing Algorithms and Applications, John Wiley, 2000

23-202 -0609 - INFORMATION RETRIEVAL

Course Outcomes:

1. *Students will get the understanding different Information retrieval model.*
2. *Students will get to know about evaluation methods of the information retrieval model.*
3. *Students will get to know the challenges associated with each topic.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	3								1		2		3
CO2	2	3	2	1								1		1	2	
CO3	2			2								1		3	3	

1-Slightly; 2-Moderately; 3-Substantially

Module 1

Introduction to Information retrieval: Information retrieval process, Indexing, Information retrieval model, Boolean retrieval model. Dictionary and Postings: Tokenization, Stop words, Stemming, Inverted index, Skip pointers, Phrase queries

Module 2

Tolerant Retrieval: Wild card queries, Permuterm index, Bigram index, Spelling correction, Edit distance, Jaccard coefficient, Soundex. Term Weighting and Vector Space Model. Evaluation: Precision, Recall, F-measure, E-measure, Normalized recall, Evaluation problems.

Module 3

Latent Semantic Indexing: Eigen vectors, Singular value decomposition, Low rank approximation, Problems with Lexical Semantics. Query Expansion: Relevance feedback, Rocchio algorithm, Probabilistic relevance feedback, Query Expansion and its types, Query drift, Probabilistic Information Retrieval: Probabilistic relevance feedback, Probability ranking principle, Binary Independence Model, Bayesian network for text retrieval

Module 4

XML Indexing and Search: Data vs. Text-centric XML, Text-Centric XML retrieval, Structural terms, Content Based Image Retrieval: Introduction to content Based Image retrieval, Challenges in Image retrieval, Image representation, Indexing and retrieving images, Relevance feedback.

References:

1. Introduction to Information Retrieval by Christopher D. Manning
2. Natural Language Processing And Information Retrieval by Tanveer Siddiqui and U. S. Tiwary

SEMESTER VII

23-202 -0701 - PRINCIPLES OF MANAGEMENT

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the basic principles underlying in the management of organizations.

2. Get exposure in all industrial management functions.

3. Get knowledge to analyse the financial accounts and ratios.

4. Understand the principles of economics and IPR aspects.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2			1				2	2	2		1			
CO2	1	2			1				2	2	2		1			
CO3	1	2			1				2	2	2		1			
CO4	1	2			1				2	2	2		1			

1-Slightly; 2-Moderately; 3-Substantially

Module I

Basic concept of Management: Introduction, definitions of managements, characteristics of management, levels of management, management skills, scientific management - Contributions of Gilbreth and Gantt. Functions of Management: Planning, forecasting, organizing, staffing, directing, motivating, controlling, co-coordinating, communicating, decision making.

Organization: Introduction, definition of organization, elements of organization, process of organization, principles of organization, formal and informal organization, organization structure, types of organization structure.

Forms of Business Organization: Concept of ownership organization, types of ownership, Individual ownership, partnership, joint stock company, private and limited company, co-operative organizations, state ownership, public corporation

Module II

Production planning and control: Objectives and functions.

Production management: Structure, objectives, productivity index, modern productivity improvement techniques.

Inventory Management: Functions, classifications of inventory, basic inventory models, inventory costs, Economic order quantity (EOQ). Materials Requirement Planning – Objectives, Functions and methods.

Project Management: Functions, Characteristics, Feasibility studies, Project network analysis – PERT/CPM.

Module III

Human Resource Management: Introduction, definition, objectives, characteristics, functions, principles and organization of HR management, Recruitment, selection process and training methods, Wages and incentives, Job evaluation and merit rating, Industrial accidents-causes and related issues Marketing Management: Introduction, Functions and objectives, Marketing environment and Information, Market segmentation, Distribution channels, Consumer and Industrial markets, Consumer behavior, Pricing methods, Sales promotion and Advertisement. Market research: Objectives and methods.

Module IV

Financial Management: Basic functions, Capital-classifications, Sources of funds, Financial accounts-types, basic concepts and importance, Financial ratios and its significance, Types of budgets and budgetary controls, Overheads, Standard costing, Marginal costing.

Economics: Principles of economics, problem of scarcity, demand, supply, utility, time value of money, inflation and deflation, Consumer Demand Curve.

IPR Aspects: General introduction to IPR, eligibility for patent, patent information and prior art search, procedure for filing patent application, rights of patent owner and duration, ownership of patent and commercialization.

References:

1. Fraidoon Mazda, Engineering Management, Addison-Wesley, (1997).
2. Koontz and O'Donnell, Essentials of Management, McGraw Hill, (1978).
3. Kotler P., Marketing Management, Prentice Hall, (2011).
4. Prasanna Chandra, Finance Management, Tata McGraw Hill, (2008).
5. Monks, J. G., Operations Management, McGraw Hill, (1982).
6. Production and Operations Management, PHI (2010)

23-202 -0702 - ADVANCED ARCHITECTURE AND PARALLEL PROCESSING

Course Outcomes:

On completion of this course the student will be able to:

1. *Summarize multiprocessors and multicomputer.*
2. *Utilize message passing mechanisms.*
3. *Outline memory hierarchy and caching mechanisms.*
4. *Elaborate pipelining and parallel programming.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3							2			3	1
CO2	2	2	1	2	2							2			2	1
CO3	3	1	1	2	3							2			2	1
CO4	3	2	2	2	3							2			2	2

1-Slightly; 2-Moderately; 3-Substantially

Module I

Parallel computer models-state of computing, multiprocessors and multicomputer, multivector and SIMD computers, PRAM and VLSI models, architectural development tracks. Program and Network Properties-Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanism, System Interconnect Architectures. Principles of Scalable Performance-Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws, Scalability Analysis and Approaches.

Module II

Processors and Memory Hierarchy- Advanced Processor Technology, Superscalar and Vector Processors, Memory hierarchy technology, virtual memory technology. Bus, Cache and Shared Memory- Bus Systems, Cache Memory Organizations, Shared-Memory Organizations, Sequential and Weak Consistency Models.

Module III

Pipelining and Superscalar Techniques- Linear Pipeline Processors, Nonlinear Pipeline Processors, Instruction Pipeline design, Arithmetic Pipeline Design. Multiprocessor and Multicomputer- Multiprocessor System Interconnects, Cache Coherence and Synchronization Mechanisms, Message Passing Mechanisms. Vector Processing Principles.

Module IV

Parallel Programming- Parallel Programming Models, Parallel Languages and Compilers. Instruction Level parallelism- Design issues, model of typical processor, compiler-directed

instruction level parallelism, operand forwarding, Tomsula's algorithm, branch prediction, thread level parallelism.

References:

1. Kai Hwang, Naresh Jotwani, "Advanced Computer Architecture parallelism, Scalability, Programmability", 3rd edition, McGraw-Hill Education, 2017, ISBN-13:978-9339220921
2. Dezso Sima, Terence Fountain, Peter Karasuk, "Advanced Computer Architecture-A design space approach", Pearson Education, 2012, ISBN-13:978-8131702086.
3. Sajjan G Shiva, "Advanced Computer Architecture", CRC Taylor & Francis, 2006.
4. David E Culler, Jaswinder Pal Singh, Anoop Gupta, "Parallel Computer Architecture", Elsevier.
5. Hwang and Briggs, "Computer Architecture and Parallel Processing", McGraw Hill, 2017, ISBN-13:978-1259029141

23-202-0703 BIG DATA ANALYTICS

Course Outcomes:

On completion of this course the student will be able to:

1. *Understand the key concepts, characteristics, and terminologies related to Big Data.*
2. *Learn the MapReduce programming model and its components within the Hadoop ecosystem.*
3. *Compare and analyze Apache Hadoop with other Big Data platforms.*
4. *Explore real-world industry use cases and applications of Big Data Analytics.*
5. *Understand how to scale existing machine learning applications to handle Big Data.*

Course Articulation Matrix:

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

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to Big Data: Evolution of Big Data, 5Vs (Volume, Velocity, Variety, Veracity, Value) and other characteristics, Data storage and analysis challenges, Big Data Analytics overview, Traditional vs. Big Data analytical architectures, Challenges in Big Data analytics

MapReduce Basics: Functional programming concepts, Map and Reduce functions, Execution framework and workflow, Partitioners and Combiners, Word count example using MapReduce

Module II

MapReduce Algorithm Design: Local aggregation techniques, Combiners and In-Mapper combining, Ensuring algorithmic correctness with local aggregation, Pairs and Stripes data organization, Computing relative frequencies, Secondary sorting, Relational joins

Hadoop Ecosystem, Hadoop Distributed File System (HDFS), HDFS architecture and use cases, Hadoop cluster architecture, Need for Hadoop framework, Comparison with other systems, Hadoop ecosystem technologies: Serialization (Avro), Coordination (ZooKeeper), Databases (HBase, Hive), Scripting (Pig), Streaming (Flink, Storm), Implementing MapReduce with Hadoop

Module III

Big Data Management Tools -Pig: Data model, use cases, Hive: Architecture, HiveQL, Hive vs. Pig, HBase: MapReduce integration, ZooKeeper, Sqoop: Importing/exporting data between Hadoop and RDBMS, Hadoop Ecosystem Integration, Importing data into Hive, Using partitioned Hive tables, Handling special delimiters

Apache Spark: Introduction to Spark and its architecture, Comparison of Hadoop vs. Spark, Use cases and applications of Spark

Module IV

Recent Trends in Big Data Analytics: Artificial Intelligence in Big Data analytics, Streaming data analytics, Databases for Big Data: Cassandra, Neo4j, Introduction to NoSQL: Features, advantages, disadvantages, Comparison of NoSQL and RDBMS
Business Intelligence vs. Big Data: Data warehousing and Hadoop coexistence, Security techniques for Big Data (cryptographic methods)
Case Studies and Research Problems: Algorithms for mining massive datasets, Big Data projects for e-Governance, Other real-world use cases and applications

References:

1. Jimmy Lin and Chris Dyer, Morgan & Claypool, Data-Intensive Text Processing with Map Reduce, Synthesis Lectures, 2010.
2. Seema Acharya and Subhashini Chellappan, Big Data and Analytics, Wiley Publication, 2015.
3. Donald Miner and Adam Shook, Map Reduce Design Pattern, O Reilly, 4th Edition, 2015.
4. Mike Frampton, Mastering Apache Spark, Packt Publishing, 2015.
5. Tom White, Hadoop: The Definitive Guide, O Reilly, 4th Edition, 2015.
6. Kathleen Ting, Jarek Jarcec Cecho, Apache Sqoop cookbook, O Reilly Media Inc, 2013.
7. Karau, H. et.al, Learning Spark: lightning-fast big data analysis, OReilly Publishers.

23-202 -0712 - LANGUAGE PROCESSORS LABORATORY

Course Outcomes:

On completion of this course the student will be able to:

1. *Design deterministic finite automata for any language.*
2. *Implement lexical analyser.*
3. *Implement YACC programs for any context free grammar.*
4. *Design any top-down or bottom-up parsing algorithm.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2													
CO2	1	2	2													
CO3	1	2	2													
CO4	1	2	3													

1-Slightly; 2-Moderately; 3-Substantially

Cycle-I

Implementation of Deterministic Finite Automata.

Cycle- II

Implementation of LEX programs.

Cycle-III

Implementation of YACC programs.

Cycle-IV

Implementation of parsing algorithms.

References:

1. Hopcroft J. E., Motwani,R. and Ullman J. D., Introduction to Automata Theory, Languages, and Computation, 3 rd Edition, ISBN : 978-03-214-5536-9.
2. Padma Reddy, A.M., Finite Automata and Formal Languages,1st Edition, Pearson , Education ISBN 978-81-317-6047-5.
3. Mishra, K.L.P. and Chandrasekaran, N., Theory of Computer Science, Automata, Languages and Computation, 3 rd Edition, PHI, 2014, ISBN 978-81-203-2968-3.
4. John R Levine, Tony Mason and Doug Brown, Lex & YAcc, Oreilly, 2nd edition6.web reference: Lex and Yacc Tutorial by Tom Niemann

23-202 -0713 - DATA ANALYTICS LAB

Course Outcomes:

On completion of this course the student will be able to:

1. *Implement numerical and statistical analysis on various data source*
2. *Implement linear regression technique on numerical data for prediction*
3. *Apply data processing and dimensionality reduction methods on raw data*
4. *Implement classification, clustering and association rule mining algorithms on datasets.*
5. *Demonstrate the knowledge of bigdata analytics and implement different file management task in Hadoop.*
6. *Develop problem solving and critical thinking skills in fundamental enable techniques such as Map Reduce and Hadoop.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3	3		1				2		3			2
CO2	3	3	3		3			1				2	3			2
CO3	3	3	3	3					1				3			2
CO4	3	3	3	3	3					1			3			2
CO5	3	2	3		3	3			1					3	2	
CO6		3		3		3						3	3			2

1-Slightly; 2-Moderately; 3-Substantially

Cycle I

1. To perform numerical operations (MIN, MAX, SUM, AVG, SQRT) using R
2. To perform matrix addition, subtraction, multiplication, inverse transpose and division operation with R.
3. To perform data pre-processing operations (i) Handling missing data (ii) Min-Max normalization

Cycle II

1. Implement Simple Linear Regression using R.
2. Implement K-means clustering operation and visualize using iris data set.
3. Implement using KNN classification technique to diagnose any disease and plot the results.
4. Implement the Market Basket Analysis with Association rules (Apriori)

Cycle III

1. Installation of Hadoop framework, its components and study of the HADOOP ecosystem.
2. Implement a word count program using MapReduce.
3. Implement the following file management tasks in Hadoop.
4. Adding files and directories (2) Retrieving files (3) Deleting files.

