



Koneru Lakshmaiah Education Foundation

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

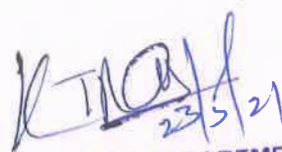
Minutes of 26th Board of Studies Meeting

May 23rd, 2021

26th BOS meeting of Computer Science and Engineering Department held on May 23rd, 2021 online from 2:00 PM to 5:00 PM.

The following members were present:

1. Dr. V R Raghuveer, Dean Academics, Member
2. Dr. K. Thirupathi Rao, Professor, Member
3. Mr. V. Hari Kiran, Professor, Member
4. Dr. P Sai Kiran, Professor, Member
5. Dr. Madhu Muthyam, Professor, IIT, Madras
6. Mr. Ramesh Kumar Dacha, Associate Director, Accenture Solutions India Pvt. Ltd., Hyderabad
7. Dr. Amaralingeswara Rao Kaka, Program Director, IBM, Hyderabad
8. Mr. Jagan Mohan Chevvakula, Sr. QA Manager, Nga HR Pvt Limited, Hyderabad
9. Dr. V. Srikanth, Professor, Member
10. Dr. Chiranjeevi, Professor, Member-Hyderabad Campus
11. Dr. B. V. Appa Rao, Professor, Department of Maths, Member
12. Dr. Shanmukh Kumar, Professor, Department of Chemistry, Member
13. Dr. M. Kameswara Rao, Professor, Department of ECM, Member
14. Dr. B. T. P. Madhav, Professor, Department of ECE, Member
15. Dr. M. V. V. K. Srinivas Prasad, Professor, Department of Physics, Member
16. Dr. V. Chandra Prakash, Professor, Member
17. Dr. K. Subrahmanyam, Professor, Member
18. Dr. Dr T Pavan Kumar, Professor, Member
19. Dr K.V.Durga Kiran, Professor, Member


23/5/21
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Computer Science and Engineering
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20. Dr. V. Krishna Reddy, Professor, Member
21. Dr. G.Pradeepini, Professor, Member
22. Dr. N. Srinivasu, Professor, Member
23. Dr. Pragnyaban Misra, Professor, Member
24. Dr. Vsrk Sharma, Professor, Member
25. Dr. P. Rajarajeswari, Professor, Member
26. Dr. K. Amarendra, Professor, Department of CS&IT, Member
27. Dr. K. V. V.Satyanarayana, Professor, Member
28. Dr. Gandharba Swain, Professor, Member
29. Dr. Y Prashanth, Professor, Member
30. Dr. K. Bhanu Prakash, Professor, Member
31. Dr. Dr.B.Vijaya Babu, Professor, Member
32. Dr. Dr.G.Krishna Mohan, Professor, Member
33. Dr. Dr.S.Sagar Imambi, Professor, Member
34. Dr. Dr.G.Sivanageswara Rao, Professor, Member
35. Dr Dr.Md.Moulana, Professor, Member
36. Dr Dr.E.Vamsidhar, Professor, Member
37. Dr Dr.T.Santhi Sri, Professor, Member
38. Dr Dr.G.Rama Koteswara Rao, Professor, Department of CS&IT, Member
39. Dr Dr.Suryakanth .V Gangashetty, Professor, Member
40. Dr Dr.D.Govind, Professor, Member
41. Mr. M. Vishnuvardhan, Assoc.Professor, Member
42. Dr V. Divya, Assoc.Professor, Member
43. Dr. A.V Praveen Krishna, Assoc.Professor, Member
44. Dr Dr.P.Ch.J.Srinivasa Rao , Assoc.Professor, Member
45. Dr Dr.Kunda Venkata Prasad, Assoc.Professor, Member


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46. Dr Dr.P.Vidya Sagar, Assoc.Professor, Member

47. Mrs. A. Roshini, Asst.Professor, Member

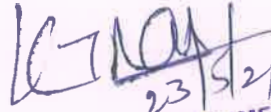
48. Mr R Sri Vishnu, Student, Member

49. Ms P Akhila, Student, Member

50. Mr G Akhil, Student, Member

Members Absent: ---NIL---

The Chairman, BoS welcomed all the members to the BoS meeting and started the meeting by highlighting the Vision & Mission statements of the department and the University. He also presented PEOs, POs and PSOs of the program


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AGENDA and RESOLUTIONS

AGENDA ITEM-1

Consider and approve the resolutions made by DAC Conducted on 22nd May 2021 in online mode from 8:00 am to 9:30 am	Resolution: Approved DAC minutes and recommended to Academic Council.
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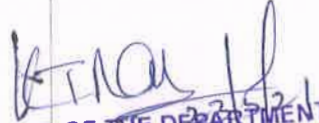
- Chairman of the BOS informed the members present about the Department Academic Committee (DAC) meeting held on 22nd May 2021 (Agenda Item No: 1) and highlighted the major resolutions of discussion.
It is resolved to approve the resolution made in DAC. **(Annexure-I)**

AGENDA ITEM-2

Proposed to introduce additional Mandatory, Flexi Core, Professional Core courses for 2021-22 B.Tech admitted Batch based on the feedback received from stakeholders for approval.	Resolution: Approved for introduced courses for B.Tech 2021-22 admitted Batch and the same is recommended to Academic Council.
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To consider and approve the proposed new courses & revision of selected set of courses for 2021-22 admitted batch B. TECH students based on the stake holder's feedback.

- Dr V K Gnanavel, Academic Peer, highly recommended a course to develop essential skills for employability. It's a valuable investment in personal and professional growth.
It is resolved to introduce a course "Essential Skills for Employability" for 2021-22 admitted batch students.
- Murali Mohan Setty, Industry Personnel, highly recommended the Probability, Statistics & Queueing Theory course to students seeking a strong foundation in data analysis and mathematical modeling, as it is invaluable for various academic and professional pursuits.
It is resolved to introduce a course "Probability, Statistics & Queueing Theory" for 2021-22 admitted batch students.
- Dr. P Manivannan, Academic Peer, suggested that the inclusion of the "Computational Thinking for Object-Oriented Design (CTOD)" course is highly recommended, as it will empower students with essential problem-solving skills and a strong foundation in object-oriented design, aligning with the evolving demands of the tech industry.
It is resolved to introduce a course "Computational Thinking for Object Oriented Design (CTOD)" for 2021-22 admitted batch students.


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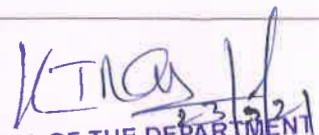
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- iv. Dr. T.S. Rajeswari, Faculty, suggested to introduce Problem Solving Skills – 1 and Problem Solving Skills - 2 into the curriculum to enhance students problem-solving capabilities and prepare them for real-world challenges.
It is resolved to introduce a course “Problem Solving Skills – 1 and Problem Solving Skills - 2” for 2021-22 admitted batch students.
- v. Mr. T. Ravi Kumar, Faculty, strongly recommended the addition of the 'Advanced Object-Oriented Programming' course to our curriculum, as it addresses the growing demand for advanced coding proficiency and design pattern expertise, crucial for students to excel in contemporary software development roles.
It is resolved to introduce a course “Advanced Object-Oriented Programming” for 2021-22 admitted batch students.
- vi. Dr. Ohm Prakash SRM University, Academic Peer suggested Integrating Quantum Computing into our curriculum, as it is crucial for empowering students with the skills and knowledge needed to harness the potential of cutting-edge technology and address intricate computational challenges.
It is resolved to introduce a course “Quantum Computing” for 2021-22 admitted batch B.Tech and Ph.D students.
- vii. Dr. PRAGNYABAN MISHRA, Professor, CSE, recommended adding the course "Multimodal Information Processing" to our curriculum, as it addresses critical skills needed in the contemporary data-driven landscape and enhances our students' competitiveness in various fields.
It is resolved to introduce a course “Multimodal Information Processing” for 2021-22 admitted batch students.

S. No	Course Code	Course Title	Course Type	Credits	Remarks
1	21UC2103	Essential Skills for Employability	Mandatory	2	Introduced in place of Professional Communication Skills course
2	21MT2103	Probability, Statistics & Queueing Theory	Mandatory	4	Introduced in place of Mathematical Programming - 1 course
3	21UC3105	Problem Solving Skills-1	Mandatory	1.5	Introduced as a Basic Science course
4	21UC3206	Problem Solving Skills-2	Mandatory	1.5	Introduced as a Basic Science course
5	21SC1203	Computational Thinking for Object Oriented Design	Mandatory	5	Introduced in place of Object Oriented Programming course
6	21CS2116	Advanced Object Oriented Programming	Professional Core Course	4	Introduced as a Professional Core course


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S. No	Course Code	Course Title	Course Type	Credits	Remarks
7	21CS3043RA	Quantum Computing	Flexi Core Course	3	Introduced as a Flexi Core course
8	21CS3120	Multimodal Information Processing	Elective Course	3	Introduced as an Elective course

The detailed syllabus for the list of proposed courses is given in Annexure-II

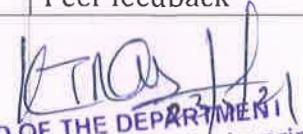
AGENDA ITEM-3

Proposed to revise the syllabus for 2021-22 B.Tech admitted Batch based on the feedback received from stakeholders.	Resolution: Approved the revision of syllabus for B.Tech 2021-22 admitted Batch and the same is recommended to Academic Council.
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To consider and approve the revision of syllabus for 2021-22 admitted batch students based on the stake holder's feedback.

- Dr. C Siva Sankar Associate professor, Academic Peer suggested a revision for the Design Thinking & Innovation course is highly recommended to incorporate the latest trends and case studies, ensuring students remain at the forefront of innovative problem-solving methodologies.
It is resolved to approve the revision of syllabus in "Design Thinking & Innovation" course to 2021-22 admitted batch.
- Dr. R Venkata Ratnam, Academic Peer, suggested a revision of the Mathematical Programming course is advisable to incorporate modern optimization techniques and real-world applications, ensuring students gain relevant skills for today's problem-solving challenges.
It is resolved to approve the revision of syllabus in "Mathematical Programming" course to 2021-22 admitted batch.
- Mr. SK. Mohammed Gouse, Assistant Professor, Faculty, recommended revising the Technical Skilling - 2 (MERN Stack Web Development) course to stay up to date with the rapidly evolving web development landscape, thereby providing students with the most relevant and practical skills for their future careers.
It is resolved to approve the revision of syllabus in "Technical Skilling - 2 (Mern Stack Web Development)" course to 2021-22 admitted batch.

S. No	Course Code	Course Name	Course Category	Overall Revision Percentage	Remarks
1	21UC1203	Design Thinking and Innovation	Mandatory	50%	Based on Academic Peer feedback


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S. No	Course Code	Course Name	Course Category	Overall Revision Percentage	Remarks
2	21CS2204	Mathematical Programming	Mandatory	50%	Based on Academic Peer feedback
3	21TS2202RA	Technical Skilling - 2 (Mern Stack Web Development)	Skill Development Course	60%	Based on Faculty feedback

The detailed comparison for the old syllabus and revised syllabus is given in Annexure -III

AGENDA ITEM-4

Proposed to revise the syllabus for M. Tech - Computer Science and Engineering 2021-22 admitted batch students based on the feedback received from stakeholders.	Resolution: It is resolved to approve the revision of selected set of courses in M. Tech - Computer Science and Engineering and same is recommended to Academic Council.
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- i. Dr. Bala Krishna, Faculty, suggested that revising the "Data Mining" course is vital to ensure that students are equipped with the latest data analysis techniques and tools, enabling them to uncover valuable insights from large datasets and address contemporary data mining challenges.
It is resolved to approve the revision of syllabus of "Data Mining" course and retitled as "Data Warehousing & Mining" to 2021-22 admitted batch.
- ii. Jack Ilamaran, Industry Person, suggested to enhance syllabus for "Principles of Programming Languages" course, consider incorporating contemporary programming languages and paradigms, emphasizing practical application and industry relevance.
It is resolved to approve the revision of syllabus in "Principles of Programming Languages" course to 2021-22 admitted batch.
- iii. For Compiler Design, Mrs. Naga Malleswari, Faculty, recommended to revise the compiler design syllabus as it's a practical oriented course.
It is resolved to approve the revision of syllabus in "Compiler Design" course to 2021-22 admitted batch.
- iv. Dr. Md. Mujahid, Associate Professor, King Khalid University Saudi Arabia, Academic Peer, suggested to enhance the "Cryptography & Network Security" course, consider integrating the latest cryptographic algorithms, cybersecurity best practices, and real-world case studies to address evolving threats.
It is resolved to approve the revision of syllabus in "Cryptography & Network Security" course to 2021-22 admitted batch.
- v. Dr. K. Raghava Rao, Professor in CSE, PI - KLIPFC and MSME-BI Projects, Assistant Professor, Academic Peer, suggested that revising the "Continuous Delivery &

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DevOps" course is essential to equip students with the late practices and tools in DevOps and continuous delivery.

It is resolved to approve the revision of syllabus in "Continuous Delivery & Devops" course to 2021-22 admitted batch.

- vi. BoS Members agreed to the revision proposal given by the DAC members on Dissertation course and new course codes are approved.

S. No	Course Code	Course Name	Course Category	Overall Revision Percentage	Remarks
1	21CS51A3	Data Warehousing & Mining	Elective	80%	Based on Faculty feedback
2	21CS51B2	Principles of Programming Languages	Elective	10%	Based on Academic Peer feedback
3	21CS51B3	Compiler Design	Elective	60%	Based on Faculty feedback
4	21CS52C1	Cryptography & Network Security	Elective	5%	Based on Academic Peer feedback
5	21CS52C5	Continuous Delivery & Devops	Elective	12%	Based on Academic Peer feedback

The syllabus for the revised courses in M. Tech -Computer Science and Engineering is given in Annexure -IV

AGENDA ITEM-5

B. Tech-CSE, M. Tech-CSE, M. Tech-AIDS, M.Tech-DFCS programs structures of 2021-2022 admitted batch students.	Resolution: It is resolved to approve the proposed changes by the stake holders and to approve the structures of B. Tech and M. Tech-CSE, M. Tech-AIDS, M. Tech-DFCS for 2021-2022 Admitted batch students and recommended to Academic Council.
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- Dr. K Thirupathi Rao, Chairman of the BOS, proposed revisions to the curriculum for the B.Tech-CSE program, stating that the admitted class of 2021-2022 students must complete at least 161 credits to earn a regular degree.
- For the admitted class of 2021-2022, an additional 20 credits are needed to get an honors degree.
- In response to the member's question about needing an additional 20 credits to earn an honors degree, Dr. K. Thirupathi Rao clarified that these extra credits could be obtained by enrolling in advanced or peer-mentoring courses from the Engineering Science, Professional Core, Professional Electives, and Project categories.

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- The courses recommended to be offered in advance and Peer mentor mode for 2021-2022 admitted batch B.Tech Students is given in **(Annexure-VII)**.
- Additionally, he said that while the credits for both Advanced and Peer Mentor are the same, the evaluation format differs. The difference in credits between Regular and Advanced, Peer Mentor, is 2. The comprehensive evaluation strategy is considered and endorsed.
- The BoS members supported the suggested revisions and acknowledged that these adjustments are required for B.Tech Computer Science and Engineering students to be ready as per modern requirements and industrial needs. Based on considering the feedback from the stakeholders A.Y 2021-22 B.Tech and M.Tech structures are proposed with following changes in 2021-22 curriculum.

The program structure for Y21 BTech-CSE is given in Annexure-V and the program structure for all M.Tech Programs is given in Annexure-V A, B, C.

AGENDA ITEM-6

List of MOOCs courses offering to B.Tech -CSE 2021-22 admitted batch students.	Resolution: It is resolved and approved the Identified MOOCs courses to offer for 2021-22 students and recommended to Academic Council.
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- As part of academic flexibilities offered to the students, BoS members discussed and proposed to offer few Open Electives, Management Electives and Foreign Language Electives through Coursera platform.

The MOOCs courses and course links are given in Annexure -VI

AGENDA ITEM-7

List of Value-Added courses offering to B.Tech -CSE 2021-22 admitted batch students.	Resolution: It is resolved to approve the list of Value-Added Courses and recommended to Academics Council for approval
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- BoS Members discussed on proposed value-added courses for 2021-22 admitted batch students and approved the same.

The detailed list of Value-Added Courses is given in Annexure -VIII

AGENDA ITEM-8

List of proposed Pre-Ph.D courses and syllabus.	Resolution: Approved for introduced Pre-Ph.D courses and the same is recommended to Academics Council.
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- The following points are discussed and resolved.


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New courses

- i. Dr. C. Karthikeyan, Associate Professor, Faculty recommended considering inclusion of "Evolution of Software Architectures". Is crucial to keep software systems relevant, efficient, secure, and adaptable to the ever-changing technological and business landscape. It ensures that software remains a valuable asset rather than becoming a liability.
It is resolved to introduce a course "Evolution of Software Architectures" for 2021-22 admitted batch students.
- ii. Dr. CHAYAN PAUL, Associate Professor, Faculty suggested to introduce "Foundations of Data Science for Extensive Research" course that incorporates advanced data analysis techniques, machine learning, and big data technologies. It is resolved to introduce a course "Foundations of Data Science for Extensive Research" for 2021-22 admitted batch students.
- iii. Eugene Akash Industry Personnel strongly endorse inclusion of new course, Financial Engineering & Business Intelligence program for its unique blend of quantitative analysis and advanced data-driven strategies, making it an ideal choice for individuals seeking a competitive edge in today's finance sector.
It is resolved to introduce a course "Financial Engineering & Business Intelligence" for 2021-22 admitted batch students.
- iv. Dr. Ohm Prakash SRM University, Associate Professor, Academic Peer suggested integrating Quantum Computing into our curriculum is crucial for empowering students with the skills and knowledge needed to harness the potential of cutting-edge technology and address intricate computational challenges.
It is resolved to introduce a course "Quantum Computing" for 2021-22 admitted batch B.Tech and Ph.D students.
- v. Dr. Y. PRASHANTH , Professor, Faculty suggested to introduce new course Object-Oriented Analysis and Design course as it provides a solid foundation for designing robust and maintainable software systems, a crucial skill in today's software development industry.
It is resolved to introduce a course "Object Oriented Analysis and Design" for 2021-22 admitted batch students.
- vi. Bandaru Ravi Teja, Industry Person highly recommend including Signal Processing in the curriculum as it is a fundamental skill for understanding and advancing technology in fields such as communications, healthcare, and audio processing.
It is resolved to introduce a course "Signal Processing" for 2021-22 admitted batch students.
- vii. Imran Rasheed, Faculty recommend including "Artificial Neural Networks" in the curriculum as it offers students invaluable insights into cutting-edge machine learning techniques, fostering their ability to tackle complex real-world problems.
It is resolved to introduce a course "Artificial Neural Networks" for 2021-22

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- admitted batch students.
- viii. P Ramya, faculty, suggested including Virtual and Augmented Reality into our program as it enriches the learning experience, fostering innovation and preparing students for the forefront of technology-driven industries. It is resolved to introduce a course "Virtual and Augmented Reality" for 2021-22 admitted batch students.
- ix. Mohan Kumar, Faculty, recommended enthusiastically endorse the inclusion of 'Blockchain and Cryptocurrencies' in the curriculum, as it empowers students with crucial expertise in an emerging and transformative domain, fostering a wide array of career prospects. It is resolved to introduce a course "Blockchain and Cryptocurrencies for 2021-22 admitted batch students.
- x. Dr. Syamsundarao, Faculty, highly recommend incorporating Speech Processing into the curriculum, as it empowers students to harness the power of human language in cutting-edge AI applications, fostering innovation and problem-solving in diverse fields. It is resolved to introduce a course "Speech Processing" for 2021-22 admitted batch students.

The syllabus for all the Pre-Ph.D courses is given in Annexure - IX

AGENDA ITEM-9

Proposed to revise the syllabus for Pre-Ph.D courses and syllabus based on the feedback received from stakeholders.	Resolution: Approved the revision of syllabus for Pre-Ph.D courses and the same is recommended to Academics Council.
---	--

Revised courses

- i. N Padmavati, Academic Peer suggested revising our Information Retrieval System course to ensure it remains current with the latest industry trends and technologies, enhancing our students' knowledge and employability in this critical field. It is resolved to approve the revision of syllabus in "Information Retrieval System" course to 2021-22 admitted batch.
- ii. Kowndanya, Industry Personnel suggested to revise Digital Image Processing in our curriculum as it is a fundamental skill in today's data-driven world, to meet current industry needs, enabling students to excel in fields like computer vision and image analysis. It is resolved to approve the revision of syllabus in "Digital Image Processing" course to 2021-22 admitted batch.
- iii. Dr.CH Rami Reddy, Academic Peer strongly recommended revising the course 'Research Foundations for Pattern Recognition' to enhance its practical applications and industry relevance, ensuring students gain both theoretical knowledge and hands-on skills vital in today's data-driven world.

[Handwritten Signature]
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Guntur District, Andhra Pradesh



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It is resolved to approve the revision of syllabus in "Research Foundations for Pattern Recognition" course to 2021-22 admitted batch.

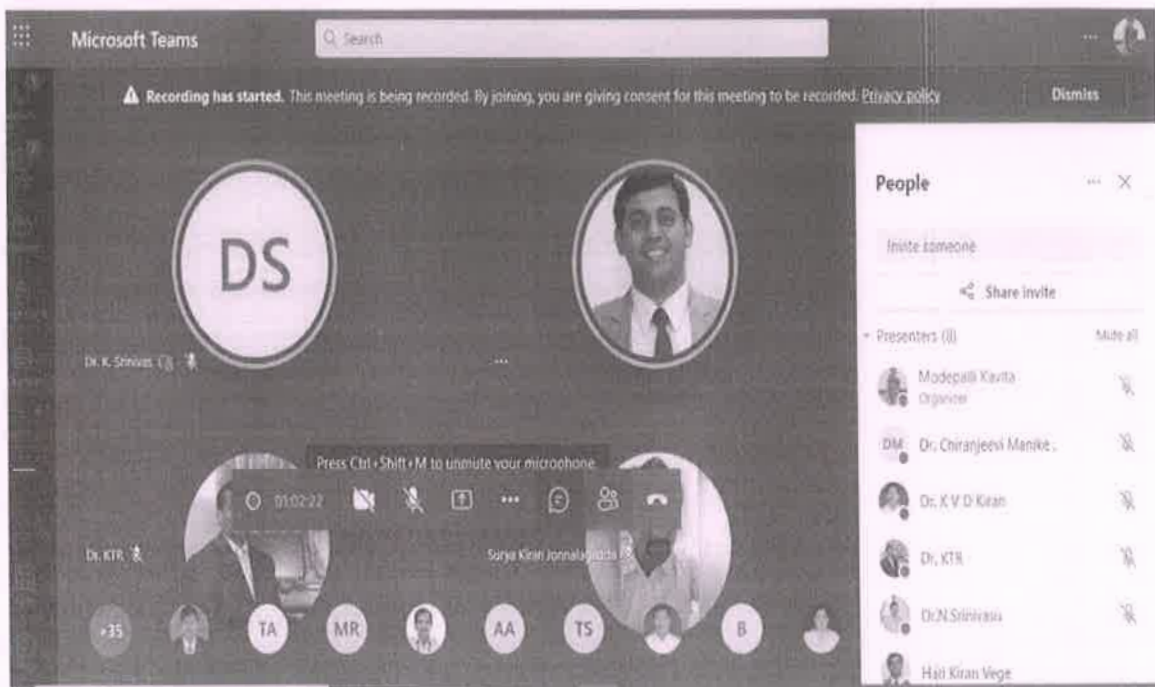
- iv. Dr. Sri Vani, Academic Peer suggested revising the Cryptography & Network Security syllabus to ensure it remains aligned with the latest cybersecurity threats and technologies, equipping students with the most relevant and up-to-date knowledge to protect digital assets and privacy.

It is resolved to approve the revision of syllabus in "Cryptography & Network Security" course to 2021-22 admitted batch.

The syllabus for the revised courses is given in Annexure -X

The detailed feedback and action taken report is presented in Annexure-XI

BoS Meeting Pictures:



K. R. N. V. S. R.
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Annexure-I

DEPARTMENT ACADEMIC COMMITTEE MEETING MINUTES

Minutes of 28th DAC meeting Conducted on 22nd May 2021 in online from 8:00 am to 9:30 am.

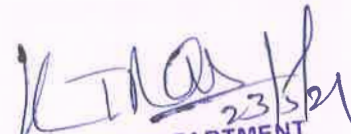
The head of the department welcomed DAC members and started the meeting by highlighting the vision & mission statements of university and department, also PEOs and PO statements of the programs.

Agenda Items:

1. To consider the feedback given by the stake holders on the program structure of 2021-22 admitted batch students.
2. To discuss on student progression.
3. To discuss and consider the feedback given by the course coordinators of 2020-21 A.Y.
4. To discuss on CO-PO Attainment of courses in 2020-2021 Even Semester.
5. To discuss on Gap Analysis report on CO-PO Attainment and Teaching Pedagogy.
6. To discuss and approve the inclusion of new courses and revision of selected set of courses in B. Tech CSE 2021-22 A.Y curriculum.
7. To consider and approve revision of M.Tech-CSE courses and syllabus.
8. To consider and approve revision of Pre-Ph.D courses and syllabus.