Note: Open-source tools preferred to conduct the lab should be (R, Python etc.)

References

1. Bharti Motwani, Data Analytics with R, publisher: Wiley (2019), ISBN: 9788126576463.
2. Anil Maheshwari, Data Analytics Made Accessible: publisher: McGraw Hill India, Edition 2017, ISBN-9789352604180.
3. Tom White, Hadoop: The Definitive Guide by, 2009, Publisher(s): O'Reilly Media, Inc, ISBN: 9780596521974.

23-202 -0714 - ENTREPRENEURSHIP DEVELOPMENT

Course Outcomes

On completion of this course the student will be able to

1. *Recognize different types of entrepreneurial ventures*
2. *Interpret opportunity and risk analysis*
3. *Summarize the strategies for valuing their own company, and how venture capitalist and angel investors use valuations in negotiating milestones, influence and control*
4. *Determine correct marketing mix and how to position the company in the market by using analytical tools*
5. *Explain how organizations operate and their process matrices*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2		1			1		1	2	1			1		
CO2		2		1			1			2	1			1		
CO3		2		1			1		1	2	1			1		
CO4		2		1			1		1	2	1			1		
CO5		2		1			1		1	2	1			1		

1-Slightly; 2-Moderately; 3-Substantially

Module I

Market Research: Introduction to Entrepreneurship, Profile of the Entrepreneur, Market Gap /Opportunity Analysis, Market Research Methods, Defining the Focal Market: Market Segmentation, Industry analyzing – Research / Competitive Analysis.

Types of Companies and Organizations: Company/ Organization Types, Legal Aspects, Taxation, Government Liaison, Building the Team, Mergers and Acquisitions, import and export nuances.

Module II

Business Finance: Shares and Stakes, Valuation, Finance Creation (Investors / Financers), Revenue Plans and Projections, Financial Ratios, Business Lifecycle, Break Even, Balance Sheets, game theory.

Module III

Marketing: Marketing Basics, Marketing Strategy and Brand Positioning, Plans and Execution Techniques, Marketing Analytics, Online Marketing, Product Life Cycle.

Sales: Understanding Sales, Pitching Techniques, Sales strategies, Inside Sales v/s Outside Sales, RFP

Module IV

Operations Management and HR: Operational Basics, Process Analysis, Productivity, Quality Start-ups: Start-up Basics, Terms, Start-up Financing, Start-up Incubation, Getting Listed

References:

1. David Kidder. The Startup Playbook: Secrets of the Fastest-Growing Start-ups from their Founding Entrepreneurs
2. Ed Catmull. Creativity, Inc.: Overcoming the Unseen Forces That Stand in the Way of True Inspiration
3. Bhargava, S. (2003). Transformational leadership: Value based management for Indian Organizations (Ed.). New Delhi: Response-Sage.
4. Hisrich, R. D. & Peters, M. P. (2001). Entrepreneurship: Starting, developing, and managing a new enterprise (5th Ed.). New York: McGraw-Hill.
5. Verma, J. C., & Singh, G. (2002). Small business and industry: A handbook for entrepreneurs. New Delhi: Response-Sage.
6. Prasanna Chandra, Financial Management: Theory and Practice, Tata McGraw Hills, 6th Edn, 2004

23-202 -0715 - PROJECT PHASE I

Course Outcomes:

On completion of the Project, the student will be able to:

1. *Conduct a comprehensive literature survey to identify and analyze a specific problem statement in Mechanical Engineering.*
2. *Formulate a well-structured project proposal by synthesizing literature insights and engaging with industry experts and academic mentors.*
3. *Develop a detailed execution plan for Phase II, including resource allocation, timeline, and risk management strategies.*
4. *Demonstrate technical communication skills through a properly formatted thesis document and professional PowerPoint presentations.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	1			1		1		1	3	3	1	1
CO2	3	3	3	3	1			1		1		1	3	3	1	
CO3	3	3	3	3	1			1		1		1	3	3	1	1
CO4	3	3	3	3	1			1		1		1	3	3	1	

1-Slightly; 2-Moderately; 3-Substantially

This course aims to equip undergraduate students in Computer Science and Engineering with the essential skills and knowledge required to successfully navigate through the initial phases of a project. Students will learn to conduct a comprehensive literature survey, identify and focus on a specific problem, formulate a project proposal, develop an execution plan for Phase II, and enhance their technical communication skills through thesis preparation and presentation techniques.

Topics to be Covered

Introduction to Literature Survey and Problem Identification: Understanding the significance of literature survey in research, Techniques for conducting a thorough literature review, identifying relevant areas of study within Computer Science and Engineering, and Narrowing down to a specific problem statement.

Formulating a Project Proposal: Guidelines for structuring a project proposal, the importance of consultation with industry experts and academic mentors, incorporating insights from the literature survey into the proposal, developing a clear and concise problem statement and objectives

Project Execution Planning: Principles of project management and planning, developing a detailed execution plan for Phase II of the project, identifying resources, timeline, and milestones.

Enhancing Presentation Skills: Understanding the elements of effective presentations, Techniques for engaging and communicating technical information, Hands-on practice sessions on preparing and delivering technical presentations, and Peer feedback and improvement strategies.

Technical Communication: Thesis Preparation- Structure and format of a thesis document, Guidelines for writing thesis chapters- introduction, literature review, methodology, results, discussion, conclusion, Typesetting using Word or LaTeX for professional thesis formatting. Prepare PPTs for technical presentation.

Assessment:

Guidelines for evaluation:		Marks
1	Attendance and Regularity	10
2	Literature Survey and Problem Identification	10 Machi, L. A., and McEvoy, B. T., The Literature Review: Six Steps to Success, Corwin Press, (2016). Friedland, A., and Folt, C., Writing Successful Science Proposals, Yale University Press, (2009). Duarte, N., Slide:ology: The Art and Science of Creating Great Presentations, O'Reilly Media, (2008). Joyner, R. L., Rouse, W. A., and Glatthorn, A. A., Writing the Winning Thesis or Dissertation: A Step-by-Step Guide, Corwin Press, (2013).
3	Project Proposal	10
4	Project Execution Plan	10
5	Thesis and Presentation Skills Assessment	10
	Total	50

Note: Points (1)-(3) are to be evaluated by the respective project guides and project coordinator based on continuous evaluation. (4)- (5) to be evaluated by the final evaluation team comprising of 3 internal Examiners.

References:

1. Jesson, J., Matheson, L., and Lacey, F. M., Doing Your Literature Review: Traditional and Systematic Techniques, Sage Publications Ltd, (2011).

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23-202 -0716 - INTERNSHIP-III

Course Outcomes:

On completion of this course the student will be able to:

1. *Understand the real time technical/managerial skills required and relevant to the subject area of internship.*
2. *Initiate a habit of proper daily diary writing with adequacy and quality of information recorded, drawing, sketches and data, thought process and the proper organisation of the information gained during the internship.*
3. *Conceive the pros and cons of working in a real time industrial environment and the wonderful results which could evolve through team-work.*
4. *Present and defend self-prepared and corrected internship report (with the help of internship guide/industry mentors) of a self-created work to a peer audience.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	1	1			2	1		2	2	2	1	2
CO2	2	3	1	2	2	1			2	2	1	1	2	2		1
CO3	2	2	3	2	2	1			2	2	1	1	2	2		2
CO4	2	2	2	3	2	1			2	2	1	1	2	2		1

1-Slightly; 2-Moderately; 3-Substantially

Internship Guidelines

- An internship plan has to be prepared by the interns incorporating the job description/internship duties, name of the project, if any and internship schedule and expected learning outcomes in consultation with industry supervisor/mentor and institute faculty.
- A detailed training report in the prescribed format shall be submitted at the end of the internship.
- Training Certificate from the industry for the prescribed period shall be submitted at the end of the internship.
- The work shall be reviewed and evaluated periodically.
- Orientation of interns, resource requirement of interns, monitoring of interns progress on a daily basis shall be carried out by the industry offering internship in addition to ensuring safety and welfare of the interns.

A committee consisting of the Internship Coordinator (nominated by the Head of the Department/Division), faculty mentor, and at least one senior faculty member at the level of Associate Professor or above will carry out the final review.

Guidelines for evaluation:

1.	Regularity and progress of work	10
2.	Work knowledge and Involvement	10
3.	Semester End presentation and oral examination	10
4.	Level of completion of internship	10
5.	Internship Report – Presentation style and content	10
Total		**50** Marks

23-202-0704 TO 23-202-0707 PROFESSIONAL ELECTIVE – III

23-202 -0704 (IE) - BLOCKCHAIN TECHNOLOGIES

Course Outcomes:

On completion of this course the student will be able to:

1. *Understand how block chain systems work.*
2. *Familiarize the functional / operational aspects of cryptocurrency ecosystem.*
3. *Design, build and deploy smart contract and distributed applications.*
4. *Design and develop smart contracts for Ethereum blockchain.*
5. *Familiarize with any one block chain platform.*
6. *Understand the industry use cases for block chain.*

Course Articulation Matrix:

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

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction – Distributed system – Blockchain Definition, architecture, elements of blockchain, benefits and limitations, types of blockchain. Consensus – definition, types, consensus in blockchain Byzantine fault tolerance (BFT) algorithms – Practical Byzantine Fault Tolerance (PBFT), Proof of work (PoW), Proof of stake (PoS)

Module II

Introduction – Bitcoin – Digital Keys and addresses – Transactions, Lifecycle, coinbase transactions, transaction validation.– Blockchain – Mining – Wallets-Types of Wallets

Use cases of Blockchain technology – Government, Health care, Finance, Supply chain management.

Module III

Decentralization – Decentralization using blockchain – Methods of decentralization – Routes to decentralization – Blockchain and full ecosystem decentralization – Decentralized Applications, Decentralized autonomous organizations – platforms for decentralization smart contracts – Definition, Smart contract templates, Oracles, Types of oracles, Deploying smart contracts

Module IV

Ethereum – Introduction – Ethereum network – Components of Ethereum ecosystem,
EVM – Development tools and Frameworks – Remix – Truffle – Solidity language
Simple smart contract contracts using solidity.

References:

1. Imran Bashin, Mastering Block chain, 2nd edition, 2018 packt publishing
2. Aravind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and steven Goldfeder, Bitcoin and crypto currency Technologies: A comprehensive Introduction, Princeton University Press
3. Ritesh Modi, Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain, Packt Publishing, First edition, 2018.
4. Kumar Saurabh, Ashutosh Saxena, Blockchain Technology: Concepts and Applications, First Edition, Wiley Publications, First edition, 2020.
5. Chandramouli Subramanian, Asha A George, et al, Blockchain Technology, Universities Press (India) Pvt. Ltd, First edition, August 2020.
6. Lorne Lantz, Daniel Cawrey, Mastering Blockchain: Unlocking the Power of cryptocurrencies, Smart Contracts, and Decentralized Applications, O'Reilly Media, First edition, 2020.
7. Andreas M. Antonopoulos, Gavin Wood, Mastering Ethereum: Building Smart Contracts and DApps, O'Reilly Media, First edition, 2018.