The following members were present:

1. Mr. V. HARI KIRAN
2. Dr. K. AMARENDRA
3. Dr. N. SRINIVASU
4. Dr. P. RAJARAJESWARAI
5. Dr. M. R. NARASINGA RAO
6. Dr. G. PRADEEPINI
7. Dr. K. SUBRAHMANYAM
8. Dr. P. SAI KIRAN
9. Dr. K. THIRUPATHI RAO


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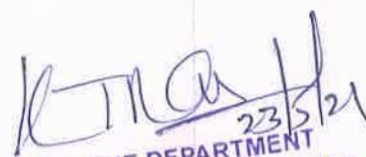
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10. Dr. M. SREEDEVI
11. Dr. P. VIDYA SAGAR
12. Dr. K. KIRAN KUMAR
13. Dr. Y. PRASANTH
14. Dr. P.V.R.D. PRASADA RAO
15. Dr. VITHYA GANESAN
16. Dr. P. CH. J. SRINIVASA RAO
17. Dr. V. CHANDRA PRAKASH
18. Dr. G. KRISHNA MOHAN
19. Dr. C. M. SHEELA RANI
20. Dr. A. V. PRAVEEN KKRISHNA
21. Dr. SURYAKANTH. V. GANGASHETTY
22. Dr. RUDRA KALYAN NAYAK
23. Dr. DHAWALESWAR RAO Ch
24. Dr. VIJAY KUMAR BURUGARI
25. Dr. T. SAJANA
26. Dr. VIJAYA SRI .K
27. Dr. P. YELLAMMA
28. Dr. S. SAGAR IMAMBI
29. Dr. K. SWARNA
30. Dr. D. GOVIND
31. Dr. P. VIDYULLATHA
32. Dr. T. SANTHI SRI
33. Dr. E. VAMSIDHAR
34. Dr. A. V. PRAVEEN KRISHNA
35. Dr. PRAGNAYABAN MISHRA
36. Dr. B. CHAITANYA KRISHNA
37. Dr. G. SIVANAGESWARA RAO


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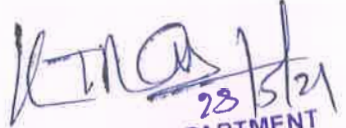
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

38. Dr. K. V. V. SATYANARAYANA
39. Dr. P. LAKSHMI PRASANNA
40. Dr. NILU SINGH
41. Dr. DEBRUP BANERJEE
42. Dr. V. S. R. K. SARMA
43. Dr. CH SMITHA
44. Ms. M.V.B.T. SANTHI
45. Mr. M. VISHNUVARDHAN
46. Mrs. V. DIVYA
47. Mrs. A. ROSHINI
48. Mrs. M. PRAVEENA
49. Mrs. K. RUTH RAMYA
50. Mr. N. RAJESH
51. Mr. VIJAYA KRISHNA SONTI
52. Mr. P. S. V. S. SRIDHAR
53. Mr. M. VENKATA NARESH
54. Mr. CH. MOHAN KUMAR
55. Mr. P V V S SRINIVAS
56. Mrs. K. MADHURI
57. Mr. N. RAVINDER
58. Mr. J. SURYA KIRAN
59. Mr. K. VAMSI KRISHNA
60. Mr. M V NARESH
61. Mrs. P. RAMYA
62. Mr. ANDE PAVAN KUMAR

The following points are discussed and resolved:

- **Students Progression**

Student Progression of Y17, Y18 and Y19:


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Y17:

- In Y17, 1000 out of 1500 students cleared all the procedures including 4 Global certifications and there are only around 99 students yet to register into global certifications and all the other students are in completion of global certifications and with that they should be able to graduate.
- Y17 graduation rate is good.
- Y17 is most successful batch till date because average pay package was 5.75 which is a tremendous increase from earlier 4.25 packages. Y17 Batch has raised the benchmark.

Y18:

- Y18 students are in process of taking care of placement training. Some of the students are yet to take makeup exam for 3rd year 1st semester and 3rd 2nd Semester.
- Placements of Y18 students are undergoing graduate in 4 different batches.
- Batch - A: slow learners - revision classes are conducting related to coding and VQR.
- Batch - B: Moderate students who are undertaking Wipro talent next training batch.
- Batch - C: Advanced coding students who are being trained by 3rd party organization.
- Batch - D: PEGA trained students.
- Best part of y18 students is 30 students have already been placed even without the actual start of placement.

Y19:

- Y19 batch are all undergoing virtual summer internships and tool-based training programs.
- 2nd Year - 2nd Semester exams are completed, and evaluation is yet to commence.
- Hardly 60 students have taken 2-1 exams and makeup test is cancelled due to pandemic situation.
- So, Y19 student's results are pending due to pandemic situation.
- CO-PO Attainment of 2020-21 odd Semester courses and gap analysis report on CO-PO attainment and teaching pedagogy are discussed.
- Result analysis on 2020-21 odd semester courses is discussed.
- Based on course Closure minutes, The Cloud computing and software engineering research group are requested to start working little more towards industrial and contemporary placement related curriculum as there is a lot of demand in the market

K. Narasimha
23/5/21
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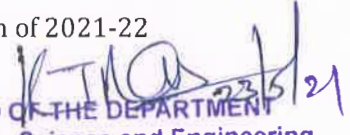
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for web of engineers and cloud engineers today and requested to work in offering some more courses to the students so that there will be flexibility in choosing from the professional electives.

- In B. Tech. CSE with Honours, 20 credits were taken only from professional courses; it is suggested to take some credits from Flexi courses also.
- AI Research group suggested to do necessary changes in BTL levels of course outcomes.
- Stakeholders feedback collected on 2021-22 Admitted batches proposed curriculum is discussed.
- CO-PO Attainment of 2020-2021 Odd Semester courses and gap analysis report on CO-PO attainment and teaching pedagogy are discussed.
- Result analysis on 2020-21 Odd semester courses is discussed.
- The following points are discussed and resolved based on the course closure minutes of A.Y 2020-21 and feedback from faculty on the curriculum of 2021-22 admitted batch students:
 1. Dr. T.S. Rajeswari, Faculty suggested to introduce Problem Solving Skills – 1 and Problem Solving Skills – 2 into the curriculum to enhance students' problem-solving capabilities and prepare them for real-world challenges.
 2. Mr. T. Ravi Kumar, Faculty, strongly recommended the addition of the 'Advanced Object-Oriented Programming' course to our curriculum, as it addresses the growing demand for advanced coding proficiency and design pattern expertise, crucial for students to excel in contemporary software development roles.
 3. Dr. PRAGNYABAN MISHRA, Professor, CSE, recommended adding the course "Multimodal Information Processing" to our curriculum, as it addresses critical skills needed in the contemporary data-driven landscape and enhances our students' competitiveness in various fields.
 4. Mr. SK. Mohammed Gouse, Assistant Professor, Faculty recommended revising the Technical Skilling - 2 (MERN Stack Web Development) course to stay up-to-date with the rapidly evolving web development landscape, thereby providing students with the most relevant and practical skills for their future careers.
- Based on the Industry and Academic Peers Feedback on curriculum of 2021-22


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1. Dr. V K Gnanavel, Academic Peer, highly recommended the course to anyone looking to develop essential skills for employability. It's a valuable investment in personal and professional growth.
 2. Murali Mohan Setty, Industry Personnel highly recommend the Probability, Statistics & Queueing Theory course to students seeking a strong foundation in data analysis and mathematical modeling, as it is invaluable for various academic and professional pursuits.
 3. Dr. P Manivannan, Academic Peer suggested that the inclusion of the "Computational Thinking for Object-Oriented Design (CTOD)" course is highly recommended, as it will empower students with essential problem-solving skills and a strong foundation in object-oriented design, aligning with the evolving demands of the tech industry.
 4. Dr. Ohm Prakash SRM University, Academic Peer suggested that Integrating Quantum Computing into our curriculum is crucial for empowering students with the skills and knowledge needed to harness the potential of cutting-edge technology and address intricate computational challenges.
 5. Dr. C Siva Sankar Associate professor, Academic Peer suggested a revision for the DESIGN THINKING & INNOVATION course is highly recommended to incorporate the latest trends and case studies, ensuring students remain at the forefront of innovative problem-solving methodologies.
 6. Dr. R Venkata Ratnam, Academic Peer suggested a revision of the Mathematical Programming course is advisable to incorporate modern optimization techniques and real-world applications, ensuring students gain relevant skills for today's problem-solving challenges.
- It is discussed and resolved to propose for introducing new courses and to revise selected set of courses in M.Tech-CSE based on the feedback given by all the stakeholders.
 1. Dr. Bala Krishna, Faculty suggested that revising the "Data Mining" course is vital to ensure that students are equipped with the latest data analysis techniques and tools, enabling them to uncover valuable insights from large datasets and address contemporary data mining challenges.
 2. Jack Ilamaran, Industry Person suggested to enhance syllabus for "Principles of Programming Languages" course, consider incorporating contemporary


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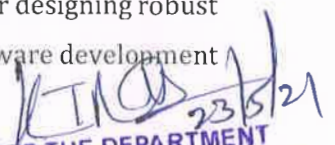
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programming languages and paradigms, emphasizing practical application and industry relevance.

3. For Compiler Design, Mrs. Naga Malleswari, Faculty recommended revising the compiler design syllabus as it's a practical oriented course.
 4. Dr. Sri Vani, Academic Peer suggested to revise the Cryptography & Network Security curriculum to ensure it remains aligned with the latest cybersecurity threats and technologies, equipping students with the most relevant and up-to-date knowledge to protect digital assets and privacy.
 5. N.V.Naresh, Assistant Professor, suggested to revise the Continuous Delivery & Devops as it's more needed for the modern era in software Industry.
 6. DAC members recommended to offer the Dissertation course with different course codes in Odd and Even Semesters and forwarded to BoS for approval.
- It is discussed and resolved to propose for introducing new courses and to revise selected set of courses in Pre-Ph.D based on the feedback given by all the stakeholders.
 1. Dr. C. Karthikeyan, Associate Professor, Faculty recommended considering inclusion of "Evolution of Software Architectures", is crucial to keep software systems relevant, efficient, secure, and adaptable to the ever-changing technological and business landscape. It ensures that software remains a valuable asset rather than becoming a liability.
 2. Dr. CHAYAN PAUL, Associate Professor, Faculty suggested to introduce "Foundations of Data Science for Extensive Research" course that incorporates advanced data analysis techniques, machine learning, and big data technologies.
 3. Eugene Akash Industry Personnel strongly endorse inclusion of new course Financial Engineering & Business Intelligence program for its unique blend of quantitative analysis and advanced data-driven strategies, making it an ideal choice for individuals seeking a competitive edge in today's finance sector.
 4. Dr. Ohm Prakash SRM University, Associate Professor, Academic Peer suggested integrating Quantum Computing into our curriculum is crucial for empowering students with the skills and knowledge needed to harness the potential of cutting-edge technology and address intricate computational challenges.
 5. Dr. Y. PRASHANTH, Professor, Faculty suggested to introduce new course Object-Oriented Analysis and Design as it provides a solid foundation for designing robust and maintainable software systems, a crucial skill in today's software development


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industry.

6. Bandaru Ravi Teja, Industry Person highly recommended including Signal Processing in the curriculum as it is a fundamental skill for understanding and advancing technology in fields such as communications, healthcare, and audio processing.
7. Imran Rasheed, Faculty recommended including "Artificial Neural Networks" in the curriculum as it offers students invaluable insights into cutting-edge machine learning techniques, fostering their ability to tackle complex real-world problems.
8. P Ramya, faculty, suggested including Virtual and Augmented Reality into our program as it enriches the learning experience, fostering innovation and preparing students for the forefront of technology-driven industries.
9. Mohan Kumar, Faculty, recommended enthusiastically endorse the inclusion of 'Blockchain and Cryptocurrencies' in the curriculum, as it empowers students with crucial expertise in an emerging and transformative domain, fostering a wide array of career prospects.
10. Dr. Syamsundaraao, Faculty, highly recommended incorporating Speech Processing into the curriculum, as it empowers students to harness the power of human language in cutting-edge AI applications, fostering innovation and problem-solving in diverse fields.
11. N Padmavati, Academic Peer suggested revising our Information Retrieval System course to ensure it remains current with the latest industry trends and technologies, enhancing our students' knowledge and employability in this critical field.
12. Kowndanya, Industry Personnel suggested to revise Digital Image Processing in our curriculum as it is a fundamental skill in today's data-driven world, to meet current industry needs, enabling students to excel in fields like computer vision and image analysis.
13. Dr. CH Rami Reddy, Academic Peer strongly recommended revising the course 'Research Foundations for Pattern Recognition' to enhance its practical applications and industry relevance, ensuring students gain both theoretical knowledge and hands-on skills vital in today's data-driven world.
14. Dr. Sri Vani, Academic Peer suggested revising the Cryptography & Network Security syllabus to ensure it remains aligned with the latest cybersecurity threats

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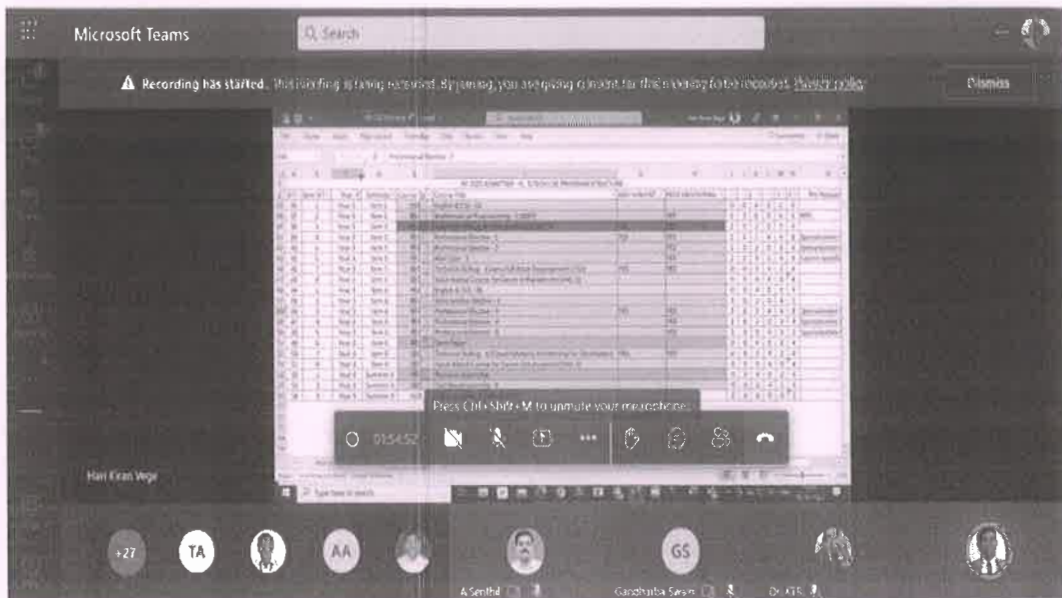
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and technologies, equipping students with the most relevant and up-to-date knowledge to protect digital assets and privacy.

DAC Meeting Pictures:



[Handwritten Signature]
23/5/21
Chairman DAC

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Annexure-II

Course Code: 21UC2103

Course Name: ESSENTIAL SKILLS FOR

EMPLOYABILITY

L-T-P-S: 0-0-4-0

Credits: 2

Prerequisite: NIL

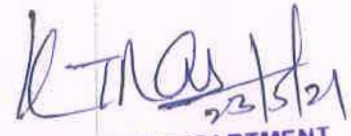
CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	Developing basic grammar Identify and organize sentence structures based on grammar and apply in writing skills	PO5	3
CO2	Develop effective interpersonal skills, cultivate a positive attitude, apply positive self-talk techniques, and use SWOC analysis to enhance employability.	PO6	3
CO3	Develop drafting skills through Cloze Test, Passage completion, E-mail writing, Paragraph writing, Essay writing	PO5	3
CO4	Develop effective communication skills through JAM and extempore, describing products and processes through JAM and extempore, demonstrating proper email and phone etiquette, and improving listening skills to enhance personal and professional relationships.	PO 5	3

Syllabus:

Grammar:: Tenses, Voice, Reported Speech, Spotting Errors, Sentence Improvement, Sentence Rearrangement, SWOC, Self-awareness, Attitude, Self-Confidence & Positive Self-Talk, Grooming, Intrapersonal skills, and Interpersonal Skills, Writing Skills: Cloze Test, Passage completion, E-mail writing, Paragraph writing, Essay writing, Speaking from the script through JAM & Extempore, Product & Process Description through JAM & Extempore, Transactional Analysis, Persuasion & Negotiation, Etiquettes (E-Mail & Phone), Listening Skills.

Textbooks:

1. Objective English for Competitive Examination Hari Mohan Prasad and Uma Sinha, McGraw Hill 2017
2. English Language Communication Skills, CY. Prabhavati Cenage 2014
3. Bridging the Softskills Gap Bruce Tulgan Jossey-Bass 2015
4. The Soft Skills Book-The Key Difference to Becoming Highly Effective & Valued, Dan White LID Publishing 2121


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code: 21MT2103
QUEUEING THEORY

Course Name: PROBABILITY, STATISTICS &

L-T-P-S: 2-2-0-0

Credits: 4

Prerequisite: NIL

CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	To understand the importance of probabilistic concepts in a wide spectrum of problems arising in engineering applied science	PO2, PSO1	3
CO2	Identify the relationship between variables using correlation and regression techniques	PO1,PO2,PSO1	4
CO3	Explain the role of Statistical tests of significance in solving real world engineering problems	PO2, PSO1	3
CO4	To formulate Stochastic process in terms of Markov chains and solve problems in queueing systems, and networks	PO2, PSO1	4

Syllabus:

Introduction to Probability: Sample Space and Events, Probabilities Defined on Events, Conditional Probabilities, Independent Events, Bayes Formula, Random Variables, Probability Distribution Function, Cumulative Distribution Function, Discrete Random Variables: Bernoulli, Binomial, and Poisson process. Continuous Random Variables: Uniform, Exponential and Normal Random Variables Expectation of a Random Variable: Discrete and Continuous Case Expectation of Function of a Random Variable: Higher Order Moments, Variance, Standard Deviation Jointly Distributed Random Variables: Joint Distribution Functions, Independent Random Variables. Measures of central tendency: Mean, Median, Mode, Measure of Dispersion: Variance, Standard deviation, coefficient of variation. Correlation and Linear regression. Sample and population, Confidence limits and intervals, Statistical tests of significance: Null and Alternate Hypothesis, t-test, Chi Square Test, ANOVA. Introduction to queues, measures of system performance, characteristics of queueing systems. Stochastic processes overview, discrete-time Markov chains, Continuous-time Markov chain, birth-death processes, Poisson process and exponential distribution, Birth-death queueing systems, Non-birth-death Markovian queueing systems, Queueing networks.

Textbooks:

1. An Introduction to Probability Theory and Its Applications, William Feller, Wiley & Sons 1991
2. Fundamentals of Queueing Theory, 4th Edition, D. Gross, J.F. Shortle, J.M. Thompson, and C.M. Harris, Wiley 2008
3. Probability and Statistics for Engineers and Scientists, Ronald E. Walpole, Sharon L. Myers and Keying Ye, 8th Edition Pearson 2008
4. "Probability and Statistics", Rukmangadachari E. and E. Keshava Reddy, First Edition Pearson 2015
5. Probability & Statistics for engineers, Dr. J. Ravichandran WILEY-INDIA 2010.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code: 21UC3105

Course Name: PROBLEM SOLVING

SKILLS - 1

L-T-P-S: 0-0-2-2

Credits: 1.5

Prerequisite:

NIL


CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	Apply the concepts of Linear Equations, concepts of Ratios, Averages, Partnership, Percentages and Interest to solve the problems related to Ages, Ratio & Proportion, Variation & Partnership, Percentages, Profit, Loss & Discounts, Simple & Compound Interest, Averages & Allegations or Mixtures.	PO1, PO5	3
CO2	Apply the concepts of Co-primes, Divisibility rules, LCM & HCF concepts to solve problems in Numbers, Apply the concepts of Algebra to solve the problems based on Sets, Relations, Functions and Graphs, Surds & Indices, Logarithms, Quadratic Equations, Inequalities & Progressions.	PO1, PO5	3
CO3	Apply Venn diagrams and other applicable diagrams to solve questions in Syllogism, Logical Venn Diagrams, Cubes & Dice. Understand the principles used in forming Number & letter series, Number, letter & word Analogy, Odd man out, Coding & Decoding.	PO1, PO5	3
CO4	Understand the underlying assumptions in the arguments presented in the topics: Statements & conclusions, statements & Arguments (Critical Reasoning), statements & Assumptions, logical connectives, Binary logic.	PO1, PO5	2

Syllabus:

Simple Equations, Problem on Ages, Ratio & Proportion, Variation & Partnership, Percentages, Profit, Loss & Discounts, Simple & Compound Interest, Averages & Allegations or Mixtures. Numbers, Divisibility, Decimal Fractions, LCM & HCF, Simplification, Sequence, Series & Progressions, Linear Algebra, Quadratic Equations & Inequalities, Theory of Equations. Sets, Relations, Functions and Graphs, Surds & Indices, Logarithms. Syllogism, Number & letter series, Number, letter & word Analogy, Odd man out, coding & decoding, Cubes & Dice, Logical Venn Diagrams, Ranking, Logical choice, Analytical reasoning. Statements & conclusions, statements & Arguments (Critical Reasoning), statements & Assumptions, logical connectives, Binary logic, Statement - Courses of Action, Inferred meaning, Logical order.

Textbooks:

1. Quantitative Aptitude, R S Aggarwal, S CHAND
2. A Modern Approach to Verbal Reasoning, R S Aggarwal, S CHAND


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code: 21UC3206

Course Name: PROBLEM SOLVING

SKILLS - 2

L-T-P-S: 0-0-2-2

Credits: 1.5

Prerequisite:

NIL

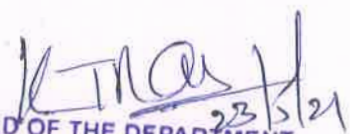
CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	Apply the concepts of Unitary method in solving problems in Time & Work, Chain Rule, Pipes & Cisterns. Apply the concept of Average speed and Relative speed to solve the problems related to Time, Speed & Distance, Trains, Boats & Streams, Races & games. Apply the concept of counting principles to solve the problems related to Permutations & Combinations and Probability.	PO1, PO5	3
CO2	Apply the concepts of Perimeter, Area, Surface Area & Volume to solve the problems in 2D & 3D Geometry. Apply the concepts of Trigonometry to solve problems related to Heights & Distances. Apply the concepts of Lines, Angles, Triangles, Quadrilaterals & Polygons to solve the problems related to Geometry, Analyzing the data given in the Table, Bar Graph, Pie Chart and Line Graph to solve the problems in Data Interpretation. Data Sufficiency, Statistics, Crypt arithmetic.	PO1, PO5	3
CO3	Apply the fundamental relationships and principles in solving questions in Blood Relations, Directions, Clocks, Calendars, Alphabet Test, Number, ranking & Time sequence test, Seating Arrangements, Mathematical Operations, Data Sufficiency, Nonverbal - series, analogy, classification.	PO1, PO5	3
CO4	Apply the conditions mentioned in the question statement to solve questions in Input & Output, Assertion and Reason, dot situation, embedded figures, figure matrix, mirror and water images, paper cutting, paper folding pattern completion, rule detection, flowcharts, Puzzles, Sudoku puzzles	PO1, PO5	3

Syllabus:

Time & Work, Chain Rule, Pipes & Cisterns, Time, Speed & Distance, Problems on Trains, Boats & Streams, Races & games, Permutations & Combinations, Combinatorics, Probability. Areas & Perimeters, Mensuration, Trigonometry, Heights & Distances, Geometry, Coordinate Geometry, Data Interpretation, Data Sufficiency, Statistics, Simplification, Crypt arithmetic, Spatial Ability. Blood Relations, Directions, clocks, calendars, Alphabet Test, Number, ranking & Time sequence test, Seating Arrangements, Mathematical Operations, Data Sufficiency, Nonverbal - series, analogy, classification, Team Formations, Rule detection. Input & Output, Assertion and reason, dot situation, embedded figures, figure matrix, mirror and water images, paper cutting, paper folding pattern completion, rule detection, flowcharts, Logical Puzzles, Sudoku, Playing cards puzzles, Attention to details, Grouping of images, Shape construction, Game based puzzles (Gamification).

Textbooks:

1. Quantitative Aptitude, R S Aggarwal, S CHAND
2. A Modern Approach to Verbal Reasoning, R S Aggarwal, S CHAND


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code: 21SC1203

Course Name: COMPUTATIONAL THINKING FOR OBJECT ORIENTED DESIGN (CTOD)

L-T-P-S: 3-0-2-4

Credits: 5

Prerequisite: CTSD

CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	Apply Object oriented paradigm for code reusability.	PSO2,PO3,PO5	3
CO2	Design object-oriented solutions to the real-world problems through SOLID design principles	PSO2,PO3,PO5	3
CO3	Build Abstract Data Types by applying generic classes and java API.	PSO2,PO3,PO5	3
CO4	Demonstrate Exception handling and String manipulation techniques	PO5,PSO2,PO3	3
CO5	Demonstrate Exception handling and String manipulation techniques	PSO1,PO7,PO9,PO10	4

Syllabus:

Introduction: Understanding Object oriented programming paradigm vs Structured paradigm. Advantages of Object-Oriented programming and its key features – abstraction, encapsulation, inheritance & polymorphism. Java program hierarchy and compilation process. Building static methods. Primitive Data Types and Arrays as a reference data type. Access specifiers for methods. Logic building using control statements and iterative statements. Wrapper classes and implicit casting. Command Line Arguments. Classes and Objects: object, class vs object and object instantiation. Abstraction and encapsulation using accessors and mutators. Constructors – default, user-defined and parametrized. Introduction to Java API, Scanner class, console-based IO. Constructor chaining, this keyword, array of objects, aggregation vs composition, Array List, SOLID design principles. Inheritance, method overriding, dynamic polymorphism, dynamic method dispatch, Singleton classes. Inner classes. Abstraction & Applications: Abstract classes, abstract methods, final keyword for methods and classes, template pattern, Introduction to interfaces, Interfaces vs implementation, Factory classes, factory method pattern, Generic classes, application of interfaces to build abstract data structures, Java API for Vector and LinkedList, comparable, comparator and cloneable, iterator interfaces. Anonymous classes, Decorator pattern. Event driven programming with event listeners. Exception handling & File IO: Introduction to exceptions & errors, Java API for exceptions, try, catch, finally, throw and throws keywords, try with resources, user defined exceptions. File IO, byte streams, character streams, wrapper classes for Object IO using serializable. String based algorithms using String Buffer and String Builder, String constant pool, regex, garbage collection.