23-202 -0705 - INTERNET OF THINGS AND APPLICATIONS

Course Outcomes:

On completion of this course the student will be able to:

1. *Familiarise IoT and its components.*
2. *Familiarise programming the microcontroller for IoT.*
3. *Get a deep insight into the market perspective of IoT.*
4. *Learn data and knowledge management and use of Devices in IoT Technology.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2									1		1		
CO2	2		3	2								2		2		2
CO3	2		1	3								2			2	
CO4	1		2	3								2				1

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to Internet of Things: Introduction – Definition - phases – Foundations – Policy - Challenges and Issues – identification - security –privacy. Components in internet of things: Control Units-Sensors -Communication modules - Power Sources -Communication Technologies - RFID - Bluetooth –Zigbee – Wifi – RF links - Mobile Internet - Wired Communication.

Module II

Programming the Microcontroller for IoT: Basics of Sensors and actuators - examples and working principles of sensors and actuators - Arduino/Equivalent Microcontroller platform- Setting up the board - Programming for IoT- Reading from Sensors; Communication: Connecting microcontroller with mobile devices – communication through Bluetooth and USB - connection with the internet using wifi / Ethernet.

Module III

Fundamental Concepts of Agility and Autonomy -Enabling Autonomy and Agility by the Internet of Things - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things - Agents for the Behaviour of Objects.

Module IV

Business Models for the Internet of Things: The Meaning of DiY in the Network Society - Sensor-actuator technologies and Middleware as a basis for a DiY Service Creation Framework - Device Integration - Middleware Technologies Needed for a DiY Internet of Things.

References:

1.Charalampos Doukas, Building Internet of Things with the Arduino, CreateSpace Independent Publishing Platform, 2012, ISBN 13: 978-1470023430.

2. Dieter Uckelmann et.al, "Architecting the Internet of Things", Springer, 2011, ISBN 13: 978-3642191565.

3. Luigi Atzor et.al, The Internet of Things: A survey, Journal on Networks, Elsevier, 2010.

4. Rajkumar Buyya; Amir Vahid Dastjerdi , "Internet of Things", Morgan Kaufmann, 2016

5. Peter Waher, "Learning Internet of Things", Packt Publishing, 2015

23-202 -0706 - BIOMETRIC TECHNOLOGIES

Course Outcomes:

On completion of this course the student will be able to:
1. Explain the need and different types of biometric systems
2. Describe the characteristics and deployment of systems using physical biometric systems
3. Describe the characteristics and deployment of different biometric interfaces.
4. Analyse different applications and suggest the suitable biometric system for a given application.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3				2	2										
CO2	2	3	3		2	1							2	1		
CO3	3	2	3		2	1								3		
CO4	1	3	3	2	1						2					

1-Slightly; 2-Moderately; 3-Substantially

Module I

Biometrics: Introduction - Biometrics versus traditional techniques -Authentication Methods- Benefits of Biometrics in Identification Systems-Biometric Characteristics - Key biometric processes - Performance measures in biometric systems - Assessing the privacy risks of biometrics

Module II

Different biometric standards - Designing and selecting a biometric system - Application - Key biometric terms and processes - Biometric matching methods - Accuracy in biometric system (False Match Rate, False Non Match rate, Failure to Enroll rate, Derived Metrics).

Module III

Physical Biometrics: Fingerprints - Technical description - Characteristics - Competing technology - Strengths, Weaknesses, Deployments. Facial scan technical description - Characteristics, Weaknesses, Deployments - Retina vascular pattern Technical description - Characteristics, Strength, Weaknesses, Deployments - DNA, Facial scan, Ear scan, Retina scan, Iris scan.

Module IV

Behavioural Biometrics: Handprint biometrics - Signature and handwriting technology - Technical description – Classification- Keyboard or keystroke dynamics - Voice, Data acquisition, Feature extraction - Characteristics, Strength, Weakness, Deployment, Security in biometric attack.

References:

1. Samir Nanavati, Michael Thieme and Raj Nanavati, “Biometrics – Identity Verification in a Networked World”, John Wiley and Sons, New Delhi, 2003.
2. Anil K Jain, Patrick Flynn and Arun A Ross, “Handbook of Biometrics”, Springer, USA, 2010.
3. Arun A.Ross, Anil Jain, Patrick Flynn,”handbook of biometrics”, Springer 2018 ISBN: 978-01333567284
4. John R Vacca, “Biometric Technologies and Verification Systems”, Elsevier, USA, 2009.
5. David Chek Ling Ngo, Andrew Beng Jin Teoh, Jiankun Hu, “Biometric Security”, Cambridge Scholars Publishing, 2015.
6. Paul Reid, “Biometrics for Network Security, Pearson Education, New Delhi, 2004.
7. Julian Ashbourn,” Guild to Biometric for Large Scale System: Technological, Operational and User Related Factor”, Springer Data London Limited, 2011

23-202 -0707 - CLOUD COMPUTING

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify benefits and challenges of cloud computing and services.*
2. *Explain structure of cloud architecture.*
3. *Illustrate cloud virtualization concepts.*
4. *Discuss computing infrastructure and the challenges in cloud security.*
5. *Analyze different cloud services.*

Course Articulation Matrix:

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

1-Slightly; 2-Moderately; 3-Substantially

Module I

Cloud Computing: Defining a Cloud, Cloud Computing Architecture ,Cloud Storage - Why Cloud Computing Matters - Advantages of Cloud Computing - Benefits and challenges of cloud computing, Companies in the Cloud Today - Computing Platforms and Technologies, Cloud Services - Next generation Cloud Applications.

Module II

Basics of Virtualization - Types of Virtualization - Virtual Machines and Virtualization of Clusters and Data Centers: Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data Center Automation

Module III

Cloud Reference Model, IaaS, PaaS, SaaS, Types of Clouds, Open Challenges. Inter cloud Resource Management, Resource Provisioning and Platform Deployment, Global Exchange of Cloud Resources. Cloud Security Challenges and Risks - Software-as-a-Service Security - Risk Management - Security Monitoring - Security Architecture Design - Data Security - Application Security - Virtual Machine Security – Identity Management and Access Control -Autonomic Security.

Module IV

Web-Based Application - Pros and Cons of Cloud Service Development - Types of Cloud Service Development - Software as a Service - Platform as a Service - Web Services - On-Demand Computing - Discovering Cloud Services Development Services and Tools - Amazon EC2 - Google App Engine , Windows Azure. Programming Support - Google App Engine, Amazon AWS, Windows Azure - Cloud Software Environments - Eucalyptus, Opennebula, OpenStack, Aneka, CloudSim.

References:

1. Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi. (2013). Mastering Cloud Computing. Tata McGraw Hill Education
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, Distributed and Cloud Computing, From Parallel Processing to the Internet of Things, Morgan Kaufmann Publishers, 2012.
3. John W. Rittinghouse and James F. Ransome, Cloud Computing: Implementation, Management and Security, CRC Press, 2010.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach, TMH, 2009.
5. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud O'Reilly.
6. James E. Smith, Ravi Nair, Virtual Machines: Versatile Platforms for Systems and Processes, Elsevier/Morgan Kaufmann, 2005.

23-202-0708 to 23-202-0711 OPEN ELECTIVE I

23-202 -0708 - MOBILE APPLICATION DEVELOPMENT

Course Outcomes:

On completion of this course the student will be able to:
1. Outline the architectures and infrastructure used in Mobile application development.
2. Identify user interface and client applications.
3. Evaluate the security issues involved in Mobile application development.
4. Design and develop android and iOS applications.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1			3		3									1	1	
CO2	1	1		3											1	
CO3					2		1						1			
CO4	2	2		1	1									1		2

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction- Mobility, Developing Mobile Applications. Mobile application architectures- Client-Server, Client, Server, Connection- types, synchronization. Mobile Infrastructure-Mobile Device Types, Mobile Device Components, Connection Methods.

Module II

Mobile client user interface-User interface, Application content, User experience. Mobile Client Applications- Thin client, Fat Client, Web page hosting. Client-Server data transfer- HTTP and HTML, WAP and WML.

Module III

Mobilizing Existing Application Architectures- Evolution of Enterprise Architectures, Anatomy of Enterprise Web Architecture. Security- Mobilized Enterprise Web Architecture, User to Mobile client security issues, Mobile client security issues, client-server communication security issues, existing web architectures and back-end systems security issues.

Module IV

Developing android app-Using eclipse for android development, android navigation and interface design, persistent data in android, lists in android, maps and locations in android, access to hardware and sensors in android. Developing iOS app- Using Xcode for iOS development, iOS navigation and interface design, persistent data, tables, maps and locations, access to hardware and sensors in iOS

References:

1. Valentino Lee, Heather Schneider and Robbie Schell, Mobile Applications: Architecture, Design and Development, Prentice Hall, 2004.
2. Jakob Iversen and Michael Eierman, Learning Mobile App Development, A hands- on Guide to building apps with iOS and android, Addison-wesley,2014.
3. Dawn Griffiths, Head First Android Development, O'Reilly Media, Inc, 2015.
4. Jeff McWherter, Scott Gowell, “Professional Mobile Application Development”, Wiley India Private Limited

23-202 -0709 - SYSTEM MODELING AND SIMULATION

Course Outcomes:

On completion of this course the student will be able to:

1. *Summarize the various simulation and modeling tools used.*
2. *Interpret how different modelings are done mathematically.*
3. *Outline how and when to collect simulation data for modeling.*
4. *Acquire knowledge in advancements in computer based simulation scenarios.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1					3									1		
CO2	1	1			2										1	1
CO3		1		2	2								1			
CO4					2										2	

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to simulation: Introduction – Simulation Terminologies – Advantages and Disadvantages of simulation-Application areas – Model Classification – Types of Simulation – Steps in a Simulation study – Concepts in Discrete Event Simulation

Module II

Mathematical Models: Statistical Models – Concepts – Discrete Distribution – continuous Distribution – Poisson Process – Empirical Distributions – Queuing Models – Characteristics – Notation – Queuing Systems – Properties of random numbers – Generation of Pseudo Random numbers– Techniques of generating random numbers – Testing random number generators - Generating Random Variants – Inverse Transform technique – Acceptance – Rejection technique

Module III

Analysis Of Simulation Data: Input Modeling – Data collection – Assessing sample independence – Hypothesizing distribution family with data – Parameter Estimation – Goodness-of-fit tests – Selecting input models in absence of data – Output analysis for a Single system – Terminating Simulations – Steady state simulations. Verification and validation: Model Building – Verification of Simulation Models – Calibration and Validation of Models – Validation of Model Assumptions – Validating Input – Output Transformations.

Module IV

Simulation of Computer Systems and Case Studies: Simulation Tools – Model Input – High level computer system simulation – CPU – Memory Simulation – Comparison of systems via simulation - simulation Programming techniques

References:

1. Jerry Banks and John Carson, “Discrete Event System Simulation”, 4th Edition, PHI, 2005.
2. Geoffrey Gordon, “System Simulation”, 2nd Edition, PHI, 2006, ISBN 978-81- 203-014005.
3. Frank L.Severance, “System Modeling and Simulation”, Wiley, 2001.
4. Averill M. Law and David Kelton, W., “Simulation Modeling and Analysis”, 3rd edition, McGraw Hill, 2006.

5. Jerry Banks, “Handbook of Simulation: Principles, Methodology, Advances, Applications and Practice”, Wiley, 1998.
6. Jerry Banks, Carson, J.S., Barry L. Nelson, David, M. N., Shahabudeen P. “Discret Event System Simulation”, Pearson 4th Edition.

23-202 -0710 - CYBER LAW AND ETHICS

Course Outcomes:

On completing this course, students should be able to:

1. *Explain the fundamental concepts, principles, and scope of cyber law, including threats to cyber security and the need for cyber laws.*
2. *Identify and analyze various types of cyber crimes, such as access-related crimes, financial crimes, damage to computer systems, and publishing obscene content online.*
3. *Understand the legal challenges and jurisdictional issues in cyberspace, as well as international measures and conventions related to combating cybercrime.*
4. *Analyze legal issues and regulations related to e-commerce, including electronic contracts, digital signatures, internet taxation, and intellectual property rights in cyberspace.*
5. *Evaluate intellectual property rights concerns in cyberspace, such as computer software, databases, domain name disputes, trademarks, and semiconductor design rights.*
6. *Examine copyright issues related to peer-to-peer file sharing, internet service provider liability, and content liability.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2				3		2				1				
CO2	2	2				3		2				1				
CO3	2	2				3		2				1				
CO4	2	2				3		2				1				
CO5	2	2				3		2				1				
CO6	2	2				3		2				1				

1-Slightly;2-Moderately;3-Substantially

Module I: Introduction to Cyber Law and Cyber security

Definition and scope of cyber law, Threats to cyber security and the need for cyber laws, Government requirements and mandates related to cyber security, International measures against cybercrime (OECD, Council of Europe Convention on Cybercrime, United Nations), Human rights in cyberspace

Module II: Cyber Crimes and Legal Issues

Access-related crimes: hacking- unauthorized access, Financial crimes: fraud-identity theft-phishing, Damage to computer systems and data, publishing obscene and offensive content on the internet, Jurisdiction in cyberspace and related legal challenges

Module III: E-Commerce and Intellectual Property Rights

Electronic contracts and digital signatures, Internet taxation and related legal issues, Intellectual property rights in cyberspace-computer software, databases, domain names, trademarks, semiconductor design- Copyright issues related to P2P file sharing, ISP liability, and content liability, Cybersquatting and domain name disputes

Module IV: Cyber Law in India and Information Security

Information Technology Act 2000 (India), Information security policies and procedures -corporate policies, asset classification, standards development- Employee responsibilities and human factors in information security, Role of information security professionals, Adoption of Information Security Management Standards

References

1. Nilakshi Jain, Ramesh Menon, "Cyber Security and Cyber Laws", Wiley, 2020.
2. G.T. Gangemi Sr, Rick Lehtinen, "Computer Security Basics: Computer Security for the 21st Century", 2nd Edition, Shroff, 2006.
3. Thomas R. Peltier, "Information Security Policies and Procedures: A Practitioner's Reference", 2nd Edition, Auerbach Publications, 2004.
4. Jonathan Rosenoer, "Cyber Law: The Law of the Internet", Springer, CBS Publishers & Distributors, 2011.
5. James Graham, Ryan Olson, Rick Howard, "Cyber Security Essentials", Auerbach Publications, 2010.

23-202 -0711 - BUSINESS INTELLIGENCE AND ANALYTICS

Course Outcomes:

On completion of this course the student will be able to:

1. *Explain the basic concepts and need of Business Intelligence and Analytics.*
2. *Explain how Business Intelligence and Analytics works.*
3. *Explain EPLC and what is expected of Business Intelligence and Analytics*
4. *Relate data mining and business intelligence.*
5. *Make use of existing data for prediction in Certain, Uncertain and risky situations.*
6. *Summarize the Role of Big Data and Big Data analytics.*
7. *Summarize recent and emerging trends in this area.*
8. *Apply various modeling techniques and propose an appropriate technique.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3										1				
CO2	2	3			2							1				
CO3	2	3										1	1			
CO4	2	3	2	2	2							1	1			2
CO5	2	3	2	2								2	1			2
CO6	2	3	2	2	2							2	1			2
CO7	2	3	2	2								2	1			2
CO8	2	3	2	2	2							2	1			2

1-Slightly;2-Moderately;3-Substantially

Module I

Introduction to Business Intelligence, Business Modeling and Analytics, History and Evolution, Data, information, knowledge and intelligence. Enterprise Performance Life Cycle (EPLC).Decision making: key issues, frameworks for computerized decision support: Classical Framework, Decision Support Systems, Business Intelligence, Business Analytics; Phases of decision making and assisting foundations and technologies.

Module II

Importance and Role of: Data Warehousing, Visualization and Visual Analytics. Data mining: Concepts, Process and Methods. Using Artificial Neural Network and Support Vector Machines: Learning Process and Prediction. Mathematical models for decision support. Case studies.

Module III

Certainty, Uncertainty and Risk; Decision Tables and Decision Trees; Heuristic Search, Simulation and Genetic Algorithms; Knowledge Management. Understanding Big Data and Big Data analytics. Familiarize tools and technologies enabling for Big Data analytics. Role of Data Scientist. Case studies.

Module IV

Analytics by mining/analysis of: Text, Web, Sentiment, Speech, Social Networks, Geospatial and location based data. Advanced Applications and emerging trends. Potential of Cloud Computing. Ethical and Legal issues with data collection and analytics.

References:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, “Decision Support and Business IntelligenceSystems”, 9th Edition, Pearson 2013.
2. Larissa T. Moss, S. Atre, “Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making”, Addison Wesley, 2003.
3. RN Prasad and Seema Acharya, "Fundamentals of Business Analytics", Second Edition, Wiley India,2016.
4. Carlo Vercellis, “Business Intelligence: Data Mining and Optimization for Decision Making”, Wiley Publications, 2009
5. David Loshin, "Business Intelligence", Second Edition, Elsevier Science and Technology, 2012.
6. Cindi Howson, “Successful Business Intelligence: Secrets to Making BI a Killer App”, McGraw-Hill, 2007.

SEMESTER VIII- Regular Track

23-202 -0818 - SEMINAR

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify and familiarize with some of the good publications and journals in his/her field of study.*
2. *Acquaint with preparation of independent reports, name them based on a central theme and write abstract, main body, conclusions and references.*
3. *Familiarize the effective use of tools for presentation and generate confidence in presenting a report before an audience.*
4. *Develop skills like time management, leadership quality and rapport with an audience.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	1			1				1	3	3	1	1
CO2	3	3	3	3	1			1				1	3	3	1	1
CO3	3	3	3	3	1			1				1	3	3	1	1
CO4	3	3	3	3	1			1				1	3	3	1	1

1-Slightly;2-Moderately;3-Substantially

Instructions

- Students shall individually prepare and submit a seminar report on a topic of current relevance related to the field of Computers either hardware or software.
- The reference shall include standard journals, conference proceedings, reputed magazines and textbooks, technical reports and URLs.
- The references shall be incorporated in the report following IEEE standards reflecting the state-of-art in the topic selected.
- Each student shall present a seminar for about 30 minutes duration on the selected topic.
- The report and presentation shall be evaluated by a team of internal experts comprising of 3 teachers based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

23-202-0819 - PROJECT PHASE II

Course Outcomes:

On completion of this course the student will be able to:

1. *Apply required theory and experiments on the problem related to industry / research identified in Phase-I and solve it.*
2. *Realize various steps involved in conducting a project work, like literature survey, methodology adopted (field study / survey / experiments / numerical work), analysis of data to arrive at final results and conclusions.*
3. *Familiarize proper report writing with all of its major components with proper style of writing and preparation of distinct abstract and conclusions.*
4. *Conceive the benefits of working as a team and the wonderful results which could evolve through team-work.*
5. *Present and defend self-prepared report, verified by the project guide before a peer audience.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	1			1		1		1	3	3	1	
CO2	3	3	3	3	1			1		1		1	3	3	1	1
CO3	3	3	3	3	1			1		1		1	3	3	1	
CO4	3	3	3	3	1			1		1		1	3	3	1	
CO5	3	3	3	3	1			1		1		1	3	3	1	

1-Slightly;2-Moderately;3-Substantially

The project work commencing from the seventh semester shall be completed and the project report shall be submitted by each student by the end of eighth semester. There shall be an internal examination of the project that includes a presentation, demonstration and oral examination of the project work.

Each batch of students shall develop the project designed during the seventh semester. The implementation phase shall proceed as follows:
A detailed algorithm level implementation, test data selection, validation, analysis of outputs and Necessary trial run shall be done.
Integration of hardware and software, if applicable, shall be carried out.
A detailed project report in the prescribed format shall be submitted at the end of the semester. All test results and relevant design and engineering documentation shall be included in the report. The work shall be reviewed and evaluated periodically.

A committee consisting of the Project Coordinator (appointed by the Head of the Department / Division), project guide and at least one senior faculty member will carry out the assessment based on at least one Interim review and a final review just before the submission of the project report.
The final evaluation of the project shall be done by a team of minimum 3 internal examiners including the Project guide and shall include the following:

Presentation of the work

Oral Examination

Demonstration of the project against design specifications

Quality and content of the project report

Guidelines for evaluation:

(i) Regularity and progress of work	40
(ii) Work knowledge and Involvement	40
(iii) End semester presentation and oral examination	40
(iv) Level of completion and demonstration of functionality/specifications	40
(v) Project Report – Presentation style and content	40
Total marks	200

Note: Points (i) and (ii) to be evaluated by the respective project guide and the project coordinator based on continuous evaluation. (iii)- (v) to be evaluated by the final evaluation team.

23-202 -0820 - COMPREHENSIVE VIVA VOCE

Course Outcomes:

On completion of this course the student will be able to:

1. *Summarize all the subjects covered during the course.*
2. *Build good knowledge of theory and practice.*
3. *Develop oral communication skills and positive attitude.*
4. *Attend technical interviews with confidence.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2										2	2	1		
CO2	3	2	1	1								1	1	2		
CO3	2	3	2	1	1				1			1	2	1		
CO4	3	2	1									1	2	1		

1-Slightly;2-Moderately;3-Substantially

Each student is required to appear for a viva-voce examination at the end of the complete course work. The examination panel shall comprise of Head of the Department / Division or his / her nominee and one senior faculty of the Department / Division and an external expert. The examination panel should be appointed by the University. The examiners shall evaluate the students in terms of their conceptual grasp of the course of study and practical/analysis skills in the field.

23-202-0801 TO 23-202-0804 PROFESSIONAL ELECTIVE IV

23-202 -0801 - RANDOMIZED ALGORITHMS

Course Outcomes:

On completion of this course the student will be able to

1. Learn about randomized algorithms.

2. learn about the tail inequalities and Random walks

3. Explain the difference between a randomized algorithm and deterministic algorithms

4. Learn to apply randomized algorithms to optimization problems, graph algorithms etc.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2												2		1	
CO2	2		1										2		1	
CO3	2		1										1	2	1	
CO4	2		2									2	2		1	

1-Slightly;2-Moderately;3-Substantially

Module I

Tools and Techniques: Introduction: Min-cut algorithm, Binary Planar partitions, Probabilistic Recurrence, Computation Model and Complexity.

Game-theoretic techniques: Game tree evaluation, Minimax principle, randomness and non-uniformity

Module II

Moments and deviations: Occupancy problems, Markov and Chebyshev inequalities, Randomized selection, two-point sampling, Stable marriage problem, coupon collector's problem Tail inequalities: Chernoff bound, Routing in parallel computers.

Module III

The probabilistic method: maximum stability, expanding graphs, Lovasz Local Lemma, Conditional probabilities Markov chains and random walks: Markov chains, Random walk in graphs, graph connectivity, expanders and rapidly mixing random walks.

Module IV

Applications: Data structures: Heaps Graph algorithm: all pairs shortest paths, min-cut problem, minimum spanning trees.

References:

1. Motwani R., & Raghavan, P. (1995). Randomized algorithms. Cambridge University Press.
2. Mitzenmacher, M., & Upfal, E. (2005). Probability and computing: Randomized algorithms and probabilistic analysis, Cambridge University Press.
3. Hromkovic J. (2005). Design and analysis of randomized algorithms introduction to design paradigms. Berlin: Springer.
4. Cormen T., & Leiserson, C and Stein,C (2009). Introduction to algorithms (3rd ed.). Mit Press.
5. Granichin O., & Volkovich, Z. (2014). Randomized algorithms in automatic control and data mining. Springer.

23-202 -0802 - AUGMENTED REALITY

Course Outcomes:

On completion of this course the student will be able to:

1. *Define alternative 3D compositing techniques using computer vision.*
2. *Extend knowledge in 3D vision.*
3. *Develop applications in interactive interfaces most notably augmented reality interfaces on mobile devices.*
4. *Develop skills in the design and development of interactive augmented reality games.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3		3		2									
CO2	3		1		3											
CO3		2	3	2	3						3			3	2	
CO4	1	2	3	2	3	1									3	1

1-Slightly;2-Moderately;3-Substantially

Module I

Introduction of Virtual Reality: Fundamental Concept and Components of Virtual Reality-Primary Features and Present Development on Virtual Reality.

Multiple Modals of Input and Output Interface in Virtual Reality:Input-Tracker, Sensor,Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3D Scanner etc. Output-Visual /Auditory / Haptic Devices.

Module II

Visual Computation in Virtual Reality: Fundamentals of Computer Graphics. Software and Hardware Technology on Stereoscopic Display. Advanced Techniques in CG: Management of Large Scale Environments & Real Time Rendering

Environment Modeling in Virtual Reality: Geometric Modeling, Behavior Simulation, Physically Based Simulation. Interactive Techniques in Virtual Reality:Body Track, Hand Gesture, 3D Manus, Object Grasp.

Module III

Introduction of Augmented Reality (AR):System Structure of Augmented Reality. Key Technology in AR. Development Tools and Frameworks in Virtual Reality:Frameworks of Software Development Tools in VR. X3D Standard; Vega, MultiGen, Virtools etc.

Module IV

Application of VR in Digital Entertainment: VR Technology in Film & TV Production.VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.