Textbooks:

1. Introduction to Java Programming, Comprehensive Version, 10th Edition by Y. Daniel Liang.
2. Herbert Schildt, "The Complete Reference Java", 7th edition TMH.
3. Timothy A. Budd, "An Introduction to Object-Oriented Programming", 3/e, Pearson, 2008.

Reference Books:

1. Deitel&Deitel, "Java – How to program", 6th edition, PHI, 2007.
2. Cay.S.Horstmann and Gary Cornell "Core Java 2, Vol 1, Fundamentals", Seventh Edition, Pearson Education.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code: 21CS2116
PROGRAMMING

Course Name: ADVANCED OBJECT ORIENTED

L-T-P-S: 2-0-2-4

Credits: 4

Prerequisite: CTOD


CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	Apply Design Patterns with Clean coding Techniques	PO1	3
CO2	Analyze the Collections & Generics over Object-oriented Programming.	PO2, PO5	4
CO3	Apply the various Concurrent Programming methodologies in Object-oriented Programming	PO2, PO5	4
CO4	Develop the applications using JDBC, Servlets, JSP.	PO2, PO5	4
CO5	Analyze the various design techniques to solve any real-world problems	PO2, PO5	4

Syllabus:

Design Patterns: Introduction to design patterns, Structural, Creational & Behavioural patterns. Decorator, Bridge, adapter and facade patterns, Singleton, factory method, abstract factory patterns, observer, command, state, iterator, chain of responsibility patterns, dependency injection. Clean Coding Techniques: Introduction to code smells - bloaters, Object-oriented abusers, change preventers, dispensable and couplers. Refactoring techniques to remove the code smells. Generics & Collections Framework: Introduction to generics, usage of generics with interfaces, building stacks, queues, and Priority Queues, applying the comparator, comparable, cloneable & iterator interfaces, Introduction to Sets and Maps and their Java API. Building BST, AVL trees and graphs-based algorithms. Graph visualization. Multi-threading & Parallel programming: Introduction to Multithreading and Parallel Programming, Thread Concepts & its States, Creating Tasks & Threads, Thread Classes, Thread Pools, Thread Synchronization & Locks, Cooperation among Threads, Case Study: Producer/Consumer, Blocking Queues, Semaphores, Deadlock Avoidance. JDBC: API, Components, Architecture (2 Tier & 3 Tier), Drivers & Its Types, Packages for JDBC Connection, Steps to connect to Databases (PostgreSQL). Servlets: Overview, Life Cycle of Servlet, Attributes in Servlets, Interaction between Client & Servlet, Servlet demo Application development with Sessions, JSP: JSP & Advantages over servlets, Features, syntax, Life Cycle of JSP, Environmental Setup for JSP, Interaction between client, JSP & server, JSP demo Application Development.

Textbooks:

1. Eric Freeman, Elisabeth Robson, Bert Bates, Kathy Sierra, Head First Design Patterns, O'Reilly Media, Inc., October 2004.
2. Y Daniel Lian, Introduction to Java Programming, Pearson, 10th Edition, 2011.


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3. Siahaan, V., Sianipar, R.H., Step by Step Database Programming, 2019, SPARTA Publishing.
4. Kathy Sierra, Bryan Basham, Bert Bates, Head First Servlets and JSP, O'Reilly Media, Inc., 2nd Edition, 2008.

Reference Books:

1. Gamma, E., Helm, R., Johnson, R., Johnson, R. E., & Vlissides, J. (1995). Design patterns: elements of reusable object-oriented software. Pearson Deutschland GmbH.
2. Kentbeck, (2002). Test-Driven Development – by Example. Pearson publication.
3. Naftalin, Maurice, and Philip Wadler. (2005). Generics and Collections in Java. O'reilly Media Inc.
4. Brian Goetz. (2006). Java Concurrency in Practice. Bible Inc.
5. Tittel, E., Dykes, L. (2011). XML For Dummies. Germany: Wiley.
6. Santosh Kumar K., Kogent Solutions Inc., Santosh Kumar K. And Kogent Solutions Inc. (2008). JDBC, Servlets, And JSP Black Book. Dreamtech Press.


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code: 21CS3043RA
COMPUTING

Course Name: QUANTUM

L-T-P-S: 2-0-2-0
MFC

Credits: 3

Prerequisite:

CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	To introduce basics of quantum computing	PO1, PO2, PSO2	3
CO2	Implementing Quantum computing algorithms	PO2, PO3, PSO1	4
CO3	Applying concepts of Quantum computing using QISKIT	PO1, PO3, PSO2	4
CO4	Analyze and Discuss Quantum Machine learning and deep learning concepts with applications	PO3, PO5, PSO2	4
CO5	Implementing quantum computing algorithms using IBM QISKIT and QSIM	PO2, PO3, PSO1	5

Syllabus:

Overview of classical mechanics, Drawbacks of classical mechanics, Quantum mechanics origin, Building blocks of quantum mechanics, Introduction to quantum computing, Quantum states and qubits, Single qubit gates, Multiple qubits and entanglement, Quantum circuits, Applications. Deutsch Jozsa algorithm, Bernstein Vazirani algorithm, Simons algorithm, Quantum fourier transform, Shors algorithm, Grovers algorithm, Superdense coding. Setting up environment, Python and Jupiter notebooks configuring, Quantum circuits implementation, Quantum measurement, Quantum phase estimation, Scalable shor's algorithm, Grover's algorithm. Unsupervised learning, Pattern recognition and neural networks, Supervised learning, Support vector machines, Regression analysis and boosting, Quantum clustering and classification, Adiabatic quantum computing, Quantum teleportation and game theory, Applications, Quantum Deep learning

Text Books:

1. Quantum Machine learning, Peter Wittek, Elsevier, 2019
2. Quantum computing for everyone, Chris Bernhardt, MIT Press, 2020
3. An Introduction to Quantum Computing, Kaye P, Oxford University Press, 2018
4. Quantum Computation and Quantum Information, Nielsen M.A, Cambridge University Press, 2017
5. Quantum Computer Science, Mermin N.D, Cambridge University Press, 2018

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code: 21CS3120
PROCESSING

Course Name: MULTIMODAL INFORMATION

L-T-P-S: 2-0-2-0
MFC

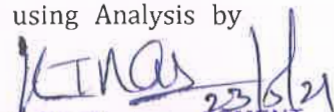
Credits: 3

Prerequisite:

CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	Utilize the various types of signals, systems and their frequency domain transformation.	PO1, PSO1	3
CO2	Apply the design methodology of different filters and their realizations.	PO1, PO3, PSO1	3
CO3	Examine signal processing approaches for extraction of information present in the natural signals.	PO1, PO2, PSO1	4
CO4	Discover machine learning approaches for processing of signals.	PO1, PO3, PSO1	4
CO5	Examine the signal processing approaches related to transformation, filtering, feature extraction, machine learning for signal processing.	PO1, PO2, PO3, PSO1	4

Syllabus:

Signals and Systems: Types of Signals: Analog, deterministic, non-deterministic, random signals, periodic, aperiodic signals, discrete time signals, digital signals. Elementary signals: impulse, unit step, ramp, sinusoidal signal, complex exponential. Systems: impulse response, Convolution, Difference Equations for representation of systems, properties of systems, linearity, superposition principle, shift invariance, causality, stability. Fourier series for periodic signals, Fourier transforms, properties of Fourier Transform, Discrete Time Fourier Transform (DTFT), Discrete Fourier Transforms (DFT), Fast Fourier Transforms (FFT), Phase and group delays, Sampling and Quantization. Transforms and Filter Design: Z-Transforms, Region of convergence (ROC), Properties of Z-Transforms, Causality and stability of filters, Finite Impulse Response (FIR), Infinite Impulse Response (IIR), Pole-Zero representation, Digital filter design: FIR filter design by Fourier Transform, Linear Phase Characteristics, low pass, high pass, band pass and band reject filters, IIR filter design by coefficient calculation, Frequency response of filters, All pass filters, Hilbert Transform, Filter realizations. 1-Dimensional and 2-Dimensional Information Processing: Windowing techniques: Rectangular, Bartlett, Hamming, Hanning, Blackwell, Kaiser. Short time analysis: Short Time Fourier Transform (STFT) of Speech signals, Enhancement (denoising) techniques such as Mean, Median, and Moving average filter for images. Feature extraction techniques: Mel Frequency Cepstral Coefficients (MFCC), Linear Prediction Coefficients (LPC) for speech, Audio Reconstruction using Analysis by Synthesis approach. Wavelet based image decomposition, Image Reconstruction using Analysis by


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Synthesis approach. Machine Learning approaches for building Multimodal Information Processing based Intelligent Systems: Pre-processing, feature extraction and classification using Convolutional Neural Networks (CNN) and Deep Neural Networks (DNN). Data augmentation using Generative Adversarial Networks (GAN), synthesis of signals using Recurrent Neural Network (RNN).

Text Books:

1. Discrete Time Signal Processing, Alan V. Oppenheim and R. W. Schaffer, 2nd, Prentice Hall, MIT Press, 1999
2. Signals and Systems, Simon Haykin and Barry Van Veen, 2nd, Wiley, 2007
3. Digital Signal Processing: Fundamentals and Applications, Li Tan, 1st, Academic Press, 2008
4. Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, 1st, MIT Press, 2021

Reference Books:

1. Digital Signal Processing: Principles, Algorithms, and Applications, J. G. Proakis and M G , Monolakis, 4th, Prentice Hall, 2007
2. Discrete-Time Speech Signal Processing: Principles and Practice, Thomas F. Quatieri, 1st, Pearson Prentice Hall, 2001
3. A Practical Guide to Wavelet Analysis, Christopher Torrence and Gilbert P. Compo, 1st, Bulletin of the American Meteorological Society
4. Digital Image Processing, R. Gonzalez and R. Woods, 4th, Pearson, 2018
5. Digital Signal Processing Using MATLAB, Vinay K. Ingle and John G. Proakis, 3rd, Cengage Learning, 2010
6. Handbook of Image and Video Processing, Alan C Bovik, 1st, Academic Press Series in Communications, Networking, and Multimedia, 2000
7. Generative Deep Learning, David Foster, 1st, O'REILLY, 2019

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Annexure-II

Course Code: 21UC2103

Course Name: ESSENTIAL SKILLS FOR EMPLOYABILITY

L-T-P-S: 0-0-4-0

Credits: 2

Prerequisite: NIL

CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	Developing basic grammar Identify and organize sentence structures based on grammar and apply in writing skills	P05	3
CO2	Develop effective interpersonal skills, cultivate a positive attitude, apply positive self-talk techniques, and use SWOC analysis to enhance employability.	P06	3
CO3	Develop drafting skills through Cloze Test, Passage completion, E-mail writing, Paragraph writing, Essay writing	P05	3
CO4	Develop effective communication skills through JAM and extempore, describing products and processes through JAM and extempore, demonstrating proper email and phone etiquette, and improving listening skills to enhance personal and professional relationships.	P0 5	3

Syllabus:

Grammar:: Tenses, Voice, Reported Speech, Spotting Errors, Sentence Improvement, Sentence Rearrangement, SWOC, Self-awareness, Attitude, Self-Confidence & Positive Self-Talk, Grooming, Intrapersonal skills, and Interpersonal Skills, Writing Skills: Cloze Test, Passage completion, E-mail writing, Paragraph writing, Essay writing, Speaking from the script through JAM & Extempore, Product & Process Description through JAM & Extempore, Transactional Analysis, Persuasion & Negotiation, Etiquettes (E-Mail & Phone), Listening Skills.

Textbooks:

1. Objective English for Competitive Examination Hari Mohan Prasad and Uma Sinha, McGraw Hill 2017
2. English Language Communication Skills, CY. Prabhavati Cenage 2014
3. Bridging the Softskills Gap Bruce Tulgan Jossey-Bass 2015
4. The Soft Skills Book-The Key Difference to Becoming Highly Effective & Valued, Dan White LID Publishing 2121

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KLEF, (Deemed to be University)
Green Fields, VADDESWAREM-522 302.
Guntur District, Andhra Pradesh



Koneru Lakshmaiah Education Foundation

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code: 21MT2103

Course Name: PROBABILITY, STATISTICS & QUEUEING THEORY

L-T-P-S: 2-2-0-0

Credits: 4

Prerequisite: NIL


CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	To understand the importance of probabilistic concepts in a wide spectrum of problems arising in engineering applied science	PO2, PSO1	3
CO2	Identify the relationship between variables using correlation and regression techniques	PO1,PO2,PSO1	4
CO3	Explain the role of Statistical tests of significance in solving real world engineering problems	PO2, PSO1	3
CO4	To formulate Stochastic process in terms of Markov chains and solve problems in queueing systems, and networks	PO2, PSO1	4

Syllabus:

Introduction to Probability: Sample Space and Events, Probabilities Defined on Events, Conditional Probabilities, Independent Events, Bayes Formula, Random Variables, Probability Distribution Function, Cumulative Distribution Function, Discrete Random Variables: Bernoulli, Binomial, and Poisson process. Continuous Random Variables: Uniform, Exponential and Normal Random Variables Expectation of a Random Variable: Discrete and Continuous Case Expectation of Function of a Random Variable: Higher Order Moments, Variance, Standard Deviation Jointly Distributed Random Variables: Joint Distribution Functions, Independent Random Variables. Measures of central tendency: Mean, Median, Mode, Measure of Dispersion: Variance, Standard deviation, coefficient of variation. Correlation and Linear regression. Sample and population, Confidence limits and intervals, Statistical tests of significance: Null and Alternate Hypothesis, t-test, Chi Square Test, ANOVA. Introduction to queues, measures of system performance, characteristics of queueing systems. Stochastic processes overview, discrete-time Markov chains, Continuous-time Markov chain, birth-death processes, Poisson process and exponential distribution, Birth-death queueing systems, Non-birth-death Markovian queueing systems, Queueing networks.

Textbooks:

1. An Introduction to Probability Theory and Its Applications, William Feller, Wiley & Sons 1991
2. Fundamentals of Queueing Theory, 4th Edition, D. Gross, J.F. Shortle, J.M. Thompson, and C.M. Harris, Wiley 2008
3. Probability and Statistics for Engineers and Scientists, Ronald E. Walpole, Sharon L. Myers and Keying Ye, 8th Edition Pearson Hub 2008
4. "Probability and Statistics", Rukmangadachari E. and E. Keshava Reddy, First Edition Pearson Hub 2015
5. Probability & Statistics for engineers, Dr. J. Ravichandran WILEY-INDIA 2010.


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code: 21UC3105

Course Name: PROBLEM SOLVING SKILLS - 1

L-T-P-S: 0-0-2-2

Credits: 1.5

Prerequisite: NIL

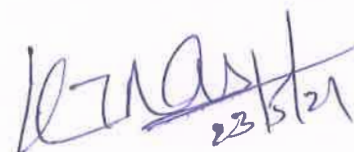
CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	Apply the concepts of Linear Equations, concepts of Ratios, Averages, Partnership, Percentages and Interest to solve the problems related to Ages, Ratio & Proportion, Variation & Partnership, Percentages, Profit, Loss & Discounts, Simple & Compound Interest, Averages & Allegations or Mixtures.	PO1, PO5	3
CO2	Apply the concepts of Co-primes, Divisibility rules, LCM & HCF concepts to solve problems in Numbers, Apply the concepts of Algebra to solve the problems based on Sets, Relations, Functions and Graphs, Surds & Indices, Logarithms, Quadratic Equations, Inequalities & Progressions.	PO1, PO5	3
CO3	Apply Venn diagrams and other applicable diagrams to solve questions in Syllogism, Logical Venn Diagrams, Cubes & Dice. Understand the principles used in forming Number & letter series, Number, letter & word Analogy, Odd man out, Coding & Decoding.	PO1, PO5	3
CO4	Understand the underlying assumptions in the arguments presented in the topics: Statements & conclusions, statements & Arguments (Critical Reasoning), statements & Assumptions, logical connectives, Binary logic.	PO1, PO5	2

Syllabus:

Simple Equations, Problem on Ages, Ratio & Proportion, Variation & Partnership, Percentages, Profit, Loss & Discounts, Simple & Compound Interest, Averages & Allegations or Mixtures. Numbers, Divisibility, Decimal Fractions, LCM & HCF, Simplification, Sequence, Series & Progressions, Linear Algebra, Quadratic Equations & Inequalities, Theory of Equations. Sets, Relations, Functions and Graphs, Surds & Indices, Logarithms, Syllogism, Number & letter series, Number, letter & word Analogy, Odd man out, coding & decoding, Cubes & Dice, Logical Venn Diagrams, Ranking, Logical choice, Analytical reasoning. Statements & conclusions, statements & Arguments (Critical Reasoning), statements & Assumptions, logical connectives, Binary logic, Statement - Courses of Action, Inferred meaning, Logical order.

Textbooks:

1. Quantitative Aptitude, R S Aggarwal, S CHAND
2. A Modern Approach to Verbal Reasoning, R S Aggarwal, S CHAND


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code: 21UC3206

Course Name: PROBLEM SOLVING SKILLS - 2

L-T-P-S: 0-0-2-2

Credits: 1.5

Prerequisite: NIL

CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	Apply the concepts of Unitary method in solving problems in Time & Work, Chain Rule, Pipes & Cisterns. Apply the concept of Average speed and Relative speed to solve the problems related to Time, Speed & Distance, Trains, Boats & Streams, Races & games. Apply the concept of counting principles to solve the problems related to Permutations & Combinations and Probability.	PO1, PO5	3
CO2	Apply the concepts of Perimeter, Area, Surface Area & Volume to solve the problems in 2D & 3D Geometry. Apply the concepts of Trigonometry to solve problems related to Heights & Distances. Apply the concepts of Lines, Angles, Triangles, Quadrilaterals & Polygons to solve the problems related to Geometry, Analyzing the data given in the Table, Bar Graph, Pie Chart and Line Graph to solve the problems in Data Interpretation. Data Sufficiency, Statistics, Crypt arithmetic.	PO1, PO5	3
CO3	Apply the fundamental relationships and principles in solving questions in Blood Relations, Directions, Clocks, Calendars, Alphabet Test, Number, ranking & Time sequence test, Seating Arrangements, Mathematical Operations, Data Sufficiency, Nonverbal - series, analogy, classification.	PO1, PO5	3
CO4	Apply the conditions mentioned in the question statement to solve questions in Input & Output, Assertion and Reason, dot situation, embedded figures, figure matrix, mirror and water images, paper cutting, paper folding pattern completion, rule detection, flowcharts, Puzzles, Sudoku puzzles	PO1, PO5	3

Syllabus:

Time & Work, Chain Rule, Pipes & Cisterns, Time, Speed & Distance, Problems on Trains, Boats & Streams, Races & games, Permutations & Combinations, Combinatorics, Probability. Areas & Perimeters, Mensuration, Trigonometry, Heights & Distances, Geometry, Coordinate Geometry, Data Interpretation, Data Sufficiency, Statistics, Simplification, Crypt arithmetic, Spatial Ability. Blood Relations, Directions, clocks, calendars, Alphabet Test, Number, ranking & Time sequence test, Seating Arrangements, Mathematical Operations, Data Sufficiency, Nonverbal - series, analogy, classification, Team Formations, Rule detection. Input & Output, Assertion and reason, dot situation, embedded figures, figure matrix, mirror and water images, paper cutting, paper folding pattern completion, rule detection, flowcharts, Logical Puzzles, Sudoku, Playing cards puzzles, Attention to details, Grouping of images, Shape construction, Game based puzzles (Gamification).

Textbooks:

1. Quantitative Aptitude, R S Aggarwal, S CHAND
2. A Modern Approach to Verbal Reasoning, R S Aggarwal, S CHAND

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code: 21SC1203

Course Name: COMPUTATIONAL THINKING FOR OBJECT ORIENTED DESIGN (CTOD)

L-T-P-S: 3-0-2-4

Credits: 5

Prerequisite: CTSD

CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	Apply Object oriented paradigm for code reusability.	PSO2,PO3,PO5	3
CO2	Design object-oriented solutions to the real-world problems through SOLID design principles	PSO2,PO3,PO5	3
CO3	Build Abstract Data Types by applying generic classes and java API.	PSO2,PO3,PO5	3
CO4	Demonstrate Exception handling and String manipulation techniques	PO5,PSO2,PO3	3
CO5	Demonstrate Exception handling and String manipulation techniques	PSO1,PO7,PO9,PO10	4

Syllabus:

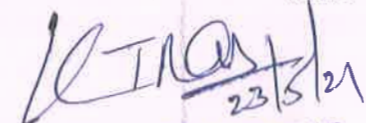
Introduction: Understanding Object oriented programming paradigm vs Structured paradigm. Advantages of Object-Oriented programming and its key features – abstraction, encapsulation, inheritance & polymorphism. Java program hierarchy and compilation process. Building static methods. Primitive Data Types and Arrays as a reference data type. Access specifiers for methods. Logic building using control statements and iterative statements. Wrapper classes and implicit casting. Command Line Arguments. Classes and Objects: object, class vs object and object instantiation. Abstraction and encapsulation using accessors and mutators. Constructors – default, user-defined and parametrized. Introduction to Java API, Scanner class, console-based IO. Constructor chaining, this keyword, array of objects, aggregation vs composition, Array List, SOLID design principles. Inheritance, method overriding, dynamic polymorphism, dynamic method dispatch, Singleton classes. Inner classes. Abstraction & Applications: Abstract classes, abstract methods, final keyword for methods and classes, template pattern, Introduction to interfaces, Interfaces vs implementation, Factory classes, factory method pattern, Generic classes, application of interfaces to build abstract data structures, Java API for Vector and LinkedList, comparable, comparator and cloneable, iterator interfaces. Anonymous classes, Decorator pattern. Event driven programming with event listeners. Exception handling & File IO: Introduction to exceptions & errors, Java API for exceptions, try, catch, finally, throw and throws keywords, try with resources, user defined exceptions. File IO, byte streams, character streams, wrapper classes for Object IO using serializable. String based algorithms using String Buffer and String Builder, String constant pool, regex, garbage collection.

Textbooks:

1. Introduction to Java Programming, Comprehensive Version, 10th Edition by Y. Daniel Liang.
2. Herbert Schildt, "The Complete Reference Java", 7th edition TMH.
3. Timothy A. Budd, "An Introduction to Object-Oriented Programming", 3/e, Pearson, 2008.

Reference Books:

1. Deitel&Deitel, "Java – How to program", 6th edition, PHI, 2007.
2. Cay.S.Horstmann and Gary Cornell "Core Java 2, Vol 1, Fundamentals", Seventh Edition, Pearson Education.


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code: 21CS2116

Course Name: ADVANCED OBJECT ORIENTED PROGRAMMING

L-T-P-S: 2-0-2-4

Credits: 4

Prerequisite: CTOD

CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	Apply Design Patterns with Clean coding Techniques	PO1	3
CO2	Analyze the Collections & Generics over Object-oriented Programming.	PO2, PO5	4
CO3	Apply the various Concurrent Programming methodologies in Object-oriented Programming	PO2, PO5	4
CO4	Develop the applications using JDBC, Servlets, JSP.	PO2, PO5	4
CO5	Analyze the various design techniques to solve any real-world problems	PO2, PO5	4

Syllabus:

Design Patterns: Introduction to design patterns, Structural, Creational & Behavioural patterns. Decorator, Bridge, adapter and facade patterns, Singleton, factory method, abstract factory patterns, observer, command, state, iterator, chain of responsibility patterns, dependency injection. Clean Coding Techniques: Introduction to code smells - bloaters, Object-oriented abusers, change preventers, dispensable and couplers. Refactoring techniques to remove the code smells. Generics & Collections Framework: Introduction to generics, usage of generics with interfaces, building stacks, queues, and Priority Queues, applying the comparator, comparable, cloneable & iterator interfaces, Introduction to Sets and Maps and their Java API. Building BST, AVL trees and graphs-based algorithms. Graph visualization. Multi-threading & Parallel programming: Introduction to Multithreading and Parallel Programming, Thread Concepts & its States, Creating Tasks & Threads, Thread Classes, Thread Pools, Thread Synchronization & Locks, Cooperation among Threads, Case Study: Producer/Consumer, Blocking Queues, Semaphores, Deadlock Avoidance. JDBC: API, Components, Architecture (2 Tier & 3 Tier), Drivers & Its Types, Packages for JDBC Connection, Steps to connect to Databases (PostgreSQL). Servlets: Overview, Life Cycle of Servlet, Attributes in Servlets, Interaction between Client & Servlet, Servlet demo Application development with Sessions, JSP: JSP & Advantages over servlets, Features, syntax, Life Cycle of JSP, Environmental Setup for JSP, Interaction between client, JSP & server, JSP demo Application Development.

Textbooks:

1. Eric Freeman, Elisabeth Robson, Bert Bates, Kathy Sierra, Head First Design Patterns, O'Reilly Media, Inc., October 2004.
2. Y Daniel Lian, Introduction to Java Programming, Pearson, 10th Edition, 2011.
3. Siahaan, V., Sianipar, R.H., Step by Step Database Programming, 2019, SPARTA Publishing.
4. Kathy Sierra, Bryan Basham, Bert Bates, Head First Servlets and JSP, O'Reilly Media, Inc., 2nd Edition, 2008.

Reference Books:

1. Gamma, E., Helm, R., Johnson, R., Johnson, R. E., & Vlissides, J. (1995). Design patterns: elements of reusable object-oriented software. Pearson Deutschland GmbH.
2. Kentbeck, (2002). Test-Driven Development – by Example. Pearson publication.
3. Naftalin, Maurice, and Philip Wadler. (2005). Generics and Collections in Java. O'reilly Media Inc.
4. Brian Goetz. (2006). Java Concurrency in Practice. Bible Inc.
5. Tittel, E., Dykes, L. (2011). XML For Dummies. Germany: Wiley.
6. Santosh Kumar K., Kogent Solutions Inc., Santosh Kumar K. And Kogent Solutions Inc. (2008). JDBC, Servlets, And JSP Black Book. Dreamtech Press.