References:

1. Virtual Reality Technology (2nd Ed.)–Grigore C. Burdea & Philippe Coiffet.John Wiley & Sons, Inc. 2003.

2. Sherman, William R. and Alan B. Craig. Understanding Virtual Reality Interface, Application, and Design, Morgan Kaufmann,2002.
3. Fei GAO. Design and Development of Virtual Reality Application System, Tsinghua Press, March 2012.
4. Julie Carmigniani and Borko Furht.Handbook of Augmented Reality, DOI10.1007/978-1-4614-0064-6 1.
5. Dieter Schmalstieg and Tobias H. Höllerer.Augmented Reality: Principles and Practice

23-202 -0803 - COMPUTATIONAL LINGUISTICS

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify the theoretical foundation of natural language processing in linguistics and formal language theory.*
2. *Explain the elements and applications of parts of speech tagging and parsing.*
3. *Explain the elements of semantic analysis.*
4. *Compare rule based and statistical algorithms used in NLP.*
5. *Discuss the limitations and capabilities of current natural language processing technologies.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2			1											1
CO2				1	2								1			
CO3		1		2	1								1			
CO4				1	1								2			
CO5				1	1								1			

1-Slightly;2-Moderately;3-Substantially

Module I

Words- Regular Expressions and Finite Automata-Morphology and Finite State Transducers- Probabilistic Models of Pronunciation and Spelling -N grams, HMMs and speech recognition, computational phonology and Text to speech.

Module II

Syntax- Word Classes and Part-of-Speech Tagging and chunking-HMM Taggers- probabilistic Context Free Grammars for English Syntax-Parsing with Context Free Grammars- lexicalized and probabilistic parsing- Features and Unification-Language and Complexity.

Module III

Semantics- Representing Meaning- canonical forms- FOPC- ambiguity resolution- scoping phenomena -Semantic Analysis- syntax driven semantic analysis- Lexical Semantics- Word Sense Disambiguation and Information Retrieval.

Module IV

Pragmatics- Discourse-Reference Resolution -Text Coherence -Dialog and Conversational Agents- Dialogue acts-dialogue structure, natural language generation, Statistical alignment and machine translation-clustering- text categorization.

References:

1. Daniel Jurafsky and James Martin, Speech and Language Processing, 2nd Edition, PH, 2008.
2. James Pustejovsky, Amber Stubbs, Natural language annotation for machine learning, O'Reilly, 2012.

3. Alexander Clark and Chris Fox, The Handbook of Computational linguistics and natural language processing, Wiley-Blackwell, 2012.
4. Grant S Ingersoll, Thomas Morton, Andrew L Farris, Taming Text, Manning Publications, 2013 Christopher D. Manning and Hin Rich Schutze, Foundations of statistical natural language processing, 1st Edition, MIT press, 1999.

23-202-0804 ADVANCED GRAPH THEORY

Course Outcomes:

On completion of this course the student will be able to:

1. *Demonstrate the concept Graphs and trees*
2. *Demonstrate the concept Connectivity*
3. *Demonstrate the concept matchings*
4. *Demonstrate the concept of colouring and planarity*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	3	2								1	2		1	
CO2	1	3	3	2								1	1			
CO3	1	3	3	2								1				
CO4	1	3	3	2								1			1	

1-Slightly;2-Moderately;3-Substantially

Module I

Introduction to Graphs and its application, incidence and degree, Isomorphism, Euler graph, Hamiltonian paths and circuits. Trees- Properties of trees, minimum spanning tree, Matrix tree theorem, Cayleys Formula.

Module II

Connectivity: Cuts and Separators, Edge connectivity, Vertex Connectivity, Block-Cut Point Graph, Menger's theorem, Applications, Properties of 2- connected and 3- connected graphs.

Module III

Matchings: Review of Basic Concepts, Bipartite Matching - Hall's Matching Condition, Konig's Min-Max theorems, Gallai's Min-Max Theorem, Maximum Bipartite Matching using augmenting path algorithm. Matchings in general graphs – Tutte's 1-factor theorem.

Module IV

Coloring: Vertex Coloring – Greedy Coloring, Brook's Theorem. Edge Coloring – Vizing's Theorem. List Coloring. Perfect Graphs – Weak Perfect Graph Theorem, Statement of Strong Perfect Graph Theorem.

Graphs on surfaces: Planar graphs, duality, Eulers formula, Kuratowskis theorem, toroidal graphs, 2-cell embeddings, graphs on other surfaces;

References:

1. Douglas B. West: Introduction to Graph Theory, Second Edition, Pearson, Singapore, 2000.
2. Narsingh Deo: Graph Theory with Applications to Engineering & Computer Sciences, Prentice Hall, 1974.
3. Frank Harary: Graph Theory, CRC Press, 2018 (originally published in 1969).
4. Reinhard Diestel: Graph Theory, Springer, 2000

23-202-0805 to 23-202-0808 PROFESSIONAL ELECTIVE - V
23-202 -0805 COMPUTER VISION

Course Outcomes:

On completion of this course the student will be able to:

1. *Familiarize both theoretical and practical aspects of computing with images.*
2. *Describe the foundation of image formation, measurement and analysis.*
3. *Implement common methods for robust image matching and alignment.*
4. *Understand the geometric relationships between 2D images and the 3D world.*
5. *Gain exposure to object and scene recognition and categorization from image.*
6. *Develop the practical skills necessary to build computer vision applications.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3		2	3				2	1					3	
CO2	3	3	3	1					2				3			2
CO3	3	3	3	1	3	2				1			3		2	
CO4	3	3	3		2	1							3			2
CO5	3	3	3			3	1						3			2
CO6	3		3		3				3	2	1		3	2		

1-Slightly;2-Moderately;3-Substantially

Module I

Image formation and Image Model-Components of a vision system-Cameras-Radiometry-Light in space-Light in surface- sources, shadows and shading, Color-Human color perception-Representation of color- A model for image color-Surface color from image color. Early vision-Linear Filters and Convolution-Shift variant Linear system- Spatial Frequency and Fourier Transforms-Sampling and Aliasing-Filters as Templates-Normalized correlation and finding patterns-Edge Detection-Texture Representation, Analysis and Application. Recognition, Methodology: Conditioning, Labeling, Grouping, Extracting.

Module II

Multiple images-The Geometry of multiple views- Stereopsis -Affine structure from motion-Elements of Affine Geometry-Affine structure and motion from two images-Affine structure and motion from multiple images-From Affine to Euclidean images. Matching Morphological Image Processing: Introduction, Dilation, Erosion, Opening, Closing, Hit-or-Miss transformation, Morphological algorithm operations on binary images, Morphological algorithm operations on gray-scale images, Thinning, Thickening, Region growing, region shrinking.

Module III

Binary Machine Vision: Thresholding, Segmentation, Connected component labeling, Hierarchical segmentation, Spatial clustering, Split & merge, Rule-based Segmentation, Motion-based segmentation. Area Extraction: Concepts, Data-structures, Edge, Line-Linking, Hough transform, Line fitting, Curve fitting (Least-square fitting). Middle level vision-Segmentation by clustering-Shot Boundary Detection and Background Subtraction-Image segmentation by clustering pixels- Segmentation by Graph-Theoretic clustering- Segmentation by fitting a model-The Hough Transform- Fitting lines-Fitting curves- Fitting as a probabilistic inference problem-Robustness-Segmentation and fitting using probabilistic methods.

Module IV

High level vision-: Geometric methods-Model based vision-Obtaining hypothesis by pose consistency, pose clustering and using Invariants- Verification-smooth surface and their outlines-Aspect graphs- Range data-Range, Data segmentation- Range image Registration and model acquisition-Object Recognition. Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition.

References:

1. Computer vision – A modern Approach, David A forsyth & Jean ponce, Prentice Hall, 2002.
2. Computer vision and Applications, Bernd Jahne and Horst HauBecker Academic press, 2000.
3. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison Wesley, 1993.
4. Milan Sonka,Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision" Thomson Learning.
5. Computer Vision: Algorithms and Applications by Richard Szliski.
6. Ma, Soatto, Kosecka and Sastry (MaSKS) An Invitation to 3D Vision. Springer Verlag, 2003

23-202-0806 AGENT BASED INTELLIGENT SYSTEM

Course Outcomes:

On completion of this course the student will be able to:

1. Define the algorithmic foundation of agents and multi agent systems.
2. Explain theoretical foundations of agent based system.
3. Apply Bayesian networks for probabilistic reasoning.
4. Create logical agents to do inference using first order logic.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	1	1								3			
CO2	3	3	1	1												
CO3	1	2	3	2							1			1	2	
CO4	2	2	3													1

1-Slightly;2-Moderately;3-Substantially

Module I

Introduction: Definitions – Foundations – History – Intelligent Agents – Problem Solving – Searching– Heuristics – Constraint satisfaction Problems – Game Playing. Knowledge representation and reasoning: Logical agents – First order logic – First Order Inference – Unification – Chaining – Resolution Strategies – Knowledge Representation – Objects – Actions – Events.

Module II

Planning Agents: Planning Problem – State Space Search – Partial Order Planning _Graphs – No deterministic Domains – Conditional Planning – continuous Planning – Multiagent Planning.

Module III

Agents And Uncertainty: Acting under uncertainty – Probability Notation – Bayes Rule and use – Bayesian Networks – Other approaches – Time and Uncertainty – Temporal Models – Utility Theory – Decision Network – Complex Decisions.

Module IV

Higher Level Agents: Knowledge in Learning – Relevance information –Statistical Learning Methods – Reinforcement Learning – Communication – Formal Grammar – Augmented Grammars-Future of AI.

References:

1. Stuart Russell and Peter Norvig, Artificial Intelligence – A Modern Approach. 3rd Edition, Prentice Hall, 2009.
2. Michael Wooldridge, An Introduction to Multi Agent System, 2 nd Edition, John Wiley,. ISBN: 978-0-470-51946-2.
3. Winston, Patrick Henry, Artificial intelligence, Addison Wesley ,2008.
4. Nils.J.Nilsson, Principles of Artificial Intelligence, Narosa Publishing House, 1992

23-202 -0807 - CLOUD SECURITY

Course Outcomes

On completion of this course the student will be able to:

1. *Demonstrate the growth of Cloud computing, architecture and different modules of implementation.*
2. *Evaluate the different types of cloud solutions among IaaS, PaaS, SaaS.*
3. *Access the security implementation flow, actions and responsibilities of stake holders.*
4. *Generalize the Data Centre operations, encryption methods and deployment details.*
5. *Provide recommendations for using and managing the customer's identity and choose the type of virtualization to be used.*

Course Articulation Matrix:

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

1-Slightly; 2-Moderately; 3-Substantially

MODULE I

Cloud Computing Architectural Framework: Cloud Benefits, Business scenarios, Cloud Computing Evolution, cloud vocabulary, Essential Characteristics of Cloud Computing, Cloud deployment models, Cloud Service Models, Multi- Tenancy, Approaches to create a barrier between the Tenants, cloud computing vendors, Cloud Computing threats, Cloud Reference Model, The Cloud Cube Model, Security for Cloud Computing, How Security Gets Integrated.

MODULE II

Compliance and Audit: Cloud customer responsibilities, Compliance and Audit Security Recommendations. Changing providers expectations, Recommendations for all cloud solutions, IaaS Cloud Solutions, PaaS Cloud Solutions, SaaS Cloud Solutions.

Traditional Security, Business Continuity, Disaster Recovery, Risk of insider abuse, Security baseline, Customers actions, Contract, Documentation, Recovery Time Objectives (RTOs), Customers responsibility, Vendor Security Process (VSP).

MODULE III

Data Centre Operations, Security challenge, Implement Five Principal Characteristics of Cloud Computing, Data centre Security Recommendations. Encryption and Key Management: Encryption for Confidentiality and Integrity, Encrypting data at rest, Key Management Lifecycle, Cloud Encryption Standards, Recommendations.

MODULE IV

Identity and Access Management in the cloud, Identity and Access Management functions, Identity and Access Management (IAM) Model, Identity Federation, Identity Provisioning

Recommendations, Authentication for SaaS and Paas customers, Authentication for IaaS customers, Introducing Identity Services, Enterprise Architecture with IDaaS , IDaaS Security Recommendations. Virtualization: Hardware Virtualization, Software Virtualization, Memory Virtualization, Storage Virtualization, Data Virtualization, Network Virtualization, Virtualization Security Recommendations.

TEXT BOOKS:

1. Cloud Security and Privacy, An Enterprise Perspective on Risks and Compliance Tim Mather, Subra Kumaraswamy , Shahed Latif Oreilly Media 2009

REFERENCES:

1. Securing the Cloud, Cloud Computer Security Techniques and Tactics Vic (J.R.) Winkler Syngress 2011
2. Mishra, P., Pilli, E.S., & Joshi, R.C. (2021). Cloud Security: Attacks, Techniques, Tools, and Challenges (1st Ed.). Chapman and Hall/CRC. https://doi.org/10.1201/9781003004486

23-202 -0808 SOCIAL NETWORK ANALYSIS

Course Outcomes

On completion of this course the student will be able to:

1. To understand the concept of semantic web related applications.
2. To learn knowledge on representation using ontology.
3. To understand human behavior in social web and related communities.
4. To learn visualization of social networks.
5. To understand usefulness of graphs in SNA
6. To learn the various use cases of SNA applied to society

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2								3	2			
CO2	3	3	3									3		2		
CO3	3	3	3	2								2		2		
CO4	3	3	3	2		2						2				
CO5	3	3	2	1		2						3			3	
CO6	3	3	3									2		3		

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web -Basics of Social Network Analysis (SNA)-Definition and scope of SNA. Historical context and development. Key Concepts in SNA-Nodes, ties, and edges. Types of networks (undirected, directed, weighted, bipartite). Data collection methods for network analysis.

Module II

Ontology and their role in the Semantic Web. Ontology -based knowledge. Representation - Ontology languages for the Semantic Web. Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data. Graph Theory and Network Representation. Basic concepts of graph theory (nodes, edges, paths, cycles).Node-Edge Diagrams Matrix representation of networks. Adjacency matrices and incidence matrices. Visualizing networks with node-link diagrams.

Module III

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. Modeling and Analysis of Social Networks. Diffusion models: information cascades, rumor propagation, epidemic models. 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 .

Module IV

Centrality, Power & Prestige, Clustering, Applications of Social Network Analysis in different domains. Cover networks - Community welfare - Collaboration networks - Co-Citation networks. Graph mining-use cases.

TEXT BOOKS:

1. Peter Mika, “Social Networks and the Semantic Web”, First Edition, Springer 2007.
2. Borko Furht, “Handbook of Social Network Technologies and Applications”, 1st Edition, Springer, 2010.
3. Networks, Crowds, and Markets: Reasoning About a Connected World" by David Easley and Jonathon Kleinberg.
4. Introduction to Social Network Analysis" by Stanley Wasserman and Katherine Faust

REFERENCES:

1. Guandong Xu ,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, Alexandre Passant and Stefan Decker, “The Social Semantic Web”, Springer, 2009.
5. Jure Leskovec, Anand Rajaraman and Jeffrey David Ullman, Mining of massive datasets, Cambridge University Press, 2014.

23-202-0809 TO 20-202-0812 PROFESSIONAL ELECTIVE - VI
23-202 -0809 – NATURAL LANGUAGE PROCESSING

Course Outcomes:

On completion of this course the student will be able to:

1. *Appreciate the fundamental concepts of Natural Language Processing.*
2. *Develop grammars for natural language.*
3. *Design algorithms for NLP tasks.*
4. *Develop useful systems for language processing and related tasks involving text processing.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2											1	1			1
CO2	2	1	2									1	1			1
CO3	2	1										1	1			1
CO4	2	2	3									1	1			1

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to Natural Language Understanding- Levels of language analysis- Syntax, Semantics, Pragmatics. Linguistic Background- An Outline of English Syntax.

Lexicons, POS Tagging, Word Senses. Grammars and Parsing- Features, Agreement and Augmented Grammars.

Module II

Grammars for Natural Language, Parsing methods and Efficient Parsing. Ambiguity Resolution- Statistical Methods. Probabilistic Context Free Grammar.

Module III

Semantics and Logical Form: Linking Syntax and Semantics-Ambiguity Resolution- other Strategies for Semantic Interpretation-Scoping and the Interpretation of Noun Phrases.

Module IV

Knowledge Representation and Reasoning- Local Discourse-Context and Reference- Using World Knowledge- Discourse Structure- Defining a Conversational Agent.

Applications- Machine Translation, Information Retrieval and Extraction, Text Categorization and Summarization.

References:

1. D. Jurafsky and J. H. Martin, Speech and Language Processing, Prentice Hall India, 2000.
2. James Allen, Natural Language Understanding, 2e, The Benjamin/Cummings Publishing Company Inc., Redwood City, CA.
3. Charniak, Eugene, Introduction to Artificial intelligence, Addison-Wesley, 1985.
4. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley,1999.
5. U. S. Tiwary and Tanveer Siddiqui, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

23-202 -0810 – PATTERN RECOGNITION

COURSE OUTCOMES

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

1. *Describe basics of Probability, Random Processes and Linear Algebra, Machine perception and pattern recognition system*
2. *Perform Bayes Decision Theory and apply Parameter Estimation Methods*
3. *Apply unsupervised learning and clustering*
4. *Apply sequential pattern recognition, dimensionality reduction and Linear discriminant functions*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2											1	1			
CO2	2	2										1	1			2
CO3	2	3	2									1	1			2
CO4	2	3	2									1	1			2

1-Slightly; 2-Moderately; 3-Substantially

Module I

Basics of Probability, Random Processes and Linear Algebra: Probability: independence of events, conditional and joint probability, Bayes' theorem; Random Processes: Stationary and nonstationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra; Linear Algebra: Inner product, outer product, inverses, eigenvalues, eigen vectors, singular values, singular vectors.

Module II

Machine perception, Pattern recognition systems, Design cycle, Learning and adaptation, Bayes Decision Theory: Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, discrete features, Parameter Estimation Methods: Maximum-Likelihood estimation: Gaussian case; Maximum a Posteriori estimation; Bayesian estimation: Gaussian case

Module III

Unsupervised learning and clustering: Criterion functions for clustering; Algorithms for clustering: K-Means, Hierarchical and other methods; Cluster validation; Gaussian mixture models; Expectation-Maximization method for parameter estimation; Maximum entropy estimation.

Module IV

Sequential Pattern Recognition: Hidden Markov Models (HMMs); Discrete HMMs; Continuous HMM, Nonparametric techniques for density estimation: Parzen-window method; K-Nearest Neighbour method. Dimensionality reduction: Fisher discriminant analysis; Principal component

analysis; Factor Analysis. Linear discriminant functions: Gradient descent procedures; Perceptron; Support vector machines

References

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001

2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009

3. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006

4. Earl Gose , Steve Jost, "Pattern Recognition and Image Analysis", PEARSON,2015.

5.. Robert J.Schalkoff, Pattern Recognition Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 1992

6. V. S. Devi, M. N. Murty, "Pattern Recognition: An Introduction", Universities Press, Hyderabad, 2011.

23-202 -0811 – REAL TIME DATA ANALYSIS

Course Outcomes:

On completion of this course the student will be able to:

1. *Describe on various stream computing aspects*
2. *Understand phases in analytic architecture.*
3. *Explain various techniques for data flow management*
4. *Describe methods for processing and storing of data*
5. *Understand the recent trends in stream data analytics*
6. *Familiarize with industry use cases for real time analytics*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2										1				
CO2	2	2										1				
CO3	2	2										1				
CO4	2	2	3									1				
CO5	2	2	3									1				
CO6	2	2	3									1				

1-Slightly; 2-Moderately; 3-Substantially

Module I: Introduction To Stream Computing

Streaming Data Sources, Difference between Streaming Data and Static Data. Overview of Large Scale Stream Processing Engines, Issues in Stream Processing ,Case study: Stream data analysis using apache storm

Module II: Streaming Analytics Architecture

Phases in Streaming Analytics Architecture - Vital Attributes - High Availability, Low Latency Horizontal Scalability-Fault Tolerance - Service Configuration and Management -Apache ZooKeeper

Case study: popular stream data analysis platforms- A study on Google cloud data flow, Azure stream analytics

Module III: Data Flow Management

Distributed Data Flows - At Least Once Delivery -Apache Kafka - Apache Flume Zero MQ - Messages, Events, Tasks & File Passing Messages, Events, Tasks & File Passing

Module IV: Processing & Storing Streaming Data

Distributed Stream Data Processing: Coordination, Partition and Merges, Transactions.

Duplication Detection using Bloom Filters - Apache Spark Streaming Examples

Choosing a storage system, NoSQL Storage Systems.

Trends in streaming data analytics: Data lakes, spark streaming, StreamSQL

References:

1. Byron Ellis,"Real-Time Analytics: Techniques to Analyze and Visualize Streaming Data",Wiley, edition 2014
2. Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming DataBy Paul Zikopoulos, Chris Eaton ·,McGraw-Hill First edition, 2011
3. Large Scale and Big Data Processing and Management by Mohamed Gaber, Sherif Sakr,CRC Press
4. Taming The Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics by Bill Franks
5. Mining of massive datasets By Jure Leskovec, Jurij Leskovec, Anand Rajaraman, Jeffrey David Ullman · 2014
6. Neha Narkhede et.al, Kafka the definitive guide, O'Reilly publishers, ISBN: 9781491936160
7. Ankit Jain, Mastering Apache storm , packt publishers .

23-202 -0812 – ADVANCED COMPILER DESIGN AND OPTIMIZATION

Course Outcomes:

On completion of this course the student will be able to:

1. Identify the requirements of each phase of compiler in detail.

2. Understand Data flow and Control flow analysis in compiler design.

3. Analyze optimization techniques to obtain high performance

4. Learn code generation algorithms

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2										1	1			
CO2	2	2										1	1			
CO3	2	2		2								1	1			
CO4	2	2	2	2								1	1			

1-Slightly; 2-Moderately; 3-Substantially

Module I

Review of compiler phases –Symbol Table Structure – Intermediate Representations. ICAN. Control Flow. Analysis: Basic Blocks and CFG, Dominators and Loops. Introduction to optimizing Compilers, Using program analysis for optimization.

Module II

Foundation of Data Flow Analysis: control-flow and data-flow analysis, Reaching Definitions, Available Expressions and Live Variable Analysis. Optimizations: classical optimization, Redundancy Elimination – Loop Optimizations –Value Numbering.

Module III

Static Single Assignment Form (SSA): SSA Construction – Optimizations on SSA Form. Register Allocation –Graph Colouring Algorithm. Case Studies – Sun Compilers for SPARC – IBM XL Compilers

Module IV

Machine dependent code generation, a simple code generator, register allocation and assignment, peephole optimization. Code Generation Algorithms. memory hierarchy management, optimization for instruction-level parallelism, modulo scheduling, predicated and speculative execution.

References:

1. Steven S. Muchnick, “Advanced Compiler Design Implementation”, Morgan Koffman – Elsevier Science, India, Indian Reprint 2003
2. Alfred V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, Compilers: Principles, Techniques, and Tools, 2nd Edition, Addison-Wesley, 2006

3. Keith Cooper and Linda Torczon, Engineering a Compiler, 2nd Edition, Morgan Kaufmann, 2011.
4. K. L. P Mishra, N. Chandrashekaran (2003), Theory of computer science- Automata Languages and computation, 2nd edition, Prentice Hall of India, New Delhi, India

23-202-0813 TO 23-202-0817 OPEN ELECTIVE –II

23-202 -0813 ETHICAL HACKING

Course Outcomes:

On completion of this course the student will be able to:

1. *Outline the vulnerabilities in a system or network.*
2. *Analyze and critically evaluate techniques used to break into an insecure web application and identify relevant countermeasures.*
3. *Demonstrate a critical evaluation of an advanced security topic with an independent project.*
4. *Critically evaluate the potential counter measures to advanced hacking techniques.*
5. *Explain computer forensic fundamentals.*

Course Articulation Matrix:

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

1-Slightly;2-Moderately;3-Substantially

Module I

Ethical Hacking−Overview-Hacker types-Threats and attacks, Vulnerabilities, Phases of hacking-Reconnaissance-Scanning-Maintaining Access with Backdoors and Rootkits-Clearing traces. System Hacking-Hacking Windows-Hacking UNIX-Remote connectivity and VoIP Hacking. Software Hacking-Hacking code-Web Hacking-Hacking the Internet User.

Module II

Password Hacking-Dictionary attack-Hybrid Dictionary attack-Brute force attack-Rainbow tables. A study on various attacks– Input validation attacks – SQL injection attacks – Buffer overflow attacks - Privacy attacks.

Module III

TCP / IP – IP Spoofing, port scanning, DNS Spoofing. Dos attacks – SYN attacks, Smurf attacks, UDP flooding, DDOS – Models. Batch File Programming.