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code: 21CS3120

Course Name: MULTIMODEL INFORMATION PROCESSING

L-T-P-S: 2-0-2-0

Credits: 3

Prerequisite: MFC

CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	Utilize the various types of signals, systems and their frequency domain transformation.	PO1, PSO1	3
CO2	Apply the design methodology of different filters and their realizations.	PO1, PO3, PSO1	3
CO3	Examine signal processing approaches for extraction of information present in the natural signals.	PO1, PO2, PSO1	4
CO4	Discover machine learning approaches for processing of signals.	PO1, PO3, PSO1	4
CO5	Examine the signal processing approaches related to transformation, filtering, feature extraction, machine learning for signal processing.	PO1, PO2, PO3, PSO1	4

Syllabus:

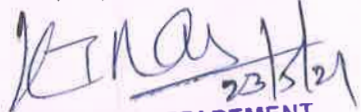
Signals and Systems: Types of Signals: Analog, deterministic, non-deterministic, random signals, periodic, aperiodic signals, discrete time signals, digital signals. Elementary signals: impulse, unit step, ramp, sinusoidal signal, complex exponential. Systems: impulse response, Convolution, Difference Equations for representation of systems, properties of systems, linearity, superposition principle, shift invariance, causality, stability. Fourier series for periodic signals, Fourier transforms, properties of Fourier Transform, Discrete Time Fourier Transform (DTFT), Discrete Fourier Transforms (DFT), Fast Fourier Transforms (FFT), Phase and group delays, Sampling and Quantization. Transforms and Filter Design: Z-Transforms, Region of convergence (ROC), Properties of Z-Transforms, Causality and stability of filters, Finite Impulse Response (FIR), Infinite Impulse Response (IIR), Pole-Zero representation, Digital filter design: FIR filter design by Fourier Transform, Linear Phase Characteristics, low pass, high pass, band pass and band reject filters, IIR filter design by coefficient calculation, Frequency response of filters, All pass filters, Hilbert Transform, Filter realizations. 1-Dimensional and 2-Dimensional Information Processing: Windowing techniques: Rectangular, Bartlett, Hamming, Hanning, Blackwell, Kaiser. Short time analysis: Short Time Fourier Transform (STFT) of Speech signals, Enhancement (denoising) techniques such as Mean, Median, and Moving average filter for images. Feature extraction techniques: Mel Frequency Cepstral Coefficients (MFCC), Linear Prediction Coefficients (LPC) for speech, Audio Reconstruction using Analysis by Synthesis approach. Wavelet based image decomposition, Image Reconstruction using Analysis by Synthesis approach. Machine Learning approaches for building Multimodal Information Processing based Intelligent Systems: Pre-processing, feature extraction and classification using Convolutional Neural Networks (CNN) and Deep Neural Networks (DNN). Data augmentation using Generative Adversarial Networks (GAN), synthesis of signals using Recurrent Neural Network (RNN).

Text Books:

1. Discrete Time Signal Processing, Alan V. Oppenheim and R. W. Schaffer, 2nd, Prentice Hall, MIT Press, 1999
2. Signals and Systems, Simon Haykin and Barry Van Veen, 2nd, Wiley, 2007
3. Digital Signal Processing: Fundamentals and Applications, LiTan, 1st, Academic Press, 2008
4. Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, 1st, MIT Press, 2021

Reference Books:

1. Digital Signal Processing: Principles, Algorithms, and Applications, J. G. Proakis and M G, Monolakis, 4th, Prentice Hall, 2007
2. Discrete-Time Speech Signal Processing: Principles and Practice, Thomas F. Quatieri, 1st, Pearson Prentice Hall, 2001


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3. A Practical Guide to Wavelet Analysis, Christopher Torrence and Gilbert P. Compo, 1st, Bulletin of the American Meteorological Society
4. Digital Image Processing, R. Gonzalez and R. Woods, 4th, Pearson, 2018
5. Digital Signal Processing Using MATLAB, Vinay K. Ingle and John G. Proakis, 3rd, Cengage Learning, 2010
6. Handbook of Image and Video Processing, Alan C Bovik, 1st, Academic Press Series in Communications, Networking, and Multimedia, 2000
7. Generative Deep Learning, David Foster, 1st, O'REILLY, 2019

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code: 21CS3043RA

Course Name: QUANTUM COMPUTING

L-T-P-S: 2-0-2-0

Credits: 3

Prerequisite: MFC

CO#	Course Outcome (CO)	PO / PSO	BTL
CO1	To introduce basics of quantum computing	PO1, PO2, PSO2	3
CO2	Implementing Quantum computing algorithms	PO2, PO3, PSO1	4
CO3	Applying concepts of Quantum computing using QISKIT	PO1, PO3, PSO2	4
CO4	Analyze and Discuss Quantum Machine learning and deep learning concepts with applications	PO3, PO5, PSO2	4
CO5	Implementing quantum computing algorithms using IBM QISKIT and QSIM	PO2, PO3, PSO1	5

Syllabus:

Overview of classical mechanics, Drawbacks of classical mechanics, Quantum mechanics origin, Building blocks of quantum mechanics, Introduction to quantum computing, Quantum states and qubits, Single qubit gates, Multiple qubits and entanglement, Quantum circuits, Applications. Deutsch Jozsa algorithm, Bernstein Vazirani algorithm, Simons algorithm, Quantum fourier transform, Shors algorithm, Grovers algorithm, Superdense coding. Setting up environment, Python and Jupiter notebooks configuring, Quantum circuits implementation, Quantum measurement, Quantum phase estimation, Scalable shor's algorithm, Grover's algorithm. Unsupervised learning, Pattern recognition and neural networks, Supervised learning, Support vector machines, Regression analysis and boosting, Quantum clustering and classification, Adiabatic quantum computing, Quantum teleportation and game theory, Applications, Quantum Deep learning

Text Books:

1. Quantum Machine learning, Peter Wittek, Elsevier, 2019
2. Quantum computing for everyone, Chris Bernhardt, MIT Press, 2020
3. An Introduction to Quantum Computing, Kaye P, Oxford University Press, 2018
4. Quantum Computation and Quantum Information, Nielsen M.A, Cambridge University Press, 2017
5. Quantum Computer Science, Mermin N.D, Cambridge University Press, 2018

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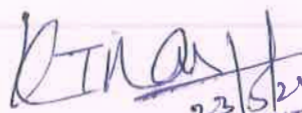
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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Annexure-III

B.Tech - Computer Science and Engineering 2021-22 Syllabus Revision

Course Code	Course Category	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed/ Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
21UC1203	BS	DESIGN THINKING & INNOVATION	Overview of Design Thinking: Define Design Thinking, Differentiate Design Thinking from Design, Get an Overview of the Design Thinking Process, Empathize and Understand: Explain how empathy influences the outcomes of Design Thinking, List Different Empathy Research Techniques, Define the Guidelines for an Empathetic Research, Defining Needs: Explain how PoV can be used in defining the design problem, Use a structured approach to arrive at a PoV, Ideation for Solutions: List the best practices for conducting a successful ideating session, Describe	Design thinking an overview, Design Thinking for Contextualized Problem-Solving: Problem Selection/Definition Need for Cultural Relevance (Time, Space, and Environment). Empathy: definition, Empathic research: framing interview questions, focus groups, procedure to conduct skilled interviews, Insights from Empathetic research, Define: Developing user personas, nuggets from insights, laying customer journey maps, POV statements and POV questions to define user needs. Ideate: Techniques to generate, shortlist and evaluate Ideas: Rapid	Complete Syllabus Modified Two courses: DESIGN THINKING & INNOVATION -1 and DESIGN THINKING & INNOVATION -2 combined into single course (Design Thinking)	All COs	To develop and launch new products and services that meet the needs of users and customers	50%


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code	Course Category	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed/ Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
			the techniques for evaluating and prioritizing ideas, Prototyping: Define prototyping, Explain how prototyping aids in communicating ideas effectively, List various tools for prototyping, Testing the Solution: Define the steps of a successful testing approach, Demonstrate the process of gathering and responding to user feedback. Design Thinking for Contextualized Problem-Solving, Empathetic Research, Analysis of Research, Defining Needs, Brainstorming and Evaluation, Prototyping and Testing, From Testing to Launch, Entrepreneurial Innovation	Estimation form and Solution concept form. Prototyping and Testing: Products vs. Services, Rough Prototypes, Testing Techniques, User Experience High-Fidelity Prototypes Entrepreneurial Innovation: Innovation Management, Business Model Basics, Financial Estimation, Pitch Decks, IPR Considerations.				
21CS2204	BS	Mathematical Programming	Linear Programming- Formulation of linear programming problem, Graphical method, Simplex algorithm, Duality theorem.	Formulation of LP Problem (LPP), Graphical method, Simplex method, Transportation problem, Duality concept in LPP.	Complete Syllabus Modified Two courses Mathematical Programming -1 and	All COs	To solve a variety of problems, including LPP problems,	50%

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Course Code	Course Category	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed/ Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
			Farka's Lemma. Network models, Transportation problem. Integer Programming- Branch & bound algorithms, valid inequalities & cuts, Karmarkar's Algorithms. Fractional Programming- Concave fractional programs, Transformation to a concave program. Combinatorial Optimization- Approximation Algorithms, Sub-modular functions, Matroids, multi-linear extensions, Continuous approximation algorithms, convex and conclave closures, Rounding techniques. Applications of linear programming in Machine Learning, Constraint programming- Penalty function approach, Barrier function approach. Robust programming- Robust stability of Linear Systems, Robust Linear	Feasibility of solution using Farka's Lemma, Ellipsoid method, Karmarkar's Algorithm, Integer Programming, Branch & bound algorithms, valid inequalities & cuts. Fractional Programming, Combinatorial Optimization: Approximation Algorithms, Submodular functions, Matroids, Continuous approximation algorithms. Dynamic programming: Knapsack problem, Travelling salesman problem Quadratic programs – Constrained quadratic programming problems, Beale's method, Wolfe method, Karush-Kuhn Tucker (KKT) Conditions. Geometric Programming: Problems with one-degree of difficulty with positive coefficients, Geometric programming with constraints, Problems with	Mathematical Programming -2 combined into single course (Mathematical Programming) into single course Mathematical Programming		nonlinear programming problems, and quadratic programming problems.	

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Course Code	Course Category	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed/ Replaced	Change In CO	Justification for the Modification	*Overall Revision Percentage
			Programming, Robust LP with poly topic & ellipsoidal uncertainty Conic programming: Linear Programming (LP), Second-Order Cone Programming (SOCP), Semidefinite Programming (SDP), linear matrix inequalities, conic duality, conic duality theorem, Wolfe's, Beale and Pivot Complementary Algorithm, Operator splitting and homogenous self-dual embedding, Case-Study (Example problems in statistics, signal and image processing, control theory). Geometric Programming: Problems with one-degree of difficulty with positive coefficients, Geometric programming with constraints, Problems with positive and negative coefficients, Case study. Quadratic programs - Constrained quadratic	positive and negative coefficients. Heuristic and Meta heuristics, Single solution vs. population-based, Parallel meta heuristics, Evolutionary algorithms, Nature-inspired metaheuristics, Genetic Algorithm, Ant-colony optimization, Particle swarm optimization, Simulated annealing.				

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Course Code	Course Category	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed/ Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
			programming problems, Wolfe method, Application of quadratic programs in some domains like portfolio optimization and Support Vector Machine, Separable Programming, Stochastic Programming with Optimization: Introduction to stochastic programming, Modeling issues in presence of uncertainty, Examples of stochastic optimization models, Monte Carlo Sampling, Sample Average Approximation (SAA) methods, Asymptotic of the SAA optimal value, Multistage portfolio optimization. Infinite-dimensional optimization: Catenoid identification methods, Heuristic and Meta heuristics, Single solution vs. population-based, Parallel meta heuristics Nature-inspired metaheuristics, Ant-colony optimization,					

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Course Code	Course Category	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed/ Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
			Particle swarm optimization, Simulated annealing, Evolutionary algorithms, Workforce modeling, Hybridization and memetic algorithms.					
21TS2202 RA	SDC	Technical Skilling - 2 (MERN STACK WEB DEVELOPMENT)	MEA(R)N Stack Web Development: Fundamentals of Web Apps, Single Page App, Full Stack Web Development, Introduction to React, JavaScript, Component State, Event Handlers, Debugging React Apps, Rendering a collection module, Forms. Node.js & Express, REST, HTTP request types, Middleware, Deploying App, Mongo DB, Validation & ES Lint. Testing Express servers, user administration.	Fundamentals of Web Applications: Overview of HTML, CSS Single Page Application (SPA), JavaScript, and ES6. Full-Stack Web Development. Introduction to React JS: class, functions, arrays, DOM methods, Components, and Multiple components JSX, Passing data to components-props. Destructuring, Page re-rendering, Stateful component, Event handling Event handler as a function, passing state to child components, Refactoring the	Added: Class, functions, arrays, DOM methods, Components, and Multiple components JSX, Passing data to components-props. Destructuring, Page re-rendering, Stateful component, Event handling Event handler as a function, passing state to child components, Refactoring the components, Rendering Collections, Key-	All COs	1. Learning React JS, MongoDB, and CRUD operations will give the skills to build modern, scalable, and user-friendly web applications.	60%

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Course Code	Course Category	Course Name	Exl sting Syllabus	New Syllabus	Topics Added/Removed/ Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
			Testing React apps, State management with Redux, React router, Custom hooks, Styling app with CSS and Webpack, GraphQL. Advanced Java: Modularisation, Array based logic building, Console based iterative applications, Object oriented concepts, Constructor chaining, Data hiding, String manipulation algorithms, Inheritance, Class abstraction, Dynamic method dispatch, Singleton class – lazy and early instantiation, Factory method pattern, Abstract factory pattern, Aggregator classes and Dependency injection, Inversion of control. Interfaces, Comparable,	components, Rendering Collections, Key-attribute, Map Controlled component Filtering Displayed Elements npm Axios and promises, Form handling, Effect-hooks, Material UI Components: Inputs, Feedback, Data Display, Surface, Navigation, Layout, Utils, MUI X. Working with Server using Node JS and Express: Simple Web server, About Node JS, modules, routes, Streaming, Files, Express, Web and express, nodemon, REST, Fetching and deleting resources, Postman, receiving data, HTTP Request types, same origin policy, and CORS, authentication and authorization, Token	attribute, Map Controlled component Filtering Displayed Elements npm Axios and promises, Form handling, Effect-hooks, Material UI Components: Inputs, Feedback, Data Display, Surface, Navigation, Layout, Utils, MUI X. Storing in MongoDB: MongoDB, Schema, CRUD operations on objects from the database, other data operations, Backend connectivity with database, Database configuration into its own module, using database in route handlers, verifying frontend and backend			


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Course Code	Course Category	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed/ Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
			Comparator, Cloneable interfaces, Generic classes, Building abstract data structures – stack, queue, linked list and BST, Collections framework - TreeSet, Hash Set, Tree Map, Hash Map and other collections. Design patterns - decorator, adapter, strategy and observer patterns, chain of responsibility, command pattern and iterator pattern, Null Object pattern and template methods. Test driven development, XUnit framework, JUnit, Assertions, Clean coding techniques to handle bloaters, Object-oriented abusers, Couplers and dispensables. SOLID Design principles with	based authentication. Storing in MongoDB: MongoDB, Schema, CRUD operations on objects from the database, other data operations, Backend connectivity with database, Database configuration into its own module, using database in route handlers, verifying frontend and backend integration, Rendering MaterialUI using RESTful API, Error handling, error handling into middleware, GraphQL, Apollo Server, Apollo Studio Explorer, Parameters resolver, Mutations, other queries, React and GraphQL, Apollo Client, Named Queries and Variables, Cache, Mutations, MongoDB and Apollo,	integration, Rendering MaterialUI using RESTful API, Error handling, error handling into middleware, GraphQL, Apollo Server, Apollo Studio Explorer, Parameters resolver, Mutations, other queries, React and GraphQL, Apollo Client, Named Queries and Variables, Cache, Mutations, MongoDB and Apollo, Validation, Subscriptions Server and Client, REDUX: Flux-architecture and Redux, communicating with a server in a redux application,			

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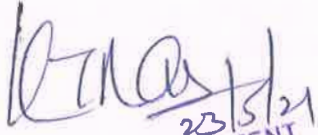
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Course Code	Course Category	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed/ Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
			emphasis on loose coupling and strong Cohesion. Java Database Connectivity, establishing connection to the MySQL database, Handling DML, DDL and DCL SQL statements using JDBC.	Validation, Subscriptions Server and Client, REDUX: Flux-architecture and Redux, communicating with a server in a redux application, Asynchronous actions, and redux-thunk, connect function in Redux, Redux, the component state.	Asynchronous actions, and redux-thunk, connect function in Redux, Redux, the component state.			


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Annexure-IV

M.Tech - Computer Science and Engineering 2021-22 Syllabus Revision

Course Code	Course Name	Course Category	Existing Syllabus	New Syllabus	Topics Added / Removed/Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
21CS51A3	Data Warehousing & Mining	PE	Introduction To Datamining Concepts; Linear Methods For Regression; Classification Methods: K-Nearest Neighbour Classifiers, Decision Tree, Logistic Regression, Naive Bayes, Gaussian Discriminant Analysis; Regularized Cost Function; Model Evaluation & Selection; Unsupervised Learning: Association Rules; Apriori Algorithm, Fp Tree, Cluster Analysis, Self Organizing Maps, Google Page Ranking; Dimensionality Reduction Methods: Supervised Feature Selection, Pca; Ensemble Learning: Bagging, Boosting, Adaboost; Outlier Mining ; Imbalance Problem; Multi Class Classification; Introduction To Semi	Introduction to Data Warehouse and mining, Data Discretization and Concept hierarchy generation, Overview of ETL and OLAP OLTP integration – comparison of OLAP with OLTP systems, ROLAP, MOLAP and DOLAP, Data Cube Computation methods, Advanced SQL support for OLAP, multi-dimensional modelling, Attribute-oriented Induction, Data Warehouse architecture and implementation - Parallel execution, Materialized views. KDD, Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Pre processing- Data Cleaning methods, Descriptive Data	All COs Replaced	CO1, CO2, CO3, CO4	1. OLAP, OLTP, data summarization, and data reduction can help to make better decisions by providing with the information to understand data and identify trends and patterns.	80%


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Course Code	Course Name	Course Category	Existing Syllabus	New Syllabus	Topics Added / Removed/Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
			Supervised Learning, Transfer Learning, Active Learning, Data Warehousing.	Summarization, Data Reduction, Corelation, Regression Analysis. Data Mining Techniques: Classification by decision tree induction, Bayesian Classification, Classification Back-propagation, Basic concepts of Association Rule Mining, Frequent Item set mining, Mining various kinds of association rules, Rule-based Classification, Associative Classification, SVM, Performance Analysis. Supervised and Unsupervised learning, Clustering methods, Partitioning-Based Clustering Methods: Hierarchical Clustering Methods; Density Based and Grid-Based Clustering Method				


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Course Code	Course Name	Course Category	Existing Syllabus	New Syllabus	Topics Added / Removed/Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
21CS51B2	Principles of Programming Languages	PE	Preliminary Concepts: Reasons for Studying Concepts of Programming Languages, Programming Domains, Language Evaluation Criteria, Influences on Language Design, Language Categories, Language Design Trade-Offs, Implementation Methods, Programming Environments - Syntax and Semantics: General Problem of Describing Syntax and Semantics, Formal Methods of Describing Syntax, Attribute Grammars, Describing the Meanings of Programs - Names, Bindings, and Scopes: Introduction, Names, Variables, Concept of Binding, Scope, Scope and Lifetime, Referencing Environments, Named Constants - Data Types: Introduction, Primitive Data Types, Character String Types, User Defined Ordinal	Preliminary Concepts: Reasons for Studying Concepts of Programming Languages, Programming Domains, Language Evaluation Criteria, Influences on Language Design, Language Categories, Language Design Trade-Offs, Implementation Methods, Programming Environments - Syntax and Semantics: General Problem of Describing Syntax and Semantics, Formal Methods of Describing Syntax, Attribute Grammars, Describing the Meanings of Programs - Names, Bindings, and Scopes: Introduction, Names, Variables, Concept of Binding, Scope, Scope and Lifetime, Referencing Environments, Named Constants - Data Types: Introduction, Primitive Data Types, Character String Types, User Defined Ordinal	Added: CO4: Scripting Language: Pragmatics, Key Concepts, Case Study: Python - Values and Types, Variables, Storage and Control, Bindings and Scope, Procedural Abstraction, Data Abstraction, Separate Compilation, Module Library.	CO4	1. Able to develop more robust and maintainable programs	10%

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			Types, Array, Associative Arrays, Record, Union, Tuple Types, List Types, Pointer and Reference Types, Type Checking, Strong Typing, Type Equivalence - Expressions and Statements: Arithmetic Expressions, Overloaded Operators, Type Conversions, Relational and Boolean Expressions, Short Circuit Evaluation, Assignment Statements, Mixed-Mode Assignment - Control Structures: Introduction, Selection Statements, Iterative Statements, Unconditional Branching, Guarded Commands - Subprograms and Blocks: Fundamentals of Sub-Programs, Design Issues for Subprograms, Local Referencing Environments, Parameter Passing Methods, Parameters that Are Subprograms, Calling Subprograms	Types, Array, Associative Arrays, Record, Union, Tuple Types, List Types, Pointer and Reference Types, Type Checking, Strong Typing, Type Equivalence - Expressions and Statements: Arithmetic Expressions, Overloaded Operators, Type Conversions, Relational and Boolean Expressions, Short Circuit Evaluation, Assignment Statements, Mixed-Mode Assignment - Control Structures: Introduction, Selection Statements, Iterative Statements, Unconditional Branching, Guarded Commands - Subprograms and Blocks: Fundamentals of Sub-Programs, Design Issues for Subprograms, Local Referencing Environments, Parameter Passing Methods, Parameters that Are Subprograms, Calling Subprograms				

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Course Code	Course Name	Course Category	Existing Syllabus	New Syllabus	Topics Added / Removed/Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
			Indirectly, Overloaded Subprograms, Generic Subprograms, Design Issues for Functions, User Defined Overloaded Operators, Closures, Co-routines - Implementing Subprograms: General Semantics of Calls and Returns, Implementing Simple Subprograms, Implementing Subprograms with Stack-Dynamic Local Variables, Nested Subprograms, Blocks, Implementing Dynamic Scoping - Abstract Data Types: The Concept of Abstraction, Introductions to Data Abstraction, Design Issues, Language Examples, Parameterized ADT, Encapsulation Constructs, Naming Encapsulations - Concurrency: Introduction, Introduction to Subprogram Level Concurrency, Semaphores, Monitors, Message Passing, Java	Indirectly, Overloaded Subprograms, Generic Subprograms, Design Issues for Functions, User Defined Overloaded Operators, Closures, Co-routines - Implementing Subprograms: General Semantics of Calls and Returns, Implementing Simple Subprograms, Implementing Subprograms with Stack-Dynamic Local Variables, Nested Subprograms, Blocks, Implementing Dynamic Scoping - Abstract Data Types: The Concept of Abstraction, Introductions to Data Abstraction, Design Issues, Language Examples, Parameterized ADT, Encapsulation Constructs, Naming Encapsulations - Concurrency: Introduction, Introduction to Subprogram Level Concurrency, Semaphores, Monitors, Message Passing, Java				

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			Threads, Concurrency in Function Languages, Statement Level Concurrency. Exception Handling and Event Handling: Introduction, Exception Handling in Ada, C++, Java, Introduction to Event Handling, Event Handling with Java and C# - Functional Programming Languages: Introduction, Mathematical Functions, Fundamentals of Functional Programming Language, LISP, Support for Functional Programming in Primarily Imperative Languages, Comparison of Functional and Imperative Languages - Logic Programming Language: Introduction, an Overview of Logic Programming, Basic Elements of Prolog, Applications of Logic Programming.	Threads, Concurrency in Function Languages, Statement Level Concurrency. Exception Handling and Event Handling: Introduction, Exception Handling in Ada, C++, Java, Introduction to Event Handling, Event Handling with Java and C# - Functional Programming Languages: Introduction, Mathematical Functions, Fundamentals of Functional Programming Language, LISP, Support for Functional Programming in Primarily Imperative Languages, Comparison of Functional and Imperative Languages - Logic Programming Language: Introduction, an Overview of Logic Programming, Basic Elements of Prolog, Applications of Logic Programming - Scripting Language: Pragmatics, Key Concepts, Case Study: Python				


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code	Course Name	Course Category	Existing Syllabus	New Syllabus	Topics Added / Removed/Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
				- Values and Types, Variables, Storage and Control, Bindings and Scope, Procedural Abstraction, Data Abstraction, Separate Compilation, Module Library.				
21CS51B3	Compiler Design	PE	INTRODUCTION TO COMPILERS: Definition of compiler, interpreter and its differences, the phases of a compiler, role of lexical analyzer, regular expressions, finite automata, from regular expressions to finite automata, pass and phases of translation, bootstrapping, LEX-lexical analyzer generator. PARSING: Parsing, role of parser, context free grammar, derivations, parse trees, ambiguity, elimination of left recursion, left factoring, eliminating ambiguity from dangling-else grammar, classes of parsing, top down parsing - backtracking, recursive descent parsing, predictive	INTRODUCTION TO COMPILERS: Definition of compiler, interpreter and its differences, the phases of a compiler, role of lexical analyzer, regular expressions, finite automata, from regular expressions to finite automata, pass and phases of translation, bootstrapping, LEX-lexical analyzer generator. PARSING: Parsing, role of parser, context free grammar, derivations, parse trees, ambiguity, elimination of left recursion, left factoring, eliminating ambiguity from dangling-else grammar, classes of parsing, top down parsing - backtracking, recursive descent parsing, predictive	Added: CO4: CODE GENERATION: Machine dependent code generation, object code forms, the target machine, a simple code generator, register allocation and assignment, peephole optimization.	CO4	1. Learning about machine dependent code generation and object code forms can also help to write low-level code, such as device drivers and firmware.	8%