Module IV

Overview of computer forensics technology: computer forensics services-Data seizure-Data duplication and preservation-Data recovery-Document searches-Media conversion-Expert witness services-Computer evidence service options-Other miscellaneous services.

References:

1. Hacking Exposed: Network Security Secrets & Solutions, Stuart McClure, Joel Scambray and George Kurtz, McGraw-Hill, 2005.
2. Patrick Engebretson, The Basics of Hacking and Penetration Testing, Elsevier, 2013.

3. Network intrusion alert: an ethical hacking guide to intrusion detection, Ankit Fadia, Manu Zacharia, Thomson Course Technology PTR, 2007.
4. Ethical Hacking, Thomas Mathew, OSB Publisher, 2003.
5. Network Security and Ethical Hacking, Rajat Khare, Luniver Press, 2006.
6. John R. Vacca, Computer Forensics: Computer Crime Scene Investigation, 2nd Edition.

23-202-0814 CYBERSPACE AND INFORMATION SYSTEM SECURITY

Course Outcomes:
On completion of this course the student will be able to:

1. *Explain the need of security in cyberspace.*
2. *Explain the components of Information System and challenges in Information System Security.*
3. *Explain why controls are necessary in Information systems.*
4. *Explain methods of controlling Information systems.*
5. *Explain how controls are introduced in Information systems.*
6. *Choose the required controls to ensure security of an Information system.*
7. *Summarize immediate steps to be taken in the event of a cybercrime .*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2										1			
CO2	3	2	2	2									1			
CO3	2	1	2	2									1			
CO4	1	1	2	2									1			
CO5	2	2	2	2									1			
CO6	2	2	2	2									1			
CO7	2	1	2	2									1			

1-Slightly;2-Moderately;3-Substantially

Module I
Computer, Network, History of Network, Types of network, Internet, www, IP Address, E-mail working, Servers, DNS Servers, Service providers, e-commerce. Cyberspace, Cyber crime, Cyber Security, importance of Cyber Laws: National and International. Data, Information, Knowledge, Information Security, need, History and evolution of Information Security, Critical Concepts of Information Security. Information System, Components of the Information System; Balancing Information Security and Access.

Module II
Need of Security: Vulnerabilities, Threats, Attacks, Risks. SecSDLC. Supporting Tools and Technology: Cryptology, Cipher methods, Symmetric and Asymmetric algorithms, Cryptanalysis, Cryptographic Tools, Protocols supporting security, Attacks on cryptosystems. Firewalls, Intrusion Detection and Prevention Systems, Honeypots, honeynets, padded cell systems, scanning and analysis tools.

Module III
Risk Management: Overview, Identification, Assessment, Control Strategies. Planning: Practices, Procedure, Guideline, Standards, Policy, Information Security Blueprint, Importance of Education, Training and awareness programs, Continuity Strategies.

Module IV

Implementing Security Controls: Information Security Project Management, technical and non-technical aspects. Positioning and staffing security function, Employment policies and practices, considerations for non-employees.

Maintenance: Maintenance models. Digital Forensics: Evidence Collection and seizure, Duplication and preservation of evidence.

References:

1. Information Technology Amended Act, 2008, Ministry of Law and Justice, Government of India.
2. M. E. Whitman and H. J. Mattord, "Principles of Information Security," 4thEdition.
3. Ron Weber, Information system Audit and Control, Pearson Education.
4. John R Vacca, Computer Forensics: Computer Crime Scene Investigation, 2nd Edition.

23-202-0815 SOFT COMPUTING

Course Outcomes:

On completion of this course the student will be able to:

1. *Describe the different soft computing techniques and their applications.*
2. *Define Artificial neural network and its applications.*
3. *Analyze various operations, models and applications of fuzzy logic.*
4. *Demonstrate the concept of genetic algorithm and its applications.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1									1				
CO2	2	2										1	1			3
CO3	2	2	3	2								1			2	
CO4	2	2	3	2								1	1			

1-Slightly;2-Moderately;3-Substantially

Module I

Introduction to Soft Computing Soft- computing versus Hard computing-Characteristics of Soft computing, Some applications of Soft computing techniques. Artificial neural networks - Biological neurons, Basic models of artificial neural networks – Connections, Learning, Activation Functions, Important terminologies of ANNs, McCulloch Pitts Neuron.

Module II

Fuzzy logic, fuzzy sets - properties - operations on fuzzy sets, fuzzy relations – properties-operations on fuzzy relations, Fuzzy membership functions, fuzzification, Methods of membership value assignments – intuition – inference – rank ordering, Lambda – cuts for fuzzy sets, Defuzzification methods.

Module III

Truth values and Tables in Fuzzy Logic, Fuzzy propositions, Formation of fuzzy rules - Decomposition of rules – Aggregation of rules, Fuzzy Inference Systems, multi-objective optimization problems (MOOPs) and issues of solving them. Multi-Objective Evolutionary Algorithm (MOEA).

Fuzzy logic control Systems, Architecture and Operation of Fuzzy logic control Systems, Fuzzy logic control System models, applications of Fuzzy logic control Systems.

Module IV

Introduction to genetic algorithm, Basic GA framework and different GA architectures- operators in genetic algorithm - encoding - selection - crossover – mutation, Stopping condition for genetic algorithm flow, Genetic-neuro hybrid systems, solving single-objective optimization problems using Gas.

References:

1. Timothy J. Ross, Fuzzy Logic with engineering applications , John Wiley & Sons, 2016.
2. S. N. Sivanandam and S. N.Deepa, Principles of soft computing – John Wiley & Sons, 2007.

3. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc.1998
4. R. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/Elsevier, 2007.
5. Driankov D., Hellendoorn H. and Reinfrank M., An Introduction to Fuzzy Control- Narosa Pub., 2001.
6. Melanie Mitchell, An Introduction to Genetic Algorithms, MIT Press, 2000.

23-202-0816 INTERNET OF THINGS

Course Outcomes:

On completion of this course the student will be able to:

1. *Familiarize IoT and its components.*
2. *Familiarize programming the microcontroller for IoT.*
3. *Get a deep insight to market perspective of IoT.*
4. *Learn data and knowledge management and use of Devices in IoT Technology.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2									1		1		
CO2	2		3	2								2		2		2
CO3	2		1	3								2			2	
CO4	1		2	3								2				1

1-Slightly;2-Moderately;3-Substantially

Module I

Introduction to Internet of Things: Introduction – Definition - phases – Foundations – Policy - Challenges and Issues – identification - security –privacy. Components in internet of things: Control Units-Sensors -Communication modules - Power Sources -Communication Technologies - RFID - Bluetooth –Zigbee – Wifi – RF links - Mobile Internet - Wired Communication.

Module II

Programming the Microcontroller for IoT: Basics of Sensors and actuators - examples and working principles of sensors and actuators - Arduino/Equivalent Microcontroller platform-Setting up the board - Programming for lOT- Reading from Sensors; Communication: Connecting microcontroller with mobile devices – communication through Bluetooth and USB - connection with the internet using wifi / Ethernet.

Module III

Fundamental Concepts of Agility and Autonomy -Enabling Autonomy and Agility by the Internet of Things - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things - Agents for the Behavior of Objects.

Module IV

Business Models for the Internet of Things: The Meaning of DiY in the Network Society - Sensor-actuator technologies and Middleware as a basis for a DiY Service Creation Framework - Device Integration - Middleware Technologies Needed for a DiY Internet of Things

References:

1. Charalampos Doukas, Building Internet of Things with the Arduino, Create space, April 2002.
2. Dieter Uckelmann et.al, “Architecting the Internet of Things”, Springer, 2011.
3. Luigi Atzor et.al, The Internet of Things: A survey, Journal on Networks, Elsevier
4. RajkumarBuyya; Amir VahidDastjerdi , “Internet of Things”, Morgan Kaufmann, 2016
5. Peter Waher, “Learning Internet of Things”, Packt Publishing, 2015

23-202-0817 CONSTITUTIONAL LAW

Course Outcomes:

On completion of this course the student will be able to:

1. *Configure the preamble and fundamental rights.*
2. *Actuate the governance and functioning of constitutional functionaries.*
3. *Describe the functions of legislative bodies.*
4. *Decipher the judiciary system and its role in governance.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1						2	1	2	2			2				1
CO2						2	1	2	2			2				1
CO3						2	1	2	2			2				1
CO4						2	1	2	2			2				1

1-Slightly;2-Moderately;3-Substantially

Module I

Introduction

Constitution Law – Constitutional Assembly Debates – Constitution of India – Basic Features of Indian Constitution – Preamble of Constitution – Structure and Content of Indian Constitution.

Module II

Fundamental Rights

Fundamental Rights – Definition of State – Fundamental Rights under Indian Constitution – Right to Equality – Untouchability – Right to Life Cultural and Educational Rights of Minorities - Enforcement of Fundamental Rights.

Module III

Directive Principles of State Policy & Fundamental Duties

DPSP's – Relationship between DPSP and Fundamental Rights – Conversion of DPSP into Fundamental Rights – Role of Judiciary – Judicial Activism – Public Interest Litigation (PIL) - Fundamental Duties.

Module IV

Constitutional Organs

Legislative Organs – Parliament – Lok Sabha, Rajya Sabha - State Legislatures - Executive Organs - President, Vice President, Council of Ministers - Judicial Organs – Supreme Court and High Courts –Other Constitutional Bodies – Election Commission - Comptroller and Auditor General of India.

References:

1. Durga Das Basu, Introduction to the Constitution of India, 24th Edition. Prentice – Hall of India Pvt. Ltd. New Delhi, 2019.
2. D.C. Gupta, Indian Government and Politics, 8th Edition. Vikas Publishing House, 2018.
3. H.M. Sreevai, Constitutional Law of India, 4th edition in 3 volumes. Universal Law Publication, 2015

List of Courses for Minor in Machine Learning

23-202-0310 – INTRODUCTION TO PYTHON PROGRAMMING

Course Outcome

On completion of this course the student will be able to:

1. *Write, test and debug Python programs*
2. *Illustrate uses of conditional (if, if-else, if-elif-else and switch-case) and iterative (while and for) statements in Python programs*
3. *Develop programs by utilizing the modules Lists, Tuples, Sets and Dictionaries in Python*
4. *Implement Object Oriented programs with exception handling*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3		3						2	3	3	2	3	1
CO2	3	3	3		3					1		3	3	2	3	1
CO3	3	3	3		3	2	1					3	3	2	3	1
CO4	3	3	3		3		1					3	3	2	3	2

1-Slightly; 2-Moderately; 3-Substantially

Module I

Programming Environment and Python Basics:

Getting Started with Python Programming - Running code in the interactive shell, Editing, Saving, and Running a script. Using editors - IDLE, Jupyter. The software development process - Case Study.

Basic coding skills - Working with data types, Numeric data types and Character sets, Keywords, Variables and Assignment statement, Operators, Expressions, Working with numeric data, Type conversions, Comments in the program. Input, Processing, and Output. Formatting output. How Python works. Detecting and correcting syntax errors. Using built in functions and modules in math module.

Module II

Building Python Programs:

Control statements - Selection structure (if-else, switch-case), Iteration structure(for, while), Testing the control statements, Lazy evaluation. Functions - Hiding redundancy and complexity, Arguments and return values, Variable scopes and parameter passing, Named arguments, Main function, Working with recursion, Lambda functions. Strings and number systems - String function, Handling numbers in various formats.

Module III

Data Representation:

Lists - Basic list Operations and functions, List of lists, Slicing, Searching and sorting list, List comprehension. Work with tuples. Sets. Work with dates and times. Dictionaries - Dictionary functions, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries, reverse lookup. Case Study - Data Structure Selection.

Module IV

Object Oriented Programming:
Design with classes - Objects and Classes, Methods, Instance Variables, Constructor, Accessors and Mutators. Structuring classes with Inheritance and Polymorphism. Abstract Classes. Exceptions - Handle a single exception, handle multiple exceptions.

Text Books:

1. 1.Kenneth A Lambert., Fundamentals of Python : First Programs, 2/e, Cengage Publishing, 2016
2. Wes McKinney, Python for Data Analysis, 2/e, Shroff / O'Reilly Publishers, 2017

Reference Books:

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2/e, Schroff, 2016
2. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
3. David M.Baezly, Python Essential Reference. Addison-Wesley Professional; 4/e, 2009.
4. Charles Severance. Python for Informatics: Exploring Information
5. http://swcarpentry.github.io/python-novice-gapminder

23-202 -0410 FOUNDATIONS FOR MACHINE LEARNING

Course Outcomes:

On completion of this course the student will be able to:

1. *Explain the basics of machine learning and use lazy learning and probabilistic learning algorithms to solve data science problems.*
2. *Describe decision trees, classification rules & regression methods and how these algorithms can be applied to solve problems.*
3. *Utilize the concepts, rules and results about probability, random variables, additive & multiplicative rules, conditional probability, probability distributions and Bayes' theorem to find solutions of computational problems*
4. *Train Machine Learning Models using unconstrained and constrained optimization methods*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2		1							1	1			
CO2	2	3										1	3			
CO3	2	3	1									1	2			
CO4	1	3			2							1				

1-Slightly; 2-Moderately; 3-Substantially

Module I

Introduction to machine learning: How machines learn - Data storage, Abstraction, Generalization, Evaluation, Machine learning in practice - Types of machine learning algorithms. Lazy learning: Classification using K-Nearest Neighbour algorithm - Measuring similarity with distance, Choice of k, Preparing data for use with k-NN. Probabilistic learning: Understanding Naive Bayes - Conditional probability and Bayes theorem, Naive Bayes algorithm for classification, The Laplace estimator, Using numeric features with Naive Bayes.

Module II

Decision tree learning: Concept of decision tree, Divide and conquer approach, Decision tree algorithm, choosing the best split, Pruning the decision tree. Classification rules learning: Concept of classification rules, Separate and conquer approach, The 1R algorithm, Rules from decision trees. Regression methods: Concept of regression, Simple linear regression, Ordinary least squares estimation, Correlations, Multiple linear regression.

Module III

Probability and Distributions: Construction of a Probability Space - Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem. Summary Statistics and Independence – Important Probability distributions – Conjugacy and the Exponential Family - Change of Variables/Inverse Transform.

Module IV

Optimization: Optimization Using Gradient Descent - Gradient Descent With Momentum, Stochastic Gradient Descent. Constrained Optimization and Lagrange Multipliers - Convex Optimization - Linear Programming - Quadratic Programming.

References:

1. Brett Lantz, Machine Learning with R, Second edition, PackT publishing 2015
2. Michael Steinbach, Pang-Ning Tan, and Vipin Kumar, Introduction to Data Mining, Pearson 2016.
3. Jiawei Han, Micheline Kamber and Jian Pei, Data mining Concepts and techniques, Morgan Kaufmann Publishers 2012.
4. Peter Harrington, Machine Learning in action, Dreamtech publishers 2012.
5. Dr M Gopal, Applied Machine learning, McGraw Hill Education Private Limited.
6. E. Alpayidin, Introduction to Machine Learning, Prentice Hall of India (2005).
7. T. Hastie, RT Ibrashiran and J. Friedman, The Elements of Statistical Learning, Springer 2001

23-202-0718 – MINI PROJECT

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify project topic of current relevance.*
2. *Explain software development cycle with emphasis on different processes - requirements, design and implementation phases.*
3. *Develop confidence at having conceptualized, designed and implemented a working, medium sized project.*
4. *Learn how to work as a team and to do a working project on time with each student taking responsibility for their part in the project.*
5. *Familiarize document and report preparation.*

Course Articulation Matrix:

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

1-Slightly; 2-Moderately; 3-Substantially

The students are expected to develop an application in the field of embedded system / mobile application / any other current relevant topic. They have to do a proper system study and prepare SRS and design documents.

Each batch comprising of 3 to 5 students. Each student shall submit a project report at the end of the semester. The project report should contain the design and engineering documentation and test results. Product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations and aesthetics / ergonomic aspects taken care of in the project shall be given due weight.

Guidelines for evaluation:

i) Attendance and Regularity	5
ii) Work knowledge and Involvement	15
iii) End-Semester presentation & Oral examination	10
iv) Level of completion and demonstration of functionality/specifications	10
v) Project Report	10
Total	50 marks

Note: External projects and R&D projects need not be encouraged at this level. Points (i) & (ii) to be evaluated by the project guide & coordinator and the rest by the final evaluation team comprising of 3 teachers including the project guide.

List of Courses for Honours

23-202-0411 - PYTHON FOR MACHINE LEARNING

Course Outcomes:

On completion of this course the student will be able to:

1. *Write, test and debug Python programs*
2. *Illustrate uses of conditional (if, if-else, if-elif-else and switch-case) and iterative (while and for) statements in Python programs*
3. *Develop programs by utilizing the modules Lists, Tuples, Sets and Dictionaries in Python*
4. *Implement Object Oriented programs with exception handling*
5. *Write programs in Python to process data stored in files by utilizing the modules Numpy, Matplotlib, and Pandas*

Course Articulation Matrix:

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

1-Slightly; 2-Moderately; 3-Substantially

Module I

Programming Environment and Python Basics:

Getting Started with Python Programming - Running code in the interactive shell, Editing, Saving, and Running a script. Using editors - IDLE, Jupyter. The software development process - Case Study.

Basic coding skills - Working with data types, Numeric data types and Character sets, Keywords, Variables and Assignment statement, Operators, Expressions, Working with numeric data, Type conversions, Comments in the program. Input, Processing, and Output. Formatting output. How Python works. Detecting and correcting syntax errors. Using built in functions and modules in math module.

Module II

Building Python Programs:

Control statements - Selection structure (if-else, switch-case), Iteration structure(for, while), Testing the control statements, Lazy evaluation. Functions - Hiding redundancy and complexity, Arguments and return values, Variable scopes and parameter passing, Named arguments, Main function, Working with recursion, Lambda functions. Strings and number systems - String function, Handling numbers in various formats.

Module III

Data Representation:

Lists - Basic list Operations and functions, List of lists, Slicing, Searching and sorting list, List comprehension. Work with tuples. Sets. Work with dates and times. Dictionaries - Dictionary

Functions, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries, reverse lookup. Case Study - Data Structure Selection.

Module IV

Object Oriented Programming:

Design with classes - Objects and Classes, Methods, Instance Variables, Constructor, Accessors and Mutators. Structuring classes with Inheritance and Polymorphism. Abstract Classes. Exceptions - Handle a single exception, handle multiple exceptions.

Data Processing:

The *os* and *sys* modules. Introduction to file I/O - Reading and writing text files, Manipulating binary files. NumPy - Basics, Creating arrays, Arithmetic, Slicing, Matrix Operations, Random numbers. Plotting and visualization. Matplotlib - Basic plot, Ticks, Labels, and Legends. Working with CSV files. – Pandas - Reading, Manipulating, and Processing Data.

Text Books:

1. Kenneth A Lambert., Fundamentals of Python : First Programs, 2/e, Cengage Publishing, 2016
2. Wes McKinney, Python for Data Analysis, 2/e, Shroff / O'Reilly Publishers, 2017

Reference Books:

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2/e, Schroff, 2016
2. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
3. David M.Baezly, Python Essential Reference. Addison-Wesley Professional; 4/e, 2009.
4. Charles Severance. Python for Informatics: Exploring Information
5. http://swcarpentry.github.io/python-novice-gapminder/

23-202-0514 - APPLIED MACHINE LEARNING

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify the characteristics of machine learning that makes it useful to solve real-world problems.*
2. *Provide solution for classification and regression approaches in real-world applications.*
3. *Choose an appropriate clustering technique to solve real world problems,*
4. *Understand the methods to reduce the dimension of the dataset used in machine learning algorithms.*
5. *Indicate a suitable machine learning model, implement and examine the performance of the chosen model for a given real world problems.*

Course Articulation Matrix:

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

1-Slightly;2-Moderately;3-Substantially

Module I

Introduction to Machine Learning

Preface of Machine Learning, Types of Learning : Supervised - Unsupervised Learning- Reinforcement- theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization – generalization bound – approximation-generalization tradeoff – bias and variance – learning curve - Finite and Infinite Hypothesis Spaces, Probably Approximately Correct (PAC) Learning-Bayes theorem ,MDL principle.

Module II

Supervised Learning

Learning a Class from Examples, Linear, Non-linear, Multi-class and Multi-label classification, Generalization error bounds: VC Dimension, Decision Trees: ID3, Classification and Regression Trees, Regression: Linear Regression, Multiple Linear Regression, Logistic Regression.

Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non-Linear, Kernel Functions, K-Nearest Neighbors.

Module III

Ensemble Learning and Unsupervised Learning

Ensemble Learning Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost. Introduction to clustering: Hierarchical: Partitional: K-means clustering, K- Mode Clustering, Self-Organizing Map, Expectation Maximization, Gaussian Mixture Models- Principal components analysis (PCA), Locally Linear Embedding (LLE), Factor Analysis.

Module IV

Reinforcement Learning

Passive reinforcement learning – Direct utility estimation - Adaptive dynamic programming- Temporal difference learning- Active Reinforcement learning –Exploration –learning an action-utility function -Generalization in reinforcement learning – policy search - Applications.

Neural Networks and Machine Learning in Practice

Introduction to Neural Networks - Fundamental concepts: neuron models and basic learning rules- Multilayer neural networks and back-propagation - Machine Learning in Practice Design, Analysis and Evaluation of Machine Learning Experiments.

Text Books:

1. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Prentice Hall of India, Third Edition 2014

Reference Books:

1. Sergios Theodoridis, Konstantinos Koutroumbas, Pattern Recognition, Academic Press, 4th edition, 2008, ISBN:9781597492720.
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012.
3. Tom Mitchell, Machine Learning, McGraw Hill, 3rd Edition, 1997.
4. Charu C. Aggarwal, Data Classification Algorithms and Applications, CRC Press, 2014.
5. Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, -Learning from Data, AMI. Book Publishers, 2012.
6. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012.

23-202-0613 OPTIMIZATION TECHNIQUES

Course Outcomes:

On completion of this course the student will be able to:

1. *To understand the need and origin of the optimization methods.*
2. *To get a broad picture of the various applications of optimization methods used in engineering.*
3. *To define optimization problem and its various components.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	2						1	2	2	1	1	1
CO2	3	3	3	2	2							2	2	2	1	1
CO3	3	3	2	2	2							2	3	1	1	1

1-Slightly;2-Moderately;3-Substantially

Module I

Introduction: Engineering applications of optimization, Formulation of design problems as mathematical programming problems, objective function, constraints, classification of optimization problems/techniques.

Optimization techniques: Classical optimization, unconstrained single and multivariable minimization- necessary and sufficient conditions for optimality, uni-modality, convexity.

Module II

Linear programming problems-I: Mathematical formulation of LP Problems, slack, surplus and artificial variables. Reduction of a LPP to the standard form, feasible solutions. Graphical solution method, simplex algorithm and solution using tabular method, optimality conditions and degeneracy. Duality in linear programming

Module III

Transportation Problem: Formulation of transportation problem, Basic feasible solution using different methods- East West corner method, Vogel approximation method, Optimality methods, MODI method, Unbalanced transportation problem

Game Theory: Introduction, 2- person zero – sum game; Saddle point; Mini-Max and Maxi-Min Theorems (statement only); Graphical solution (2x n, m x 2 game), dominance property. Network path Models: Tree Networks – Minimal Spanning Tree - Prim's Algorithm. Shortest path problems- solution methods – Dijkstra's Method.

Module IV

Nonlinear unconstrained optimization: Single variable optimization methods- Fibonacci search method, Newton- Raphson method.

Multi-variable methods- Hook-Jeeves pattern search method, Cauchy's (steepest descent) method.

Modern methods of optimization: Introduction to Genetic algorithm, Cross over, Mutation, Reproduction, Simple examples of applications in electronics engineering

Text Books:

1. H.A. Taha, "Operations Research", 5/e, Macmillan Publishing Company, 1992.
2. Kalynamoy Deb. "Optimization for Engineering Design- Algorithms and Examples",

Prentice-Hall of India Pvt. Ltd., New Delhi
3. Singiresu S Rao, “Engineering optimization Theory and Practice”, New Age International, 2009

References:

1. A. Ravindran, D. T. Phillips, J. J. Solberg, Operations Research – Principles and Practice, John Wiley and Sons.
2. Ashok D Belegundu, Tirupathi R Chandrupatla, “Optimization concepts and Application in Engineering”, Pearson Education.
3. Hadley, G. “Linear programming”, Narosa Publishing House, New Delhi
4. J. S. Arora, Introduction to Optimum Design, McGraw-Hill Book Company.
5. Kanti Swarup, P.K.Gupta and Man Mohan, Operations Research, Sultan Chand and Sons
6. Papalambros & Wilde, Principles of Optimal Design, Cambridge University Press, 2008