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code	Course Name	Course Category	Existing Syllabus	New Syllabus	Topics Added / Removed/Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
			<p>parsers, LL (1) grammars. BOTTOM UP PARSING: Definition of bottom up parsing, handles, handle pruning, stack implementation of shift-reduce parsing, conflicts during shift-reduce parsing, LR grammars, LR parsers-simple LR, canonical LR(CLR) and Look Ahead LR (LALR) parsers. SYNTAX DIRECTED TRANSLATION: Syntax directed definition, construction of syntax trees, Sattributed and L-attributed definitions, translation schemes, emitting a translation. INTERMEDIATE CODE GENERATION: intermediate forms of source programs- abstract syntax tree, polish notation and three address code, types of three address statements and its implementation, syntax directed translation into three-address code, translation of simple</p>	<p>parsers, LL (1) grammars. BOTTOM UP PARSING: Definition of bottom up parsing, handles, handle pruning, stack implementation of shift-reduce parsing, conflicts during shift-reduce parsing, LR grammars, LR parsers-simple LR, canonical LR(CLR) and Look Ahead LR (LALR) parsers. SYNTAX DIRECTED TRANSLATION: Syntax directed definition, construction of syntax trees, Sattributed and L-attributed definitions, translation schemes, emitting a translation. INTERMEDIATE CODE GENERATION: intermediate forms of source programs- abstract syntax tree, polish notation and three address code, types of three address statements and its implementation, syntax directed translation into three-address code, translation of simple</p>				


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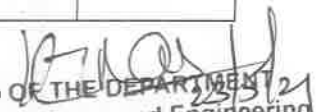
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Course Code	Course Name	Course Category	Existing Syllabus	New Syllabus	Topics Added / Removed/Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
			statements, Boolean expressions and flow-of-control statements. CODE OPTIMIZATION: Organization of code optimizer, basic blocks and flow graphs, optimization of basic blocks, the principal sources of optimization, the directed acyclic graph (DAG) representation of basic block, global data flow analysis.	statements, Boolean expressions and flow-of-control statements. CODE OPTIMIZATION: Organization of code optimizer, basic blocks and flow graphs, optimization of basic blocks, the principal sources of optimization, the directed acyclic graph (DAG) representation of basic block, global data flow analysis. CODE GENERATION: Machine dependent code generation, object code forms, the target machine, a simple code generator, register allocation and assignment, peephole optimization.				
21CS52C1	Cryptography & Network Security	PE	Computer Networks and the Internet , Application Layer, Transport Layer, The Network Layer. The LinkLayer: Links, Access Networks, and LANs, 122 Congestion Control and Resource Allocation. Introduction to Network	Computer Networks and the Internet , Application Layer, Transport Layer, The Network Layer. The LinkLayer: Links, Access Networks, and LANs, 122 Congestion Control and Resource Allocation. Introduction to Network	Added: CO3: E-Mail Security: PGP, SMIME, Intruders	CO3	1. Learning Email security is important to protect sensitive information from unauthorized access.	5%


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Course Code	Course Name	Course Category	Existing Syllabus	New Syllabus	Topics Added / Removed/Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
			Security: Attacks, services, Security. A model of Inter network Security, Principles of Symmetric and public key cryptography, Steganography, One time PADS., Intrusion Prevention and Detection: Introduction, Prevention versus Detection, Types of Intrusion Detection systems, DoS Attack Prevention/Detection, Malware Defense.	Security: Attacks, services, Security. A model of Inter network Security, Principles of Symmetric and public key cryptography, Steganography, One time PADS., E-Mail Security: PGP, SMIME, Intruders, Intrusion Prevention and Detection: Introduction, Prevention versus Detection, Types of Intrusion Detection systems, DoS Attack Prevention/Detection, Malware Defense.				
21CS52C5	CONTINUOUS DELIVERY & DEVOPS		Introduction to DevOps: Introduction to DevOps, Overview of DevOps, Relationship Between Agile and DevOps, Principles of DevOps, DevOps Tools, Best Practices for DevOps. Version Control Systems: Role of Version Control System in DevOps Environment, GitHub, Deploy the files to Bitbucket via Git. Need of Cloud in DevOps: Popular Cloud	Introduction to DevOps: Introduction to DevOps, Overview of DevOps, Relationship Between Agile and DevOps, Principles of DevOps, DevOps Tools, Best Practices for DevOps. Version Control Systems: Role of Version Control System in DevOps Environment, GitHub, Deploy the files to Bitbucket via Git. Need of Cloud in DevOps: Popular Cloud	Added: CO4: Role of Infrastructure as Code in DevOps Environment, Puppet. Continuous Monitoring: Role of Monitoring Systems, Types of Monitoring, Popular Monitoring Tools: Nagios. Orchestrating application deployment.	CO4	1. DevOps environments help to automate and manage the infrastructure and application development and deployment process.	12%

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Course Code	Course Name	Course Category	Existing Syllabus	New Syllabus	Topics Added / Removed/Replaced	Change in CO	Justification for the Modification	*Overall Revision Percentage
			Providers, CI/CD in AWS, CI/CD Services in AWS. Continuous Integration and Continuous Deployment: Continuous Integration and Continuous Deployment using Jenkins, Continuous Integration with Jenkins, Git, and AWS, Build Applications using Pipeline on AWS platform. Software and Automation Testing Frameworks: Popular Testing Tools, Test Driven Development Cycle, Behavior driven development is an extension of test driven development, Automated Testing using Cucumber. Docker as Containerization: Virtualization, Docker on Windows Desktop, Creating an Account in Docker Hub, MySQL in Docker. Kubernetes: Components, Kubernetes Architecture, Minikube, Pod Configuration on Windows. Configuration	Providers, CI/CD in AWS, CI/CD Services in AWS. Continuous Integration and Continuous Deployment: Continuous Integration and Continuous Deployment using Jenkins, Continuous Integration with Jenkins, Git, and AWS, Build Applications using Pipeline on AWS platform. Software and Automation Testing Frameworks: Popular Testing Tools, Test Driven Development Cycle, Behavior driven development is an extension of test driven development, Automated Testing using Cucumber. Docker as Containerization: Virtualization, Docker on Windows Desktop, Creating an Account in Docker Hub, MySQL in Docker. Kubernetes: Components, Kubernetes Architecture, Minikube, Pod Configuration on Windows. Configuration				

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			Management: Configuration Management Process	Management: Configuration Management Process, Role of Infrastructure as Code in DevOps Environment, Puppet. Continuous Monitoring: Role of Monitoring Systems, Types of Monitoring, Popular Monitoring Tools: Nagios. Orchestrating application deployment.				


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Annexure-V

B.Tech 2021-22 Admitted Batch Category wise Course Structure

Course Code	Course Title	Category	Mode	L	T	P	S	Cr	CH	Pre-requisite	New/Revised /Retained	EES	Stake holders	Justification for Considering the feedback
20UC1101	INTEGRATED PROFESSIONAL ENGLISH	HSS	R	0	0	4	0	2	4	NIL	Retained	SKILL DEVELOPMENT	No Changes	
20UC1202	ENGLISH PROFICIENCY	HSS	R	0	0	4	0	2	4	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21UC2103	ESSENTIAL SKILLS FOR EMPLOYABILITY	HSS	R	0	0	4	0	2	4	NIL	New	EMPLOYABILITY	Academic Peer	To develop essential skills for employability.
21UC2204	CORPORATE READINESS SKILLS	HSS	R	0	0	4	0	2	4	NIL	Retained	EMPLOYABILITY	No Changes	
21UC0010	UNIVERSAL HUMAN VALUES & PROFESSIONAL ETHICS	HSS	R	2	0	0	0	2	2	NIL	Retained	EMPLOYABILITY	No Changes	
Total Credits								10						
20MT1101	MATHEMATICS FOR COMPUTING	BS	R	2	2	0	2	4.5	6	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21MT2102	MATHEMATICS FOR ENGINEERS	BS	R	2	1	0	0	3	3	NIL	Retained	SKILL DEVELOPMENT	No Changes	

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21UC1203	DESIGN THINKING & INNOVATION	BS	R	0	0	4	0	2	5	NIL	50%-Revised Considered as new course	ENTREPRENEUR SHIP	Academic Peer	To incorporate the latest trends and case studies, ensuring students remain at the forefront of innovative problem-solving methodologies.
21MT2103	PROBABILITY, STATISTICS & QUEUEING THEORY	BS	R	2	2	0	0	4	4	NIL	New	SKILL DEVELOPMENT	Industry Personnel	To students seeking a strong foundation in data analysis and mathematical modeling, as it is invaluable for various academic and professional pursuits.
21CS2204	MATHEMATICAL PROGRAMMING	BS	R	2	2	0	0	4	4	NIL	50%-Revised Considered as new course	SKILL DEVELOPMENT	Academic Peer	To incorporate modern optimization techniques and real-world applications, ensuring students gain relevant skills for today's

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														problem-solving challenges.
SE-1	PHYSICS ELECTIVE	BS	R	3	0	2	0	4	5	NIL	Retained	-	No Changes	
SE-2	CHEMISTRY ELECTIVE	BS	R	3	0	0	0	3	3	NIL	Retained	-	No Changes	
21UC3105	PROBLEM SOLVING SKILLS - 1	BS	R	0	0	2	2	1.5	4	NIL	New	EMPLOYABILITY	Faculty	To enhance students' problem-solving capabilities and prepare them for real-world challenges.
21UC3206	PROBLEM SOLVING SKILLS - 2	BS	R	0	0	2	2	1.5	4	21UC3105	New	EMPLOYABILITY	Faculty	To enhance students' problem-solving capabilities and prepare them for real-world challenges.
Total Credits								27.5						
21SC1101	COMPUTATIONAL THINKING FOR STRUCTURED DESIGN	ES	R	3	0	2	6	5.5	11	NIL	Retained	EMPLOYABILITY	No Changes	
20ME1103	DESIGN TOOLS WORKSHOP - 1	ES	R	0	0	4	0	2	4	NIL	Retained	SKILL DEVELOPMENT	No Changes	

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20EC1101	DIGITAL LOGIC & PROCESSORS	ES	R	3	0	2	0	4	5	NIL	Retained	EMPLOYABILITY	No Changes		
21SC1203	COMPUTATIONAL THINKING FOR OBJECT ORIENTED DESIGN	ES	R	3	0	2	4	5	9	21SC1101	New	EMPLOYABILITY	Academic Peer	It will empower students with essential problem-solving skills and a strong foundation in object-oriented design, aligning with the evolving demands of the tech industry.	
21SC1202	DATA STRUCTURES	ES	R	3	0	2	4	5	9	21SC1101	Retained	EMPLOYABILITY	No Changes		
21SC1209	DESIGN TOOLS WORKSHOP - II	ES	R	0	0	4	0	2	4	NIL	Retained	SKILL DEVELOPMENT	No Changes		
21EC1202	COMPUTER ORGANIZATION & ARCHITECTURE	ES	R	2	0	0	0	2	2	20EC1101	Retained	EMPLOYABILITY	No Changes		
Total Credits								25.5							
21CS2109	OPERATING SYSTEMS	PC	R	2	0	2	0	3	4	21EC1202	Retained	EMPLOYABILITY	No Changes		
21CS2116	ADVANCED OBJECT ORIENTED PROGRAMMING	PC	R	2	0	2	4	4	8	21SC1101	New	EMPLOYABILITY	Faculty	It addresses the growing demand for advanced coding proficiency and design pattern expertise, crucial	

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Course Code	Course Title	Category	Mode	L	T	P	S	Cr	CH	Pre-requisite	New/Revised /Retained	EES	Stake holders	Justification for Considering the feedback
														for students to excel in contemporary software development roles.
21CS2110	DATABASE MANAGEMENT SYSTEMS	PC	R	2	0	2	0	3	4	21SC1202	Retained	EMPLOYABILITY	No Changes	
21CS2111	SOFTWARE ENGINEERING	PC	R	2	1	0	0	3	3	NIL	Retained	EMPLOYABILITY	No Changes	
21CS2215	AUTOMATA THEORY & FORMAL LANGUAGES	PC	R	2	1	0	0	3	3	NIL	Retained	EMPLOYABILITY	No Changes	
21CS2212	COMPUTER NETWORKS & SECURITY	PC	R	2	2	0	0	4	4	NIL	Retained	EMPLOYABILITY	No Changes	
21CS2213	AI FOR DATA SCIENCE	PC	R	2	0	2	0	3	4	21SC1202	Retained	EMPLOYABILITY	No Changes	
21CS2214	DESIGN & ANALYSIS OF ALGORITHMS	PC	R	2	0	2	4	4	8	21SC1202	Retained	EMPLOYABILITY	No Changes	
21CS2107	ENTERPRISE PROGRAMMING	PC	R	2	0	2	4	4	8	21SC1203	Retained	EMPLOYABILITY	No Changes	
21CS4115	PARALLEL & DISTRIBUTED COMPUTING	PC	M	2	1	0	0	3	3	21CS2109	Retained	EMPLOYABILITY	No Changes	
Total Credits								34						

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PE-1	PROFESSIONAL ELECTIVE - 1	PE	R	2	0	2	4	4	8	Course Specific	Retained		No Changes	
PE-2	PROFESSIONAL ELECTIVE - 2	PE	R	2	0	2	0	3	4	Course Specific	Retained		No Changes	
PE-3	PROFESSIONAL ELECTIVE - 3	PE	R	2	0	2	4	4	8	Course Specific	Retained		No Changes	
PE-4	PROFESSIONAL ELECTIVE - 4	PE	R	2	0	2	0	3	4	Course Specific	Retained		No Changes	
PE-5	PROFESSIONAL ELECTIVE - 5	PE	R	2	1	0	0	3	3	Course Specific	Retained		No Changes	
Total Credits								17						
21IE2040	SOCIAL INTERNSHIP (SI)	PJ	R	0	0	0	4	1	2	NIL	Retained	EMPLOYABILITY	No Changes	
21IE3041	TECHNICAL INTERNSHIP	PJ	R	0	0	0	4	1	4	NIL	Retained	EMPLOYABILITY	No Changes	
21IE3042AA	RESEARCH SEMINAR	PJ								Nil	Retained	SKILL DEVELOPMENT	No Changes	
21IE3243	TERM PAPER	PJ	R	0	0	4	0	1	4	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21IE4042AA	INDUSTRY INTERNSHIP	PJ	R	0	0	0	4	1	4	21IE3243	Retained	EMPLOYABILITY	No Changes	
21IE4053	CAPSTONE PROJECT - 1	PJ	R	0	0	4	16	6	20	21IE3243	Retained	EMPLOYABILITY	No Changes	
21IE4054	CAPSTONE PROJECT - 2	PJ	R	0	0	4	16	6	20	21IE4053	Retained	EMPLOYABILITY	No Changes	
Total Credits								16						

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FL	FOREIGN LANGUAGE ELECTIVE	OE	R	2	0	0	0	2	2	NIL	Retained	-	No Changes	
OE-1	OPEN ELECTIVE - 1	OE	R	3	0	0	0	3	3	NIL	Retained		No Changes	
ME	MANAGEMENT ELECTIVE	OE	R	3	0	0	0	3	3	NIL	Retained		No Changes	
OE-2	OPEN ELECTIVE - 2	OE	R	3	0	0	0	3	3	NIL	Retained		No Changes	
OE-3	OPEN ELECTIVE - 3	OE	R	3	0	0	0	3	3	NIL	Retained		No Changes	
Total Credits								14						
FC-1	FLEXI CORE COURSE - 1	FC	R	2	0	2	0	3	4	Course Specific	Retained		No Changes	
FC-2	FLEXI CORE COURSE - 2	FC	R	2	0	2	0	3	4	Course Specific	Retained		No Changes	
Total Credits								6						
	TOOL BASED LEARNING - 1	SDC	R	0	0	0	4	1	4	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21TS2101RA	TECHNICAL SKILLING - 1 (PYTHON FULL STACK DEVELOPMENT)	SDC	R	0	0	2	4	2	6	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21TS2202RA	TECHNICAL SKILLING - 2 (MERN)	SDC	R	0	0	2	4	2	6	21SC1203	60%-Revised Considered as new course	SKILL DEVELOPMENT	Faculty	To stay up-to-date with the rapidly evolving web

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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	STACK WEB DEVELOPMENT)													development landscape, thereby providing students with the most relevant and practical skills for their future careers.
21TS3103RA	TECHNICAL SKILLING - 3 (JAVA FULL STACK DEVELOPMENT + MICROSERVICES)	SDC	R	0	0	2	4	2	6	21SC1203	Retained	SKILL DEVELOPMENT	No Changes	
VAC-1	VALUE ADDED COURSE - 1	SDC	R	0	0	0	4	0	0	NIL	Retained	-	No Changes	
21TS3204	TECHNICAL SKILLING - 4 (SDC ELECTIVES)	SDC	R	0	0	2	4	2	6	DOMINE SPECIFIC	Retained	SKILL DEVELOPMENT	No Changes	
VAC-2	VALUE ADDED COURSE- 2	SDC	R	0	0	0	4	0	0	NIL	Retained	-	No Changes	
	TOOL BASED LEARNING - 2	SDC	R	0	0	0	4	0	4	NIL	Retained	SKILL DEVELOPMENT	No Changes	
VAC-3	VALUE ADDED COURSE - 3	SDC	R	0	0	0	4	0	0	NIL	Retained	-	No Changes	
VAC-4	VALUE ADDED COURSE - 4	SDC	R	0	0	0	4	0	4	NIL	Retained	-	No Changes	

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21CS3EL01A	COMPETITIVE CODING TRAINING-LEVEL 1	SDC	R	0	0	0	8	0	0	NIL	Retained	EMPLOYABILITY	No Changes	
21CS3EL02A	COMPETITIVE CODING TRAINING-LEVEL 2	SDC	R	0	0	0	8	0	0	NIL	Retained	EMPLOYABILITY	No Changes	
Total Credits								9						
21UC0009	ECOLOGY & ENVIRONMENT	AUC	R	2	0	0	0	0	2	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21UC0008	AUDIT COURSE- 1 (INDIAN CONSTITUTION)	AUC	R	2	0	0	0	0	2	NIL	Retained	-	No Changes	
21UC0011	AUDIT COURSE- 3 (GENDER SENSITIZATION)	AUC	M	2	0	0	0	2	2	NIL	Retained	-	No Changes	
20UC0007	AUDIT COURSE - 2 (INDIAN HERITAGE & CULTURE)	AUC	R	2	0	0	0	0	2	NIL	Retained	ENTREPRENEURSHIP	No Changes	
21UC0012	AUDIT COURSE - 4 (INNOVATION MANAGEMENT)	AUC	M	2	0	0	0	0	2	NIL	Retained	ENTREPRENEURSHIP	No Changes	
UC0014	ACTIVITY BASED LEARNING	AUC	R	0	0	4	0	0	4	NIL	Retained	-	No Changes	
UC0015	SOCIAL WORK	AUC	R	0	0	0	4	0	4	NIL	Retained	-	No Changes	
Total Credits								2						

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21UC2001	BRIDGE COURSE - 1 (PROGRAMMING ESSENTIALS IN PYTHON)	Bridge Course	R	0	0	0	4	0	2	NIL	Retained	EMPLOYABILITY	No Changes	
21UC2002	BRIDGE COURSE - 2 (PROGRAMMING ESSENTIALS IN PYTHON)	Bridge Course	M	0	0	0	4	0	4	NIL	Retained	EMPLOYABILITY	No Changes	
Total Credits								0						
Sports Certificate	SPORTS CERTIFICATE	Sports	R	0	0	2	0	0	2	NIL	Retained	-	No Changes	
Total Credits								161						
PROFESSIONAL ELECTIVES														
ARTIFICIAL INTELLIGENCE & INTELLIGENT PROCESS AUTOMATION (AI & IPA)														
21CS3021	MACHINE LEARNING	PE-1	R	2	0	2	4	4	8	21CS2213	Retained	SKILL DEVELOPMENT	No Changes	
21CS3022	SOFT COMPUTING	PE-2	R	2	0	2	0	3	4	21CS2213	Retained	EMPLOYABILITY	No Changes	
21CS3026	ARTIFICIAL NEURAL NETWORKS	PE-2	R	2	0	2	0	3	4	21CS2213	Retained	EMPLOYABILITY	No Changes	
21CS3120	MULTIMODEL INFORMATION PROCESSING	PE-2	R	2	0	2	0	3	4	20MT1101	New	EMPLOYABILITY	Faculty	To addresses critical skills needed in the

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														data-driven landscape and enhances our students' competitiveness in various fields.
21CS3269	DEEP LEARNING	PE-3	R	2	0	2	4	4	8	21CS3021	Retained	SKILL DEVELOPMENT	No Changes	
21CS3270	COGNITIVE COMPUTING	PE-4	R	2	0	2	0	3	4	21CS2213	Retained	EMPLOYABILITY	No Changes	
21CS3271	PERCEPTION AND COMPUTER VISION	PE-4	R	2	0	2	0	3	4	21CS2213	Retained	EMPLOYABILITY	No Changes	
21CS3278	DIGITAL VIDEO PROCESSING	PE-4	R	2	0	2	0	3	4	20MT1101	Retained	EMPLOYABILITY	No Changes	
21CS3282	MACHINE LEARNING ON CLOUD	PE-4	R	2	0	2	0	3	4	21CS3021	Retained	SKILL DEVELOPMENT	No Changes	
21CS3272	COMPUTATIONAL EPIDEMIOLOGY	PE-5	R	2	0	2	0	3	4	21CS2213	Retained	EMPLOYABILITY	No Changes	
21CS3273	NATURAL LANGUAGE PROCESSING	PE-5	R	2	0	2	0	3	4	21CS2213	Retained	EMPLOYABILITY	No Changes	
21CS3274	SPEECH PROCESSING	PE-5	R	2	0	2	0	3	4	21CS2213	Retained	EMPLOYABILITY	No Changes	
21CS3292	DESIGN & MANAGEMENT OF DISTRIBUTED	PE-5	R	2	0	2	0	3	4	21CS2213	Retained	SKILL DEVELOPMENT	No Changes	


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	APPLICATIONS FOR AI ON CLOUD													
21CS3293	ARCHITECTING DEEP LEARNING WORKLOADS ON CLOUD	PE-5	R	2	0	2	0	3	4	21CS2213	Retained	EMPLOYABILITY	No Changes	
DATA SCIENCE & BIG DATA ANALYTICS (DS&BDA)														
21CS3051	DATA VISUALISATION TECHNIQUES	PE-1	R	2	0	2	4	4	8	21CS2110	Retained	EMPLOYABILITY	No Changes	
21CS3052	DATA WAREHOUSING & MINING	PE-2	R	2	0	2	0	3	4	21CS2110	Retained	EMPLOYABILITY	No Changes	
21CS3275	BIG DATA ANALYTICS	PE-3	R	2	0	2	4	4	8	21CS2110	Retained	EMPLOYABILITY	No Changes	
21CS3276	BIG DATA OPTIMIZATION	PE-4	R	2	0	2	0	3	4	21CS2110	Retained	EMPLOYABILITY	No Changes	
21CS3277	BIOINFORMATICS	PE-4	R	2	0	2	0	3	4	21CS2214	Retained	EMPLOYABILITY	No Changes	
21CS3278	DIGITAL VIDEO PROCESSING	PE-4	R	2	0	2	0	3	4	21CS2213	Retained	EMPLOYABILITY	No Changes	
21CS3283	DATA ANALYTICS ON CLOUD	PE-4	R	2	0	2	0	3	4	21CS2213	Retained	EMPLOYABILITY	No Changes	
21CS3284	DIGITAL MEDIA ANALYTICS	PE-4	R	2	0	2	0	3	4	21CS2213	Retained	EMPLOYABILITY	No Changes	
21CS3272	COMPUTATIONAL EPIDEMIOLOGY	PE-5	R	2	0	2	0	3	4	21CS2213	Retained	EMPLOYABILITY	No Changes	

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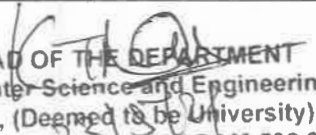
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21CS3279	ADVANCED DATABASES	PE-5	R	2	0	2	0	3	4	21CS2110	Retained	EMPLOYABILITY	No Changes	
21CS3289	BUSINESS ANALYTICS	PE-5	R	2	0	2	0	3	4	21CS2110	Retained	EMPLOYABILITY	No Changes	
21CS3280	GRAPH & WEB ANALYTICS	PE-5	R	2	0	2	0	3	4	21CS2213	Retained	EMPLOYABILITY	No Changes	
21CS3294	DATA GOVERNANCE ON CLOUD	PE-5	R	2	0	2	0	3	4	NIL	Retained	EMPLOYABILITY	No Changes	
CLOUD AND EDGE COMPUTING (CEC)														
21CS3037	CLOUD INFRASTRUCTURE & SERVICES	PE-1	R	2	0	2	4	4	8	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21CS3032	ADVANCED OPERATING SYSTEMS	PE-2	R	2	0	2	0	3	4	21CS2109	Retained	EMPLOYABILITY	No Changes	
21CS3036RA	FUNCTIONAL & CONCURRENT PROGRAMMING	PE-2	R	2	0	2	0	3	4	21SC1203	Retained	EMPLOYABILITY	No Changes	
21CS3086	CLOUD DEVOPS	PE-2	R	2	0	2	0	3	4	21CS2111	Retained	SKILL DEVELOPMENT	No Changes	
21CS3281	CLOUD & SERVERLESS COMPUTING	PE-3	R	2	0	2	4	4	8	NIL	Retained	EMPLOYABILITY	No Changes	
21CS3251	ADVANCED COMPUTER ARCHITECTURE	PE-4	R	2	0	2	0	3	4	21EC1202	Retained	EMPLOYABILITY	No Changes	


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21CS3252	PARALLEL ALGORITHMS	PE-4	R	2	0	2	0	3	4	21CS2109 / 21SC1203	Retained	EMPLOYABILITY	No Changes	
21CS3287	CLOUD SECURITY	PE-4	R	2	0	2	0	3	4	21CS2109 & 21CS2212	Retained	EMPLOYABILITY	No Changes	
21CS3285	ARCHITECTING CLOUD SOLUTIONS*	PE-4	R	2	0	2	0	3	4	21CS2109 & 21CS2212	Retained	EMPLOYABILITY	No Changes	
21CS3253	EDGE COMPUTING	PE-5	R	2	0	2	0	3	4	21CS2109	Retained	EMPLOYABILITY	No Changes	
21CS3038	HIGH PERFORMANCE COMPUTING	PE-5	R	2	0	2	0	3	4	21CS2109	Retained	EMPLOYABILITY	No Changes	
21CS3290	DESIGN OF DISTRIBUTED APPLICATIONS ON CLOUD (DDA)	PE-5	R	2	0	2	0	3	4	21CS2109	Retained		No Changes	
21CS3288	CLOUD NETWORKING	PE-5	R	2	0	2	0	3	4	21CS2109	Retained	EMPLOYABILITY	No Changes	
CYBERSECURITY & BLOCKCHAIN TECHNOLOGY (CYS&BCT)														
21CS3041	CRYPT ANALYSIS & CYBER DEFENSE	PE-1	R	2	0	2	4	4	8	21CS2212	Retained	SKILL DEVELOPMENT	No Changes	
21CS3042	NETWORK & INFRASTRUCTURE SECURITY	PE-2	R	2	0	2	0	3	4	21CS2212	Retained	SKILL DEVELOPMENT	No Changes	
21CS3045	INTRODUCTION TO BLOCKCHAIN &	PE-2	R	2	0	2	0	3	4	21CS2212	Retained	SKILL DEVELOPMENT	No Changes	

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	CRYPTO CURRENCIES													
21CS3259	DIGITAL FORENSICS	PE-3	R	2	0	2	4	4	8	21CS3041	Retained	EMPLOYABILITY	No Changes	
21CS3260	DATABASE & SYSTEM SECURITY	PE-4	R	2	0	2	0	3	4	21CS2110	Retained	EMPLOYABILITY	No Changes	
21CS3261	PROGRAMMING FOR SMART CONTRACTS	PE-4	R	2	0	2	0	3	4	21CS3045	Retained	EMPLOYABILITY	No Changes	
21CS3287	CLOUD SECURITY	PE-4	R	2	0	2	0	3	4	1CS2212	Retained	EMPLOYABILITY	No Changes	
21CS3262	SECURE SOFTWARE ENGINEERING	PE-5	R	2	0	2	0	3	4	21CS2111	Retained	EMPLOYABILITY	No Changes	
21CS3264	WEB SECURITY	PE-5	R	2	0	2	0	3	4	21CS2212	Retained	EMPLOYABILITY	No Changes	
21CS3291	SECURITY GOVERNANCE & MANAGEMENT	PE-5	R	2	0	2	0	3	4	NIL	Retained	EMPLOYABILITY	No Changes	
SOFTWARE MODELLING & DEVOPS (SM&DPS)														
21CS3062	SOFTWARE VERIFICATION & VALIDATION	PE-1	R	2	0	2	4	4	8	21CS2111	Retained	EMPLOYABILITY	No Changes	
21CS3064	UX DESIGN	PE-2	R	2	0	2	0	3	4	21UC1203	Retained	EMPLOYABILITY	No Changes	
21CS3065	DESIGN PATTERNS & CLEAN CODING TECHNIQUES	PE-2	R	2	0	2	0	3	4	21SC1203	Retained	EMPLOYABILITY	No Changes	

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21CS3256	CONTINUOUS DELIVERY & DEVOPS	PE-3	R	2	0	2	4	4	8	21CS2111	Retained	EMPLOYABILITY	No Changes	
21CS3257	SOFTWARE PROJECT MANAGEMENT	PE-4	R	2	0	2	0	3	4	21CS2111	Retained	EMPLOYABILITY	No Changes	
21CS3231	VISUAL PROGRAMING	PE-4	R	2	0	2	0	3	4	21SC1203	Retained	EMPLOYABILITY	No Changes	
21CS3295	SOFTWARE ARCHITECTURE & DESIGN	PE-5	R	2	0	2	0	3	4	21CS2111	Retained	EMPLOYABILITY	No Changes	
21CS3258	SOFTWARE RELIABILITY	PE-5	R	2	0	2	0	3	4	21CS2111	Retained	EMPLOYABILITY	No Changes	
21CS3255	CROSS-PLATFORM DEVELOPMENT FRAMEWORKS	PE-5	R	2	0	2	0	3	4	21SC1203	Retained	EMPLOYABILITY	No Changes	
GAME DEVELOPMENT & UX DESIGN (GUX)														
21CS3071	PROGRAMMING FOR GAME DEVELOPMENT	PE-1	R	2	0	2	4	4	8	21CS2109	Retained	ENTREPRENEURSHIP	No Changes	
21CS3064	UX DESIGN	PE-2	R	2	0	2	0	3	4	21UC1203	Retained	EMPLOYABILITY	No Changes	
21CS3266	AR & VR APPLICATION DEVELOPMENT	PE-3	R	2	0	2	4	4	8	21CS2109	Retained	EMPLOYABILITY	No Changes	
21CS3296	COMPUTER GRAPHICS	PE-4	R	2	0	2	0	3	4	NIL	Retained	EMPLOYABILITY	No Changes	

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21CS3297	3D MODELLING & ANIMATION	PE-4	R	2	0	2	0	3	4	NIL	Retained	EMPLOYABILITY	No Changes		
21CS3278	DIGITAL VIDEO PROCESSING	PE-4	R	2	0	2	0	3	4	20MT1101	Retained	EMPLOYABILITY	No Changes		
21CS3268	PRINCIPLES OF GAME DESIGN	PE-5	R	2	0	2	0	3	4	NIL	Retained	EMPLOYABILITY	No Changes		
21CS3267	BUSINESS OF GAMES & ENTREPRENEURSHIP	PE-5	R	2	0	2	0	3	4	NIL	Retained	ENTREPRENEURSHIP	No Changes		
CYBER PHYSICAL SYSTEM & INTERNET OF THINGS (CPS & IOT)															
21CS3117	IOT SENSING AND ACTUATING DEVICES	PE-1	R	2	0	2	4	4	8	NIL	Retained	EMPLOYABILITY	No Changes		
21CS3118	INTERNET OF THINGS: ARCHITECTURES AND PROTOCOLS	PE-2	R	2	0	2	0	3	4	21CS2212	Retained	EMPLOYABILITY	No Changes		
21CS3298	CYBER PHYSICAL SYSTEMS	PE-3	R	2	0	2	4	4	8	21CS2212	Retained	EMPLOYABILITY	No Changes		
21CS3278	DIGITAL VIDEO PROCESSING	PE-4	R	2	0	2	0	3	4	20MT1101	Retained	EMPLOYABILITY	No Changes		
21CS3299	FOUNDATIONS OF HYBRID AND EMBEDDED SYSTEMS	PE-4	R	2	0	2	0	3	4	NIL	Retained	EMPLOYABILITY	No Changes		


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code	Course Title	Category	Mode	L	T	P	S	Cr	CH	Pre-requisite	New/Revised /Retained	EES	Stake holders	Justification for Considering the feedback
21CS3250	CLOUD COMPUTING FOR IOT ENGINEERS	PE-5	R	2	0	2	0	3	4	NIL	Retained	EMPLOYABILITY	No Changes	
21CS3265	WIRELESS SENSOR NETWORKS	PE-5	R	2	0	2	0	3	4	21CS2212	Retained	EMPLOYABILITY	No Changes	
21CS3253	EDGE COMPUTING	PE-5	R	2	0	2	0	3	4	NIL	Retained	EMPLOYABILITY	No Changes	
FLEXI CORE COURSES														
21CS3064RA	UX DESIGN	FXC	R	2	0	2	0	3	4	21UC1203	Retained	EMPLOYABILITY	No Changes	
21CS3060RA	CONTINUOUS DELIVERY & DEVOPS	FXC	R	2	0	2	0	3	4	21CS2111	Retained	EMPLOYABILITY	No Changes	
21CS3116RA	SIGNAL PROCESSING	FXC	R	2	2	0	0	4	4	20MT1101	Retained	EMPLOYABILITY	No Changes	
21CS3039RA	CLOUD INFRASTRUCTURE & SERVICES	FXC	R	2	0	2	0	3	4	21CS2109 & 21CS2212	Retained	SKILL DEVELOPMENT	No Changes	
21CS3041RA	CRYPT ANALYSIS & CYBER DEFENSE	FXC	R	2	0	2	0	3	4	21CS2212	Retained	SKILL DEVELOPMENT	No Changes	
21CS3015RA	EMBEDDED SYSTEMS	FXC	R	2	0	2	0	3	4	21EC1202	Retained	EMPLOYABILITY	No Changes	
21CS3232R	MACHINE LEARNING	FXC	R	2	0	2	0	3	4	21CS2213	Retained	SKILL DEVELOPMENT	No Changes	
21CS3133RA	DATA VISUALIZATION TECHNIQUES	FXC	R	2	0	2	0	3	4	21CS2110	Retained	EMPLOYABILITY	No Changes	

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21CS3255RA	CROSS-PLATFORM DEVELOPMENT FRAMEWORKS	FXC	R	2	0	2	0	3	4	21CS2107	Retained	EMPLOYABILITY	No Changes	
21CS3234RA	APPLICATION DEVELOPMENT ON CLOUD	FXC	R	2	0	2	0	3	4	21CS2107	Retained	EMPLOYABILITY	No Changes	
21CS3235RA	SOLUTIONS ARCHITECTING ON CLOUD	FXC	R	2	0	2	0	3	4	21CS2109 & 21CS2212	Retained	EMPLOYABILITY	No Changes	
21CS3231RA	VISUAL PROGRAMING	FXC	R	2	0	2	0	3	4	21SC1203	Retained	EMPLOYABILITY	No Changes	
21CS3279RA	ADVANCED DATABASES	FXC	R	2	0	2	0	3	4	21CS2110	Retained	EMPLOYABILITY	No Changes	
21CS3045RA	INTRODUCTION TO BLOCKCHAIN AND CRYPTO CURRENCIES	FXC	R	2	0	2	0	3	4	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21CS3042RA	NETWORK & INFRASTRUCTURE SECURITY	FXC	R	2	0	2	0	3	4	21CS2212	Retained	SKILL DEVELOPMENT	No Changes	
21CS3119RA	INTERNET OF THINGS	FXC	R	2	0	2	0	3	4	NIL	Retained	EMPLOYABILITY	No Changes	
21CS3204RA	COMPILER DESIGN	FXC	R	2	0	2	0	3	4	21CS2215	Retained	EMPLOYABILITY	No Changes	
21CS3036RA	FUNCTIONAL & CONCURRENT PROGRAMMING	FXC	R	2	0	2	0	3	4	21SC1203	Retained	EMPLOYABILITY	No Changes	

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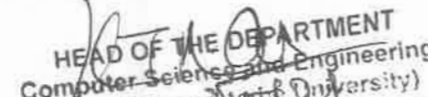
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21CS3043RA	QUANTUM COMPUTING	FXC	R	2	0	2	0	3	4	20MT1101	New	EMPLOYABILITY	Academic Peer	Empowering students with the skills and knowledge needed to harness the potential of cutting-edge technology and address intricate computational challenges.
21CS3061RA	AUTOMATA THEORY AND FORMAL LANGUAGES	FXC	R	2	1	0	0	3	3	Nil	Retained	EMPLOYABILITY	No Changes	
21CS3066RA	SOFTWARE VERIFICATION & VALIDATION	FXC	R	2	0	2	0	3	4	21CS2111	Retained	EMPLOYABILITY	No Changes	
21CS3016RA	.NET PROGRAMMING (EPAM)	FXC	R	2	0	2	0	3	4	NIL	Retained	EMPLOYABILITY	No Changes	
21CS3017RA	FRONT END WEB DEVELOPMENT (EPAM)	FXC	R	2	0	2	0	3	4	NIL	Retained	EMPLOYABILITY	No Changes	
21CS3018RA	SOFTWARE TESTING (EPAM)	FXC	R	2	0	2	0	3	4	NIL	Retained	EMPLOYABILITY	No Changes	
21CS3019RA	CLOUD DEVOPS (EPAM)	FXC	R	2	0	2	0	3	4	NIL	Retained	EMPLOYABILITY	NoF Changes	


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SCIENCE ELECTIVE COURSES														
21PH1001	ENGINEERING PHYSICS	SE	R	3	0	2	0	4	5	NIL	Retained	-	No Changes	
21PH1008	PHYSICS FOR ELECTRONICS ENGINEERING	SE	R	3	0	2	0	4	5	NIL	Retained	-	No Changes	
21PH1004	SOLID STATE PHYSICS	SE	R	3	0	2	0	4	5	NIL	Retained	-	No Changes	
21PH4101	QUANTUM PHYSICS FOR ENGINEERS	SE	R	3	0	2	0	4	5	NIL	Retained	SKILL DEVELOPMENT	No Changes	
18CY1005	CHEMISTRY FOR ENGINEERS	SE	R	3	0	0	0	3	3	NIL	Retained	EMPLOYABILITY	No Changes	
21CY1001	ENGINEERING CHEMISTRY	SE	R	3	0	2	0	4	5	NIL	Retained	EMPLOYABILITY	No Changes	
21CY1003	CHEMISTRY & BIO-INFORMATICS FOR ENGINEERS	SE	R	3	0	2	0	4	5	NIL	Retained	-	No Changes	
21CY1004	ORGANIC ELECTRONICS	SE	R	3	0	2	0	4	5	NIL	Retained	-	No Changes	
SDP-4 ELECTIVE COURSES														
21TS3292RA	TS-SDP4 (CLOUD DEVOPS)	TS-DPS	R	0	0	2	4	2	6	21CS2111	Retained	SKILL DEVELOPMENT	No Changes	
21TS3291RA	TS-SDP4 (CLOUD BASED SOLUTIONS ARCHITECT)	TS-CEC	R	0	0	2	4	2	6	21CS3037	Retained	SKILL DEVELOPMENT	No Changes	


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21TS3293RA	TS-SDP4 (CLOUD BASED SECURITY SPECIALITY)	TS-CYS	R	0	0	2	4	2	6	21CS2212	Retained	SKILL DEVELOPMENT	No Changes	
21TS3294RA	TS-SDP4 (CERTIFIED GAME DEVELOPER)	TS-GUX	R	0	0	2	4	2	6	21CS3071	Retained	SKILL DEVELOPMENT	No Changes	
21TS3295RA	TS SDP-4 (CLOUD BASED AI/ML SPECIALITY)	TS-AI	R	0	0	2	4	2	6	21CS2213	Retained	SKILL DEVELOPMENT	No Changes	
21TS3296RA	TS SDP-4 (CLOUD BASED DATA ANALYTICS SPECIALITY)	TS-BDA	R	0	0	2	4	2	6	21CS2213	Retained	SKILL DEVELOPMENT	No Changes	
21TS3290RA	TS-SDP4 (CLOUD BASED IOT DEVELOPER)	TS-IOT	R	0	0	2	4	2	6	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21TS3297RA	TS-SDP4 (IT VENTURE MANAGEMENT)	TS-ITVM	R	0	0	2	4	2	6	NIL	Retained	SKILL DEVELOPMENT	No Changes	
OPEN ELECTIVES, FOREIGN LANGUAGE ELECTIVES, MANAGEMENT ELECTIVES														
21FL3054	FRENCH LANGUAGE	FL	R	2	0	0	0	2	2	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21FL3058	JAPANESE LANGUAGE-1	FL	R	2	0	0	0	2	2	NIL	Retained	-	No Changes	
21FL3063	JAPANESE LANGUAGE-2	FL	R	3	0	0	0	3	3	NIL	Retained	-	No Changes	


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21FL3064	JAPANESE LANGUAGE-3	FL	R	3	0	0	0	3	3	NIL	Retained	-	No Changes	
21MB4053	MANAGING PERSONAL FINANCES	ME	R	3	0	0	0	3	3	NIL	Retained	EMPLOYABILITY	No Changes	
21MB4055	ORGANIZATION MANAGEMENT	ME	R	3	0	0	0	3	3	NIL	Retained	EMPLOYABILITY	No Changes	
21CS40A7	FUNDAMENTALS OF SOFTWARE ENGINEERING	OE	R	3	0	0	0	3	3	NIL	Retained	EMPLOYABILITY	No Changes	
21CS40A6	FUNDAMENTALS OF DBMS	OE	R	3	0	0	0	3	3	NIL	Retained	EMPLOYABILITY	No Changes	
21CS40A8	FUNDAMENTALS OF IT	OE	R	3	0	0	0	3	3	NIL	Retained	EMPLOYABILITY	No Changes	
21GN40D7	NATIONAL CADET COPS-4	OE	R	2	0	6	0	5	8	NIL	Retained	-	No Changes	
21GN40D8	CAMP-1	OE	R	0	0	4	0	5	4	NIL	Retained	-	No Changes	
21GN40D9	CAMP-2	OE	R	0	0	4	0	5	4	NIL	Retained	-	No Changes	
21GN40D1	NATIONAL CADET COPS-1	OE-1	R	2	0	2	0	3	4	NIL	Retained	-	No Changes	
21GN40D4	NATIONAL SERVICE SCHEME-1	OE-1	R	2	0	2	0	3	4	NIL	Retained	-	No Changes	
21BT40A1	IPR & PATENT LAWS	OE-1	R	3	0	0	0	3	3	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21BT40A9	BIOMATERIALS	OE-1	R	3	0	0	0	3	3	NIL	Retained	-	No Changes	


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21GN40D2	NATIONAL CADET COPS-2	OE-2	R	2	0	2	0	3	4	NIL	Retained	-	No Changes	
21GN40D5	NATIONAL SERVICE SCHEME-2	OE-2	R	2	0	2	0	3	4	NIL	Retained	-	No Changes	
21CE40A2	ENVIRONMENTAL POLLUTION CONTROL METHODS	OE-2	R	3	0	0	0	3	3	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21CE40A3	SOLID AND HAZARDOUS WASTE MANAGEMENT	OE-2	R	3	0	0	0	3	3	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21CE40A4	REMOTE SENSING & GIS	OE-2	R	3	0	0	0	3	3	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21CE40A5	DISASTER MANAGEMENT	OE-2	R	3	0	0	0	3	3	NIL	Retained	SKILL DEVELOPMENT	No Changes	
21MB4056	RESOURCES SAFETY AND QUALITY MANAGEMENT	OE-2	R	2	0	0	0	2	2	NIL	Retained	EMPLOYABILITY	No Changes	
21MB4058	CONSTRUCTION PROJECT MANAGEMENT	OE-2	R	2	0	0	0	2	2	NIL	Retained	EMPLOYABILITY	No Changes	
21GN40D3	NATIONAL CADET COPS-3	OE-3	R	2	0	2	0	3	4	NIL	Retained	-	No Changes	
21GN40D6	NATIONAL SERVICE SCHEME-3	OE-3	R	2	0	2	0	3	4	NIL	Retained	-	No Changes	

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20ME40B7	HYBRID ELECTRIC VEHICLES	OE-3	R	3	0	0	0	3	3	NIL	Retained	EMPLOYABILITY	No Changes	
20ME40B4	ROBOTICS	OE-3	R	3	0	0	0	3	3	NIL	Retained	EMPLOYABILITY	No Changes	
20ME40B5	MECHATRONICS	OE-3	R	3	0	0	0	3	3	NIL	Retained	SKILL DEVELOPMENT	No Changes	
TOOL BASED LEARNING														
	CLOUD FOUNDATIONS-AWS(CF)	TBL	R	0	0	0	4	1	4	NIL	Retained	SKILL DEVELOPMENT	No changes	
	GOOGLE CLOUD(GC)	TBL	R	0	0	0	4	1	4	NIL	Retained	SKILL DEVELOPMENT	No changes	
	BLUEPRISM(BP)	TBL	R	0	0	0	4	1	4	NIL	Retained	SKILL DEVELOPMENT	No changes	
	UI PATH(UP)	TBL	R	0	0	0	4	1	4	NIL	Retained	SKILL DEVELOPMENT	No changes	
	ROBOTIC PROCESS AUTOMATION(RPA)	TBL	R	0	0	0	4	1	4	NIL	Retained	SKILL DEVELOPMENT	No changes	

Total number of courses =145

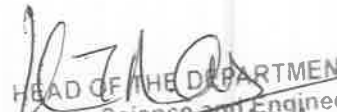
Percentage of Syllabus Revision= (Total No. of courses revised + new courses) *100/Total Courses

= ((3+7)*100)/145 = 6.89

Percentage of Courses focusing on Employability= 84*100/145=57.93

Percentage of Courses focusing on Entrepreneurship = 8*100/145=5.52

Percentage of Courses focusing on Skill Development = 53*100/145=36.55


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Annexure-V A

M.Tech – Computer Science and Engineering

2021-22 Admitted Batch Category Wise Course Structure

Course Code	Course Name	L	T	P	S	Cr	CH	New/Revised/Retained	EES	Stake Holders Category	Justification for Considering the feedback
21CS5101	MATHEMATICAL FOUNDATIONS FOR COMPUTER SCIENCE	3	2	0	0	5	5	Retained	SKILL DEVELOPMENT	No Changes	
21CS5102	COMPUTER ORGANIZATION & ARCHITECTURE	3	2	0	0	5	5	Retained	EMPLOYABILITY	No Changes	
21CS5103	DATA STRUCTURES & ALGORITHMS	3	0	2	0	4	5	Retained	EMPLOYABILITY	No Changes	
21CS5104	DISTRIBUTED DATA BASE MANAGEMENT SYSTEMS	3	0	2	0	4	5	Retained	EMPLOYABILITY	No Changes	
	ELECTIVE - 1	2	0	2	4	4	8				
	ELECTIVE-2	2	0	2	0	3	4				
21IE5149	SEMINAR	0	0	4	0	2	4	Retained	SKILL DEVELOPMENT	No Changes	
21CS5205	OPERATING SYSTEM DESIGN	3	2	0	0	5	5	Retained	EMPLOYABILITY	No Changes	
21CS5206	COMPUTER NETWORKS & SECURITY	3	2	0	0	5	5	Retained	EMPLOYABILITY	No Changes	
21CS5207	OBJECT ORIENTED ANALYSIS AND DESIGN	3	0	2	0	4	5	Retained	EMPLOYABILITY	No Changes	

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21CS5208	ENTERPRISE PROGRAMMING	3	0	2	0	4	5	Retained	EMPLOYABILITY	No Changes	
	ELECTIVE-3	3	0	4	4	6	11				
	ELECTIVE-4	3	0	4	4	6	11				
21IE5250	TERMPAPER	0	0	4	0	2	4	Retained	SKILL DEVELOPMENT	No Changes	
21IE6150	Dissertation	0	0	36	0	18	36	Revised	EMPLOYABILITY		Second Year Semester - I
21IE6250	Dissertation	0	0	36	0	18	36	Revised	EMPLOYABILITY		Second Year Semester - II
	Total Credits	34	8	100	12	95	154				
ELECTIVE COURSES LIST											
ELECTIVE-1											
21CS51A1	Soft Computing	2	0	2	4	4	8	Retained	EMPLOYABILITY	No Changes	
21CS51A2	Machine Learning	2	0	2	4	4	8	Retained	EMPLOYABILITY	No Changes	
21CS51A3	Data Warehousing & Mining	2	0	2	4	4	8	80%-Revised Considered as new Course	EMPLOYABILITY	Faculty	To ensure that students are equipped with the latest data analysis techniques and tools
21CS51A4	Natural Language Processing	2	0	2	4	4	8	Retained	EMPLOYABILITY	No Changes	
ELECTIVE-2											


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code	Course Name	L	T	P	S	Cr	CH	New/Revised/Retained	EES	Stake Holders Category	Justification for Considering the feedback
21CS51B1	Requirements Engineering	2	0	2	0	3	4	Retained	EMPLOYABILITY	No Changes	
21CS51B2	Principles of Programming Languages	2	0	2	0	3	4	10%-Revised	EMPLOYABILITY	Industry Person	For emphasizing practical applications that are relevant to Industry needs
21CS51B3	Compiler Design	2	0	2	0	3	4	8%-Revised	EMPLOYABILITY	Faculty	Can help to write low-level code, such as device drivers and firmware.
21CS51B4	Software Verification & Validation	2	0	2	0	3	4	Retained	SKILL DEVELOPMENT	No Changes	
ELECTIVE-3											
21CS52C1	Cryptography & Network Security	3	0	4	4	6	11	5%-Revised	EMPLOYABILITY	Academic Peer	To protect sensitive information from unauthorized access.
21CS52C2	Mobile computing	3	0	4	4	6	11	Retained	EMPLOYABILITY	No Changes	
21CS52C3	High Performance Computing	3	0	4	4	6	11	Retained	EMPLOYABILITY	No Changes	
21CS52C4	Network management Systems	3	0	4	4	6	11	Retained	EMPLOYABILITY	No Changes	
21CS52C5	CONTINUOUS DELIVERY & DEVOPS	3	0	4	4	6	11	12%-Revised	EMPLOYABILITY	Academic Peer	As it's more needed for the modern era in software Industry
ELECTIVE-4											
21CS52D1	Service Oriented Architecture	3	0	4	4	6	11	Retained	SKILL DEVELOPMENT	No Changes	

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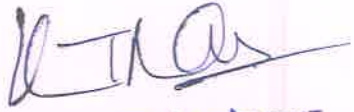
Course Code	Course Name	L	T	P	S	Cr	CH	New/Revised/Retained	EES	Stake Holders Category	Justification for Considering the feedback
21CS52D2	Visual Programming	3	0	4	4	6	11	Retained	EMPLOYABILITY	No Changes	
21CS52D3	Digital Image Processing	3	0	4	4	6	11	Retained	SKILL DEVELOPMENT	No Changes	
21CS52D4	Big Data Analytics	3	0	4	4	6	11	Retained	SKILL DEVELOPMENT	No Changes	

Total number of courses =28

Percentage of Syllabus Revision=(Total No.of courses revised + new courses)*100/Total Courses=((7)*100)/28 = 25%

Percentage of Courses focusing on Employability= 18*100/28=75%

Percentage of Courses focusing on Skill Development = 7*100/28=25%


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Annexure-V B

M.Tech - Artificial Intelligence & Data Science

2021-22 Admitted Batch Category Wise Course Structure

Sl No	Course Code	Course Name	L	T	P	S	Cr	CH	PRE-REQUISITE	EES
1	21CS5109	MATHEMATICAL PROGRAMMING - 1	3	2	0	0	5	5	NIL	SKILL DEVELOPMENT
2	21CS5110	COMPUTATIONAL THINKING FOR OBJECT ORIENTED DESIGN	3	0	4	0	5	7	NIL	SKILL DEVELOPMENT
3	21CS5111	BIG DATA ANALYTICS	3	0	2	0	4	5	NIL	EMPLOYABILITY
4	21CS5112	MACHINE LEARNING & REINFORCEMENT LEARNING	3	0	2	0	4	5	NIL	SKILL DEVELOPMENT
5		ELECTIVE - 1	2	0	2	4	4	8	NIL	
6		ELECTIVE - 2	2	0	2	0	3	4	NIL	
7	21IE 5149	SEMINAR	0	0	4	0	2	4	NIL	SKILL DEVELOPMENT
8	21CS5113	MATHEMATICAL PROGRAMMING - 2	2	2	0	0	4	4	NIL	SKILL DEVELOPMENT
9	21CS5114	DATA STRUCTURES & ALGORITHMS	3	0	4	4	6	11	NIL	SKILL DEVELOPMENT
10	21CS5115	ADVANCED DATABASES	3	0	2	0	4	5	NIL	EMPLOYABILITY
11	21CS5116	DEEP LEARNING	3	0	4	4	6	11	NIL	SKILL DEVELOPMENT
12		ELECTIVE-3	3	0	2	0	4	5	NIL	

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Sl No	Course Code	Course Name	L	T	P	S	Cr	CH	PRE-REQUISITE	EES
13		ELECTIVE-4	3	0	2	0	4	5	NIL	
14	21IE5250	TERMPAPER	0	0	4	0	2	4	NIL	SKILL DEVELOPMENT
15	21IE6150	DISSERTATION	0	0	36	0	18	36	NIL	EMPLOYABILITY
16	21IE6250	DISSERTATION	0	0	36	0	18	36	NIL	EMPLOYABILITY
Total Credits							93			
ELECTIVE COURSES LIST										
ELECTIVE-1										
1	21CS51E1	CLOUD INFRASTRUCTURE & SERVICES	2	0	2	4	4	8	NIL	EMPLOYABILITY
2	21CS51E2	PARALLEL & DISTRIBUTED COMPUTING	2	0	2	4	4	8	NIL	SKILL DEVELOPMENT
3	21CS51E3	CLOUD DEVOPS	2	0	2	4	4	8	NIL	EMPLCYABILITY
ELECTIVE-2										
1	21CS51F1	COMPUTER VISION AND PERCEPTION	2	0	2	0	3	4	NIL	SKILL DEVELOPMENT
2	21CS51F2	SOFT COMPUTING	2	0	2	0	3	4	NIL	SKILL DEVELOPMENT
3	21CS51F3	ARTIFICIAL NEURAL NETWORKS	2	0	2	0	3	4	NIL	SKILL DEVELOPMENT
ELECTIVE-3										


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Sl No	Course Code	Course Name	L	T	P	S	Cr	CH	PRE-REQUISITE	EES
1	21CS51G1	DATA WAREHOUSING & MINING	3	0	2	0	4	5	NIL	SKILL DEVELOPMENT
2	21CS51G2	GRAPH & WEB ANALYTICS	3	0	2	0	4	5	NIL	EMPLOYABILITY
3	21CS51G3	BIG DATA OPTIMIZATION	3	0	2	0	4	5	NIL	EMPLOYABILITY
ELECTIVE-4										
1	21CS52H1	COGNITIVE COMPUTING	3	0	2	0	4	5	NIL	EMPLOYABILITY
2	21CS52H2	NATURAL LANGUAGE PROCESSING	3	0	2	0	4	5	NIL	EMPLOYABILITY
3	21CS52H3	EDGE COMPUTING	3	0	2	0	4	5	NIL	EMPLOYABILITY


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Annexure-V C

M.Tech – Digital Forensics and Cyber Security

2021-22 Admitted Batch Category Wise Course Structure

SL NO	COURSE CODE	COURSE TITLE	L	T	P	S	CR	CH	PRE-REQUISITE	EES
1	21CS5121	INTRODUCTION TO CYBER SECURITY & ICT	3	2	0	0	5	5	NIL	SKILL DEVELOPMENT
2	21CS5120	SOFTWARE SECURITY	3	2	0	0	5	5	NIL	SKILL DEVELOPMENT
3	21CS5122	CLOUD INFRASTRUCTURE & SERVICES	3	0	2	0	4	5	NIL	EMPLOYABILITY
4	21CS5119	ADVANCE NETWORK SECURITY & INVESTIGATIONS	3	0	2	0	4	5	NIL	SKILL DEVELOPMENT
5	21CS5221	CRYPTOGRAPHY FOR CYBER DEFENCE	3	0	2	0	4	5	NIL	SKILL DEVELOPMENT
6	21CS5222	MALWARE ANALYSIS & REVERSE ENGINEERING	3	0	2	0	4	5	NIL	EMPLOYABILITY
7	21CS5223	CYBER INCIDENT RESPONSE & RESILIENCE	3	0	2	0	4	5	NIL	EMPLOYABILITY
8	21CS5224	CYBER LAW, GOVERNANCE & COMPLIANCE	3	0	2	0	4	5	NIL	EMPLOYABILITY
9		ELECTIVE-1	2	0	2	4	4	8	NIL	
10		ELECTIVE-2	2	0	2	0	3	4	NIL	
11		ELECTIVE-3	3	0	4	4	6	11	NIL	

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SL NO	COURSE CODE	COURSE TITLE	L	T	P	S	CR	CH	PRE-REQUISITE	EES
12		ELECTIVE-4	3	0	4	4	6	11	NIL	
13	21IE5149	SEMINAR	0	0	4	0	2	4	NIL	SKILL DEVELOPMENT
14	21IE5250	TERM PAPER	0	0	4	0	2	4	NIL	SKILL DEVELOPMENT
15	21IE6150	DISSERTATION	0	0	36	0	18	36	NIL	EMPLOYABILITY
16	21IE6250	DISSERTATION	0	0	36	0	18	36	NIL	EMPLOYABILITY
TOTAL CREDITS							93			
ELECTIVE - 1										
1	21CS5111	MOBILE DEVICE THREATS & INVESTIGATION	2	0	2	4	4	8	NIL	EMPLOYABILITY
2	21CS5112	FUNDAMENTALS OF E-DISCOVERY	2	0	2	4	4	8	NIL	SKILL DEVELOPMENT
3	21CS5113	FUZZY SETS AND FUZZY LOGIC	2	0	2	4	4	8	NIL	SKILL DEVELOPMENT
4	21CS5114	DIGITAL FORENSICS	2	0	2	4	4	8	NIL	EMPLOYABILITY
ELECTIVE - 2										
5	21CS51J1	INTRODUCTION TO BIG DATA ANALYTICS	2	0	2	0	3	4	NIL	SKILL DEVELOPMENT
6	21CS51J2	SOCIAL MEDIA FORENSICS	2	0	2	0	3	4	NIL	SKILL DEVELOPMENT
7	21CS51J3	CRITICAL INFORMATION INFRASTRUCTURE SECURITY	2	0	2	0	3	4	NIL	EMPLOYABILITY

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SL NO	COURSE CODE	COURSE TITLE	L	T	P	S	CR	CH	PRE-REQUISITE	EES
ELECTIVE - 3										
8	21CS52K1	INFRASTRUCTURE ATTACKS AND DEFENCE	2	0	2	4	4	8	NIL	EMPLOYABILITY
9	21CS52K2	SOFTWARE VULNERABILITY ANALYSIS AND RESILIENCE	2	0	2	4	4	8	NIL	EMPLOYABILITY
10	21CS52K3	PARALLEL & CLOUD COMPUTING	2	0	2	4	4	8	NIL	SKILL DEVELOPMENT
11	21CS52K4	CLOUD SECURITY	3	0	4	4	6	11	NIL	EMPLOYABILITY
ELECTIVE - 4										
12	21CS52L1	APPLIED CRYPTOGRAPHY AND STEGANOGRAPHY	2	0	2	0	3	4	NIL	SKILL DEVELOPMENT
13	21CS52L2	SOFTWARE MODELLING	2	0	2	0	3	4	NIL	SKILL DEVELOPMENT
14	21CS52L3	DIGITAL IMAGE PROCESSING	2	0	2	0	3	4	NIL	SKILL DEVELOPMENT
15	21CS52L4	PROGRAMMING FOR BLOCKCHAIN	3	0	4	4	6	11	NIL	EMPLOYABILITY


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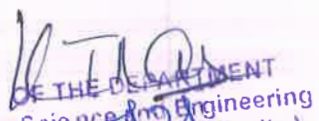
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Annexure-VI

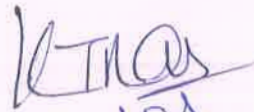
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

2021-22 MOOCS COURSES

Sl No	Course Code	Course Title	Category	Mode	L	T	P	S	Cr	CH
1	21CS4115M	PARALLEL & DISTRIBUTED COMPUTING	PC	M	2	1	0	0	3	3
2	21UC0011	AUDIT COURSE- 3 (GENDER SENSITIZATION)	AUC	M	2	0	0	0	2	2
3	21UC0012	AUDIT COURSE - 4 (INNOVATION MANAGEMENT)	AUC	M	2	0	0	0	0	2
4	21UC2002	BRIDGE COURSE - 2 (PROGRAMMING ESSENTIALS IN PYTHON)	Bridge Course	M	0	0	0	4	0	4
5	21UC2002	BRIDGE COURSE - 2 (PROGRAMMING ESSENTIALS IN PYTHON)	Bridge Course	M	0	0	0	4	0	4
6	21UC0011	AUDIT COURSE - 3 (GENDER SENSITIZATION)	HSS	M	2	0	0	0	0	2
7	21UC0012	AUDIT COURSE - 4 (INNOVATION MANAGEMENT)	HSS	M	2	0	0	0	0	2
8	21FL3055	GERMAN LANGUAGE	FL	M	3	0	0	0	3	3
9	21FL3052M	LEARN SPANISH: BASIC SPANISH VOCABULARY	FL	M	3	0	0	0	4	4
10	21FL3060M	RUSSIAN FOR BEGINNERS	FL	M	3	0	0	0	4	4
11	21FL3063M	KOREAN LANGUAGE	FL	M	3	0	0	0	4	4
12	18FL3064M	JAPANESE LANGUAGE	FL	M	4	0	0	0	4	4
13	21FL3053M	LEARN CHINESE: HSK TEST PREPARATION	FL	M	3	0	0	0	4	4
14	21MB4058M	SIX SIGMA YELLOW BELT	ME	M	4	0	0	0	4	4
15	21MB4059M	SEARCH ENGINE OPTIMIZATION	ME	M	4	0	0	0	4	4
16	21MB4060M	FINTECH: FINANCE INDUSTRY TRANSFORMATION AND REGULATION	ME	M	4	0	0	0	4	4
17	21MB4061M	AN INTRODUCTION TO MICROECONOMICS	ME	M	4	0	0	0	4	4
18	21OE4001M	GRAPHIC DESIGN	OE-1	M	4	0	0	0	4	4
19	21OE4002M	PHOTOGRAPHY BASICS AND BEYOND FROM SMART PHONE TO DSLR	OE-1	M	4	0	0	0	4	4
20	21OE4003M	EXPLORING OUR RESPONSES TO CLIMATE CHANGE	OE-1	M	4	0	0	0	4	4


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SI No	Course Code	Course Title	Category	Mode	L	T	P	S	Cr	CH
21	21OE4011M	PATENT LAW FOR ENGINEERS AND SCIENTISTS	OE-1	M	4	0	0	0	3	3
22	21OE4004M	SELF DRIVING CARS	OE-2	M	4	0	0	0	4	4
23	21OE4005M	ENERGY PRODUCTION, DISTRIBUTION & SAFETY	OE-2	M	4	0	0	0	4	4
24	21OE4006M	CONSTRUCTION MANAGEMENT	OE-2	M	4	0	0	0	4	4
25	21OE4007M	GEOGRAPHIC INFORMATION SYSTEMS	OE-2	M	4	0	0	0	4	4
26	21OE4008M	NON-CONVENTIONAL ENERGY RESOURCES	OE-2	M	4	0	0	0	4	4
27	21OE4009M	LEADING SUSTAINABLE COMMUNITY TRANSFORMATION	OE-3	M	4	0	0	0	4	4
28	21OE4010M	DIGITAL MARKETING	OE-3	M	4	0	0	0	4	4
29	20ME40B6	EDUCATION FOR SUSTAINABLE DEVELOPMENT	OE-3	M	4	0	0	0	4	4


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Annexure-VII


DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ADVANCE AND PEER MENTOR MODE COURSES


S. No	Course Code	Course Title	Category	Mode	L	T	P	S	Cr	CH	Pre-requisite
1	21CS2109	OPERATING SYSTEMS	PC	A/P	3	0	4	0	5	7	COA
2	21CS2116	ADVANCED OBJECT ORIENTED PROGRAMMING	PC	A/P	3	0	4	4	6	11	CTOD
3	21CS2110	DATABASE MANAGEMENT SYSTEMS	PC	A/P	3	0	4	0	5	7	DS
4	21CS2111	SOFTWARE ENGINEERING	PC	A/P	3	1	2	0	5	6	NIL
5	21CS2215	AUTOMATA THEORY & FORMAL LANGUAGES	PC	A/P	3	1	2	0	5	6	NIL
6	21CS2212	COMPUTER NETWORKS & SECURITY	PC	A/P	3	2	2	0	6	7	NIL
7	21CS2213	AI FOR DATA SCIENCE	PC	A/P	3	0	4	0	5	7	DS
8	21CS2214	DESIGN & ANALYSIS OF ALGORITHMS	PC	A/P	3	0	4	4	6	11	DS
9	21CS2107RA	ENTERPRISE PROGRAMMING	PC	A/P	3	0	4	4	6	11	CTOD
10	21TS2101RA	TECHNICAL SKILLING - 1 (PYTHON FULL STACK DEVELOPMENT)	SDC	A/P	0	1	4	4	4	9	NIL
11	21TS2202RA	TECHNICAL SKILLING - 2 (MERN STACK WEB DEVELOPMENT)	SDC	A/P	0	1	4	4	4	9	EP
12	21TS3103RA	TECHNICAL SKILLING - 3 (JAVA FULL STACK DEVELOPMENT + MICROSERVICES)	SDC	A/P	0	1	4	4	4	9	EP/CTOD
13	21TS3204	TECHNICAL SKILLING - 4 (SDC ELECTIVES)	SDC	A/P	0	1	4	4	4	9	DOMINE SPECIFIC
14	21CS3021	MACHINE LEARNING	PE-1	A/P	3	0	4	4	6	11	AIDS
15	21CS3022	SOFT COMPUTING	PE-2	P	3	0	4	0	5	7	AIDS
16	21CS3026	ARTIFICIAL NEURAL NETWORKS	PE-2	P	3	0	4	0	5	7	AIDS
17	21CS3120	MULTIMODEL INFORMATION PROCESSING	PE-2	P	3	0	4	0	5	7	MFC


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S. No	Course Code	Course Title	Category	Mode	L	T	P	S	Cr	CH	Pre-requisite
18	21CS3269	DEEP LEARNING	PE-3	A/P	3	0	4	4	6	11	ML
19	21CS3270	COGNITIVE COMPUTING	PE-4	P	3	0	4	0	5	7	AIDS
20	21CS3271	PERCEPTION AND COMPUTER VISION	PE-4	P	3	0	4	0	5	7	AIDS
21	21CS3278	DIGITAL VIDEO PROCESSING	PE-4	P	3	0	4	0	5	7	MFC
22	21CS3282	MACHINE LEARNING ON CLOUD	PE-4	P	3	0	4	0	5	7	ML
23	21CS3272	COMPUTATIONAL EPIDEMIOLOGY	PE-5	P	3	0	4	0	5	7	AIDS
24	21CS3273	NATURAL LANGUAGE PROCESSING	PE-5	P	3	0	4	0	5	7	AIDS
25	21CS3274	SPEECH PROCESSING	PE-5	P	3	0	4	0	5	7	AIDS
26	21CS3292	DESIGN & MANAGEMENT OF DISTRIBUTED APPLICATIONS FOR AI ON CLOUD	PE-5	P	3	0	4	0	5	7	CIS
27	21CS3293	ARCHITECTING DEEP LEARNING WORKLOADS ON CLOUD	PE-5	P	3	0	4	0	5	7	AIDS& CIS
28	21CS3051	DATA VISUALISATION TECHNIQUES	PE-1	A/P	3	0	4	4	6	11	DBMS
29	21CS3052	DATA WAREHOUSING & MINING	PE-2	P	3	0	4	0	5	7	DBMS
30	21CS3275	BIG DATA ANALYTICS	PE-3	A/P	3	0	4	4	6	11	DBMS
31	21CS3276	BIG DATA OPTIMIZATION	PE-4	P	3	0	4	0	5	7	DBMS
32	21CS3277	BIOINFORMATICS	PE-4	P	3	0	4	0	5	7	DAA
33	21CS3283	DATA ANALYTICS ON CLOUD	PE-4	P	3	0	4	0	5	7	AIDS
34	21CS3284	DIGITAL MEDIA ANALYTICS	PE-4	P	3	0	4	0	5	7	AIDS
35	21CS3279	ADVANCED DATABASES	PE-5	P	3	0	4	0	5	7	DBMS
36	21CS3289	BUSINESS ANALYTICS	PE-5	P	3	0	4	0	5	7	DBMS
37	21CS3280	GRAPH & WEB ANALYTICS	PE-5	P	3	0	4	0	5	7	AIDS
38	21CS3294	DATA GOVERNANCE ON CLOUD	PE-5	P	3	0	4	0	5	7	NIL
39	21CS3037	CLOUD INFRASTRUCTURE & SERVICES	PE-1	A/P	3	0	4	4	6	11	NIL
40	21CS3032	ADVANCED OPERATING SYSTEMS	PE-2	P	3	0	4	0	5	7	OS
41	21CS3036RA	FUNCTIONAL & CONCURRENT PROGRAMMING	PE-2	P	3	0	4	0	5	7	CTOD


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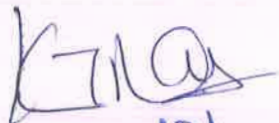
S. No	Course Code	Course Title	Category	Mode	L	T	P	S	Cr	CH	Pre-requisite
42	21CS3086	CLOUD DEVOPS	PE-2	P	3	0	4	0	5	7	SE
43	21CS3281	CLOUD & SERVERLESS COMPUTING	PE-3	A/P	3	0	4	4	6	11	NIL
44	21CS3251	ADVANCED COMPUTER ARCHITECTURE	PE-4	P	3	0	4	0	5	7	COA
45	21CS3252	PARALLEL ALGORITHMS	PE-4	P	3	0	4	0	5	7	OS / CTOD
46	21CS3287	CLOUD SECURITY	PE-4	P	3	0	4	0	5	7	OS & CNS
47	21CS3285	ARCHITECTING CLOUD SOLUTIONS*	PE-4	P	3	0	4	0	5	7	OS & CNS
48	21CS3253	EDGE COMPUTING	PE-5	P	3	0	4	0	5	7	OS
49	21CS3038	HIGH PERFORMANCE COMPUTING	PE-5	P	3	0	4	0	5	7	OS
50	21CS3290	DESIGN OF DISTRIBUTED APPLICATIONS ON CLOUD (DDA)	PE-5	P	3	0	4	0	5	7	OS
51	21CS3288	CLOUD NETWORKING	PE-5	P	3	0	4	0	5	7	OS
52	21CS3041	CRYPT ANALYSIS & CYBER DEFENSE	PE-1	A/P	3	0	4	4	6	11	CNS
53	21CS3042	NETWORK & INFRASTRUCTURE SECURITY	PE-2	P	3	0	4	0	5	7	CNS
54	21CS3045	INTRODUCTION TO BLOCKCHAIN & CRYPTO CURRENCIES	PE-2	P	3	0	4	0	5	7	CNS
55	21CS3259	DIGITAL FORENSICS	PE-3	A/P	3	0	4	4	6	11	CACD
56	21CS3260	DATABASE & SYSTEM SECURITY	PE-4	P	3	0	4	0	5	7	DBMS
57	21CS3261	PROGRAMMING FOR SMART CONTRACTS	PE-4	P	3	0	4	0	5	7	IBCC
58	21CS3262	SECURE SOFTWARE ENGINEERING	PE-5	P	3	0	4	0	5	7	SE
59	21CS3264	WEB SECURITY	PE-5	P	3	0	4	0	5	7	CNS
60	21CS3291	SECURITY GOVERNANCE & MANAGEMENT	PE-5	P	3	0	4	0	5	7	NIL
61	21CS3062	SOFTWARE VERIFICATION & VALIDATION	PE-1	A/P	3	0	4	4	6	11	SE
62	21CS3064	UX DESIGN	PE-2	P	3	0	4	0	5	7	DTI
63	21CS3065	DESIGN PATTERNS & CLEAN CODING TECHNIQUES	PE-2	P	3	0	4	0	5	7	CTOD
64	21CS3256	CONTINUOUS DELIVERY & DEVOPS	PE-3	A/P	3	0	4	4	6	11	SE
65	21CS3257	SOFTWARE PROJECT MANAGEMENT	PE-4	P	3	0	4	0	5	7	SE


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S. No	Course Code	Course Title	Category	Mode	L	T	P	S	Cr	CH	Pre-requisite
66	21CS3231	VISUAL PROGRAMING	PE-4	P	3	0	4	0	5	7	CTOD
67	21CS3295	SOFTWARE ARCHITECTURE & DESIGN	PE-5	P	3	0	4	0	5	7	SE
68	21CS3258	SOFTWARE RELIABILITY	PE-5	P	3	0	4	0	5	7	SE
69	21CS3255	CROSS-PLATFORM DEVELOPMENT FRAMEWORKS	PE-5	P	3	0	4	0	5	7	CTOD
70	21CS3071	PROGRAMMING FOR GAME DEVELOPMENT	PE-1	A/P	3	0	4	4	6	11	OS
71	21CS3266	AR & VR APPLICATION DEVELOPMENT	PE-3	A/P	3	0	4	4	6	11	OS
72	21CS3296	COMPUTER GRAPHICS	PE-4	P	3	0	4	0	5	7	NIL
73	21CS3297	3D MODELLING & ANIMATION	PE-4	P	3	0	4	0	5	7	NIL
74	21CS3268	PRINCIPLES OF GAME DESIGN	PE-5	P	3	0	4	0	5	7	NIL
75	21CS3267	BUSINESS OF GAMES & ENTREPRENEURSHIP	PE-5	P	3	0	4	0	5	7	NIL
76	21CS3117	IOT SENSING AND ACTUATING DEVICES	PE-1	A/P	3	0	4	4	6	11	NIL
77	21CS3118	INTERNET OF THINGS: ARCHITECTURES AND PROTOCOLS	PE-2	P	3	0	4	0	5	7	CNS
78	21CS3298	CYBER PHYSICAL SYSTEMS	PE-3	A/P	3	0	4	4	6	11	CNS
79	21CS3299	FOUNDATIONS OF HYBRID AND EMBEDDED SYSTEMS	PE-4	P	3	0	4	0	5	7	NIL
80	21CS3250	CLOUD COMPUTING FOR IOT ENGINEERS	PE-5	P	3	0	4	0	5	7	NIL
81	21CS3265	WIRELESS SENSOR NETWORKS	PE-5	P	3	0	4	0	5	7	CNS
82	21CS3064RA	UX DESIGN	FXC	P	3	0	4	0	5	7	DTI
83	21CS3060RA	CONTINUOUS DELIVERY & DEVOPS	FXC	P	3	0	4	0	5	7	SE
84	21CS3116RA	SIGNAL PROCESSING	FXC	P	3	2	2	0	6	7	MFC
85	21CS3039RA	CLOUD INFRASTRUCTURE & SERVICES	FXC	P	3	0	4	0	5	7	OS & CNS
86	21CS3015RA	EMBEDDED SYSTEMS	FXC	P	3	0	4	0	5	7	COA
87	21CS3232R	MACHINE LEARNING	FXC	P	3	0	4	0	5	7	IAD
88	21CS3133RA	DATA VISUALIZATION TECHNIQUES	FXC	P	3	0	4	0	5	7	DBMS
89	21CS3255RA	CROSS-PLATFORM DEVELOPMENT FRAMEWORKS	FXC	P	3	0	4	0	5	7	EP


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S. No	Course Code	Course Title	Category	Mode	L	T	P	S	Cr	CH	Pre-requisite
90	21CS3234RA	APPLICATION DEVELOPMENT ON CLOUD	FXC	P	3	0	4	0	5	7	EP
91	21CS3235RA	SOLUTIONS ARCHITECTING ON CLOUD	FXC	P	3	0	4	0	5	7	OS & CNS
92	21CS3231RA	VISUAL PROGRAMING	FXC	P	3	0	4	0	5	7	CTOD
93	21CS3279RA	ADVANCED DATABASES	FXC	P	3	0	4	0	5	7	DBMS
94	21CS3045RA	INTRODUCTION TO BLOCKCHAIN AND CRYPTO CURRENCIES	FXC	P	3	0	4	0	5	7	NIL
95	21CS3042RA	NETWORK & INFRASTRUCTURE SECURITY	FXC	P	3	0	4	0	5	7	CNS
96	21CS3119RA	INTERNET OF THINGS	FXC	P	3	0	4	0	5	7	NIL
97	21CS3204RA	COMPILER DESIGN	FXC	P	3	0	4	0	5	7	ATFL
98	21CS3043RA	QUANTUM COMPUTING	FXC	P	3	0	4	0	5	7	MFC
99	21CS3061RA	AUTOMATA THEORY AND FORMAL LANGUAGES	FXC	P	3	1	2	0	5	6	Nil
100	21CS3066RA	SOFTWARE VERIFICATION & VALIDATION	FXC	P	3	0	4	0	5	7	SE
101	21CS3016RA	.NET PROGRAMMING (EPAM)	FXC	A/P	3	0	4	0	5	7	NIL
102	21CS3017RA	FRONT END WEB DEVELOPMENT (EPAM)	FXC	A/P	3	0	4	0	5	7	NIL
103	21CS3018RA	SOFTWARE TESTING (EPAM)	FXC	A/P	3	0	4	0	5	7	NIL
104	21CS3019RA	CLOUD DEVOPS (EPAM)	FXC	A/P	3	0	4	0	5	7	NIL
105	21TS3292RA	TS-SDP4 (CLOUD DEVOPS)	TS-DPS	P	0	1	4	4	4	9	SE, OOP
106	21TS3291RA	TS-SDP4 (CLOUD BASED SOLUTIONS ARCHITECT)	TS-CEC	P	0	1	4	4	4	9	CIS
107	21TS3293RA	TS-SDP4 (CLOUD BASED SECURITY SPECIALITY)	TS-CYS	P	0	1	4	4	4	9	CNS
108	21TS3294RA	TS-SDP4 (CERTIFIED GAME DEVELOPER)	TS-GUX	P	0	1	4	4	4	9	PGD
109	21TS3295RA	TS SDP-4 (CLOUD BASED AI/ML SPECIALITY)	TS-AI	P	0	1	4	4	4	9	AIDS
110	21TS3296RA	TS SDP-4 (CLOUD BASED DATA ANALYTICS SPECIALITY)	TS-BDA	P	0	1	4	4	4	9	AIDS
111	21TS3290RA	TS-SDP4 (CLOUD BASED IOT DEVELOPER)	TS-IOT	P	0	1	4	4	4	9	NIL
112	21TS3297RA	TS-SDP4 (IT VENTURE MANAGEMENT)	TS-ITVM	A/P	0	1	4	4	4	9	NIL


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Koneru Lakshmaiah Education Foundation

(Category -1, Deemed to be University estd- u/s. 3 of the UGC Act, 1956)

Accredited by NAAC as 'A++' Approved by AICTE ISO 21001:2018 Certified

Campus: Green Fields, Vaddeswaram - 522 302, Guntur District, Andhra Pradesh, INDIA

Phone No. +91 8645 - 350 200; www.klef.ac.in; www.klef.edu.in; www.kluniversity.in


Admin Off: 29-26-30, Museum Road, Government, Vijayawada - 520 002, Ph: +91 -886 - 3500122, 2576129

Annexure-VIII


DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

2021-22 VALUE ADDED COURSES

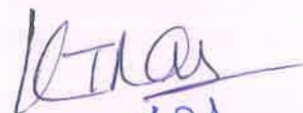
Sl No	Course Code	Course Title	L	T	P	S	Cr
1	21CC3000	AWS CERTIFIED CLOUD PRACTITIONER (CLF-C01)	0	0	0	4	0
2	21CC3010	MICROSOFT CERTIFIED: AZURE DEVELOPER ASSOCIATE (AZ-204)	0	0	0	4	0
3	21CC3011	MICROSOFT CERTIFIED: AZURE FUNDAMENTALS (AZ-900)	0	0	0	4	0
4	21CC3020	MONGODB CERTIFIED DBA ASSOCIATE LEVEL (C100DBA)	0	0	0	4	0
5	21CC3021	MONGODB CERTIFIED DEVELOPER ASSOCIATE (C100DEV)	0	0	0	4	0
6	21CC3040	RED HAT CERTIFIED ENTERPRISE APPLICATION DEVELOPER	0	0	0	4	0
7	21CC3001	AWS CERTIFIED DEVELOPER ASSOCIATE	0	0	0	4	0
8	21CC3002	AWS CERTIFIED SOLUTIONS ARCHITECT ASSOCIATE	0	0	0	4	0
9	21CC3012	MICROSOFT CERTIFIED: AZURE AI FUNDAMENTALS (AI-900)	0	0	0	4	0
10	21CC3030	CODECHEF CERTIFIED DSA (CCDSAP-FOUNDATION LEVEL)	0	0	0	4	0
11	21CC3223	PCAP™ - CERTIFIED ASSOCIATE IN PYTHON PROGRAMMING	0	0	0	4	0
12	21CC3224	C++ CERTIFIED ASSOCIATE PROGRAMMER (CPA)	0	0	0	4	0
13	21CC3225	C PROGRAMMING LANGUAGE CERTIFIED ASSOCIATE (CLA)	0	0	0	4	0
14	21CC3226	CODECHEF CERTIFIED DATA STRUCTURE & ALGORITHMS PROGRAMME	0	0	0	4	0
15	21CC3063	WIPRO TALENT NEXT JAVA FULL STACK CERTIFICATION	0	0	0	4	0
16	21CC3062	WIPRO TALENT NEXT J2EE CERTIFICATION	0	0	0	4	0
17	21CC3015	TENSORFLOW DEVELOPER CERTIFICATE	0	0	0	4	0


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Sl No	Course Code	Course Title	L	T	P	S	Cr
18	21CC3227	SERVICENOW CERTIFIED SYSTEM ADMINISTRATOR	0	0	0	4	0
19	21CC3228	SERVICENOW CERTIFIED DEVELOPER	0	0	0	4	0
20	21CC3229	SALESFORCE ADMINISTRATOR CERTIFICATION EXAM (CRT101)	0	0	0	4	0
21	21CC3230	SALESFORCE DEVELOPER CERTIFICATION EXAM	0	0	0	4	0
22	21CC3231	PEGA CERTIFIED SYSTEM ARCHITECT	0	0	0	4	0
23	21CC3232	PEGA CERTIFIED SENIOR SYSTEM ARCHITECT	0	0	0	4	0
24	21CC3058	PALO ALTO NETWORKS CERTIFIED CYBERSECURITY ENTRY-LEVEL TECHNICIAN (PCCT)	0	0	0	4	0
25	21CC3233	ORACLE CLOUD INFRASTRUCTURE CERTIFICATION	0	0	0	4	0
26	21CC3234	MULESOFT CERTIFIED DEVELOPER	0	0	0	4	0
27	21CC3235	MONGODB ASSOCIATE DBA EXAM	0	0	0	4	0
28	21CC3016	MONGODB ASSOCIATE DEVELOPER EXAM	0	0	0	4	0
29	21CC3236	MICROSOFT CERTIFIED: DEVOPS ENGINEER EXPERT (AZ-400)	0	0	0	4	0
30	21CC3237	MICROSOFT CERTIFIED: AZURE SOLUTIONS ARCHITECT EXPERT	0	0	0	4	0
31	21CC3238	MICROSOFT CERTIFIED: AZURE AI ENGINEER ASSOCIATE	0	0	0	4	0
32	21CC3239	MICROSOFT CERTIFIED: AZURE NETWORK ENGINEER ASSOCIATE	0	0	0	4	0
33	21CC3240	MICROSOFT CERTIFIED: AZURE SECURITY ENGINEER ASSOCIATE	0	0	0	4	0
34	21CC3241	MICROSOFT CERTIFIED: AZURE DATA ENGINEER ASSOCIATE	0	0	0	4	0
35	21CC3061	JUNIPER NETWORKS CERTIFIED ASSOCIATE, JUNOS(JNCIA-JUNOS)	0	0	0	4	0
36	21CC3242	GOOGLE CLOUD ASSOCIATE CLOUD ENGINEER (GCP-ACE)	0	0	0	4	0
37	21CC3243	CAMBRIDGE ASSESSMENT ENGLISH BEC-PRELIMINARY	0	0	0	4	0
38	21CC3244	AWS CERTIFIED SOLUTIONS ARCHITECT - ASSOCIATE (AWS-SAA)	0	0	0	4	0
39	21CC3010	AWS CERTIFIED DEVELOPER - ASSOCIATE (AWS-DA)	0	0	0	4	0


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Sl No	Course Code	Course Title	L	T	P	S	Cr
40	21CC3000	AWS CERTIFIED CLOUD PRACTITIONER (AWS-CP)	0	0	0	4	0
41	21CC3245	AWS CERTIFIED MACHINE LEARNING SPECIALITY	0	0	0	4	0
42	21CC3246	AWS CERTIFIED DATABASE SPECIALITY	0	0	0	4	0
43	21CC3247	AWS CERTIFIED SECURITY SPECIALITY	0	0	0	4	0
44	21CC3248	AWS CERTIFIED DATA ANALYTICS SPECIALITY	0	0	0	4	0
45	21CC3249	AWS CERTIFIED ADVANCED NETWORKING SPECIALITY	0	0	0	4	0
46	21CC3250	AWS CERTIFIED DEVOPS ENGINEER PROFESSIONAL	0	0	0	4	0
47	21CC3251	AWS CERTIFIED SOLUTIONS ARCHITECT PROFESSIONAL	0	0	0	4	0
48	21CC3252	AVIATRIX CERTIFIED ENGINEER MULTI-CLOUD NETWORKING ASSOCIATE (ACE-MCNA)	0	0	0	4	0
49	21CC3253	CERTIFIED ETHICAL HACKER (CEH)	0	0	0	4	0
50	21CC3254	AUTOMATION ANYWHERE RPA CERTIFICATION	0	0	0	4	0
51	21CC3255	PEN-200 PENETRATION TESTING OFFENSIVE SECURITY CERTIFICATION	0	0	0	4	0


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Ph.D. Course work
Pre-Ph.D. Examination Syllabus



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VADDESARAM - 522502, ANDHRA PRADESH, INDIA.

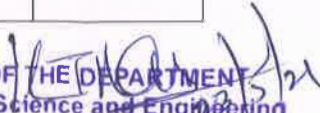

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Pre-PhD

Subjects List - Computer Science and Engineering

LTPS: 3-0-0-0

Subject Code	PAPER 2	New/Revised	Subject Code	PAPER 3	New/Revised
21CS201	Information Retrieval System	80%-Revision Considered as new course	21CS301	Big Data Analytics	Retained
21CS202	Data Ware Housing And Mining	Retained	21CS302	Cloud Computing	Retained
21CS203	Computer Networks	Retained	21CS303	Distributed Databases	Retained
21CS204	Data Center Virtualization	Retained	21CS304	Research Foundations for Pattern Recognition	80%-Revised Considered as new course
21CS205	Network Security	Retained	21CS305	Soft Computing	Retained
21CS206	Evolution of Software Architectures	New	21CS306	Software Engineering	Retained
21CS207	Software Testing And Quality Assurance	Retained	21CS307	Cryptography & Network Security	80%-Revised Considered as new course
21CS208	Foundations of Data Science for Extensive Research	New	21CS308	Web Security	Retained
21CS209	Advanced Data Structures	Retained	21CS309	Wireless Sensor Networks	Retained
21CS210	Digital Image Processing	60%-Revision considered as new Course	21CS310	Software Project Management	Retained
21CS211	Bio-Informatics	Retained	21CS311	Artificial Intelligence	Retained
21CS212	Software Reliability	Retained	21CS312	Virtual and Augmented Reality	New
21CS213	Deep Learning	Retained	21CS313	Data Security & Privacy	Retained
21CS214	Distributed Computing	Retained	21CS314	Wireless Communication and Mobile Computing	Retained
21CS215	Mobile Cloud	Retained	21CS315	Parallel Algorithms	Retained
21CS216	Financial Engineering & Business Intelligence	New	21CS316	Blockchain and Cryptocurrencies	New
21CS217	Quantum computing	New	21CS317	Machine Learning	Retained
21CS218	Object Oriented Analysis and Design	New	21CS318	Speech Processing	New
21CS219	Advances in Computing	Retained	21CS319	Natural Language Processing	Retained
21CS220	Signal Processing	New	21CS320	Cloud Security	Retained
21cs221	Artificial Neural Networks	New	21CS321	Cognitive Computing	Retained


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Information Retrieval

Unit-1:

Introduction to Information Retrieval: The nature of unstructured and semi-structured text. Inverted index and Boolean queries.

Text Indexing, Storage and Compression: Text encoding: tokenization, stemming, stop words, phrases, index optimization. Index compression: lexicon compression and postings lists compression. Gap encoding, gamma codes, Zipf's Law. Index construction. Postings size estimation, merge sort, dynamic indexing, positional indexes, n-gram indexes.

Unit-2:

Retrieval Models: Boolean, vector space, TFIDF, Okapi, probabilistic, language modeling, latent semantic indexing. Vector space scoring. The cosine measure. Efficiency considerations. Document length normalization. Relevance feedback and query expansion. Rocchio.

Unit-3:

Performance Evaluation: Evaluating search engines. User happiness, precision, recall, F-measure. Creating test collections: kappa measure, interjudge agreement.

Text Clustering: Clustering versus classification. Partitioning methods. k-means clustering. Mixture of gaussians model. Hierarchical agglomerative clustering. Clustering terms using documents.

Unit-4:

Text Categorization and Filtering: Introduction to text classification. Naive Bayes models. Spam filtering. Vector space classification using hyperplanes; centroids; k Nearest Neighbors. Support vector machine classifiers. Kernel functions. Boosting.

Unit-5:

Web Information Retrieval: Hypertext, web crawling, search engines, ranking, link analysis, PageRank, HITS.

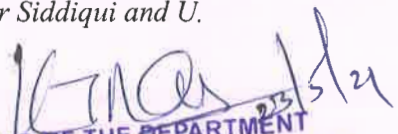
Retrieving Structured Documents: XML retrieval, semantic web

Text Books:

1. **Introduction to Information Retrieval** by Christopher D. Manning

Reference Book:

2. **Natural Language Processing and Information Retrieval** by *Tanveer Siddiqui and U. S. Tiwary*


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DATA WARE HOUSING & DATA MINING

Syllabus

UNIT – I

The compelling need for data warehousing: Escalating need for strategies information, Failures of Past Decision-Supporting System, Operational Versus Decision-Supporting System, Data Warehousing- The only Viable Solution, data Warehouse Defined. The Building Blocks: Defining Features, Data Warehouse and Data Marts, Overview of the Components, Metadata in the Data Warehouse. Planning and Planning Management: Planning your Data Warehousing, The Data Warehouse Project, The project team, Project Management Considerations. Defining the Business Requirement: Dimension Analysis, Information Package- A New Concept, Requirements Gathering Methods, Requirements Definition: Scope and content. Requirements as the Driving force for Data Warehousing: Data Design, The Architectural Plan, Data Storage Specification, and Information Delivery Strategy.

UNIT – II


The Architectural Component: Understanding Data Warehouse Architecture, Distinguishing Characteristics, Architectural framework, Technical Architecture. Infrastructure as the Foundation for Data Warehousing: Infrastructure Support Architecture, Hardware Operational System, Database Software, Collection of Tools. The Significant Role of Metadata: Why Metadata is Important, Metadata Types by Functional Areas, Business Metadata, How to Provide Metadata. Principles of Dimensional Modeling: From Requirement to Data Design, The STAR Schema, STAR Schema keys, Advantages of STAR Schema. Dimensional Modeling: Updates to the Dimensional Tables, Miscellaneous Dimensions, The Snowflake Schema, Aggregate Fact Tables, and Families of STARS. Data Extraction, Transformation, and Loading. OLAP in the Data Warehouse: Demand for Online Analytical Processing, Major Features and Functions, OLAP Models, OLAP Implementation Consideration

UNIT – III

Introduction : Data mining, kinds of data mined, kinds of patterns mined, technologies used: statistics, Machine learning, Database systems and Data Warehousing, Information Retrieval, Major issues in Data Mining: Mining methodology, User Interaction, Efficiency and Scalability, Diversity and database types, Data Mining & society.

UNIT – IV

Data Preprocessing: Overview, Data cleaning, Data Integration, Data Reduction, Data Transformation, Data cleaning: Missing Values, Noisy data, Data cleaning as a process. Data Integration: Entity identification problem, Redundancy and Correlation Analysis, Tuple duplication, Data value conflict detection and Resolution. Data Reduction: Overview, wavelet transforms, Principle components Analysis, Attribute subset selection, Regression and log-linear models, Histograms, clustering, sampling, Data cube Aggregation. Data Transformation and Data Discretization by Binning, Discretization by Histogram Analysis, Discretization by cluster, Decision Tree and correlation Analysis, concept Hierarchy generation for Nominal data.


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UNIT – V


Mining Frequent Patterns, Association and Correlations: Basic Concepts, Frequent itemset Mining methods: Apriori Algorithm, Generate Association rules from Frequent itemsets, Improving the efficiency of Apriori, A pattern-growth approach for mining frequent itemsets, using frequent itemset using Vertical data format, Mining closed and max. patterns. Pattern Evaluation Methods, Advanced Pattern Mining: A Road map, Pattern mining in Multilevel, Multidimensional space, Constraint Based Frequent Mining, Classification: Basic Concepts, Decision Tree induction, Bayes Classification Method, Rule based Classification, Model evaluation & selection, techniques to improve classification accuracy. Classification Advanced Methods: Bayesian Belief networks, Classification by Back Propagation, Support Vector Method, Classification using frequent Patterns, lazy learners, other classification methods. Cluster Analysis: Basic Concepts & Methods, Cluster Analysis, partitioning methods, Hierarchical Methods, Density based Methods, Grid based Methods, Evaluation of Clustering. Advanced Cluster Analysis: Probabilistic Model based Clustering, Clustering High Dimensional Data, Clustering Graph & Network data, Clustering & Constraints.

Textbooks:

1. Data warehousing fundamentals, first edition, paulraj ponniah, Wiley.
2. Data Mining Concept & Techniques, Jiawei Han|Micheline Kamber|Jian Pei, 3rd Edition, M K Publishers.

Reference Books:

1. Data Warehousing in the real world, low price edition, Sam Anahory, Dennis Murray, Pearson Education.
2. Data warehousing Tool kit
3. Data Mining Techniques: For Marketing, Sales, and Customer Relationship Management by Gordon S. Linoff and Michael J. Berry (Apr 12, 2011).
4. Data Mining: A Tutorial Based Primer by Richard Roiger and Michael Geatz (Oct 6, 2002).


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COMPUTER NETWORKS

SYLLABUS

UNIT I

Introduction: OSI, TCP/IP and other networks models, Examples of Networks: Novell Networks, Arpanet, Internet, Network Topologies WAN, LAN, MAN. Physical Layer : Transmission media copper, twisted pair wireless, switching and encoding asynchronous communications; Narrow band, broad band ISDN and ATM.

UNIT-II

Network Layer: Virtual circuit and Datagram subnets-Routing algorithm shortest path routing, Flooding, Hierarchical routing, Broad cast, Multi cast, distance vector routing.

UNIT-III

Dynamic routing – Broadcast routing. Rotary for mobility. Congestion, Control Algorithms – General Principles – of Congestion prevention policies. Internet working: The Network layer in the internet and in the ATM Networks.

UNIT-IV

Transport Layer: Transport Services, Connection management, TCP and UDP protocols; ATM AAL

Layer Protocol.

UNIT – V

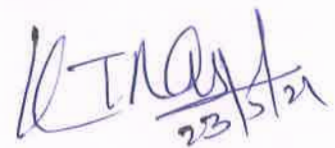
Application Layer – Network Security, Domain name system, SNMP, Electronic Mail; the World WEB, Multi Media.

TEXT BOOKS :

1. Computer Networks — Andrew S Tanenbaum, 4th Edition. Pearson Education/PHI
2. Data Communications and Networking – Behrouz A. Forouzan. Third Edition TMH.

REFERENCES:

1. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, Pearson Education
2. Understanding communications and Networks, 3rd Edition, W.A. Shay, Thomson



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DATA CENTRE VIRTUALIZATION

Syllabus

Unit I

Data Center Challenges: How server, desktop, network Virtualization and cloud computing reduce data centre footprint, environmental impact and power requirements by driving server consolidation; **Evolution of Data Centres:** The evolution of computing infrastructures and architectures from stand alone servers to rack optimized blade servers and unified computing systems (UCS).

Unit II

Enterprise-level Virtualization: Provision, monitoring and management of a virtual datacenter and multiple enterprise-level virtual servers and virtual machines through software management interfaces; **Networking and Storage in Enterprise Virtualized Environments:** Connectivity to storage area and IP networks from within virtualized environments using industry standard protocols.

Unit III

Virtual Machines & Access Control: Virtual machine deployment, modification, management, monitoring and migration methodologies.

Unit IV


Resource Monitoring: Physical and virtual machine memory, CPU management and abstraction techniques using a hypervisor.

Unit V

Virtual Machine Data Protection: Backup and recovery of virtual machines using data recovery techniques; **Scalability:** Scalability features within Enterprise virtualized environments using advanced management applications that enable clustering, distributed network switches for clustering, network and storage expansion; **High Availability :** Virtualization high availability and redundancy techniques.

Reference Books:

1. Mickey Iqbal 2010, IT Virtualization Best Practices: A Lean, Green Virtualized Data Center Approach, MC Press [ISBN: 978-1583473542]
2. Mike Laverick, VMware vSphere 4 Implementation [ISBN: 978-0071664523]
3. Jason W. McCarty, Scott Lowe, Matthew K. Johnson, VMware vSphere 4 Administration Instant Reference [ISBN: 978-0470520727]
4. Brian Perry, Chris Huss, Jeantet Fields, VCP VMware Certified Professional on vSphere 4 Study Guide [ISBN: 978-0470569610]
5. Brian Perry, Chris Huss, Jeantet Fields, VCP VMware Certified Professional on vSphere 4 Study Guide [ISBN: 978-0470569610]
6. Jason Kappel, Anthony Velte, Toby Velte, Microsoft Virtualization with Hyper-V: Manage Your Datacenter with Hyper-V, Virtual PC, Virtual Server, and Application Virtualization [ISBN: 978-0071614030]


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NETWORK SECURITY

Syllabus

Unit I:

Introduction to Network Security: Attacks, services, Security. A model of Inter network Security, Steganography, One time PADS. Basic and ESOTERIC Cryptographic Protocols: Key Exchange, Authentication, Formal Analysis of Authentication and key Exchange Protocols, Multiple & Public Key Cryptography, Secret Splitting & Sharing Secure elections, Secure multiparty, Communication, Digital Cash.

Unit II:

Crypto Graphic Algorithms (Block Cipher): RC2, GOST, CAST, BLOW FISH, SAFEER, RC5, NEWDES, CRAB, Theory of Block Cipher design. Key Management: Key lengths, Generating Keys, Transferring, Verification, Updating, Storing, Backup, Compromised, Lifetime of, Destroying Keys, Public key Management.

Unit III:

Digital Signature Algorithms: Digital Signature, DSA, DSA variants, Gost, Discrete Lagorithm, One – Schnorr – Shamir digital Signatures, Esign, Cellular Automata. Mails: Electronic Mail & IO Security good Privacy, SIMIME, IP Security Architecture, Authentication Header, Encapsulating Security, Pay load Key Management Issues.

Unit IV:

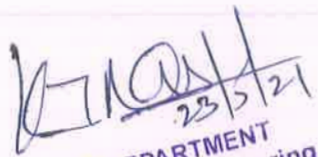
Security: Web Security Web Security requirements, Secure Sockets Layer and Transport Layer Security, Secure Electronic Transaction.

Unit V:

Viruses and Threats: Intruders, Viruses, Worms and Firewalls Intruders, Viruses and Related Threats, Firewall Design Principles, Trusted Systems.

REFERENCE BOOKS:

1. Applied Cryptography, 7/e, Bruce SCHNEIER John Wiley & Sons Inc.
2. Cryptography and Network Security, William Stallings, PHI.
3. Introduction to cryptography with coding Theory, 7/e, Wade Trappe, C. Washington, PEA.
4. Cryptography and Information Security, V.K. Pachghare, PHI.
5. Cryptography and Network Security, Forouzan, TMH, 2007.
6. Cryptography and Network Security, 2/e, Kahate , TMH.
7. Modern Cryptography, Wenbo Mao, PEA


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EVOLUTION OF SOFTWARE ARCHITECTURES

Syllabus

Unit-I – Introduction to Software Architecture

Meaning and Concept of Software Architecture - Definitions of Software Architecture- Characteristics - Types of Architectures..

Unit-II-Architectural Styles

Architectural styles and Technologies, Heterogeneity Layered Systems, Repositories, Pipes and Filters, Data Abstraction and Object Oriented Paradigm, Event – Based Implicit Invocation, Interpreters, Process Control ,Other familiar Architectures, Heterogeneous Architecture.

Unit-III-Software Architecture Design and Quality Aspects

Design spaces and rules for Interfaces, Work flow, Databases – Interoperability - Software Agents and Compatibility - Quality Attributes, Performance, Scalability, Modifiability, Integration, Application Security, Application Availability, Other Quality Attributes - Caveats.

Unit-IV- Common & Popular Architectures

N-Tier Architectures: 1-tier, 2-tier, 3-tier and Multi-tier Architectures – Advantages and disadvantages. Event-driven Architectures: Event flow - Simple and Multi-event Stream processing. Micro kernel Architectures: Components of Micro-kernel architecture – Managing Plug-in Modules. Space-based architectures: Components of Space-based architectures- Advantages.

Unit-V-Web Service-Oriented Architecture

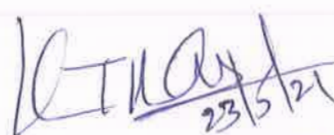
Evolution of SOA - Web Services- Principles – Building blocks of SOA-Service Description, Discovery and Delivery Strategies - SOAP – WSDL - SOA Business Process Design WS-BPEL language basics-WS Coordination – Specific Technologies that support SOA.

Text Books:

1. Mary Shaw and David Garlan, Software Architecture- Perspectives on an Emerging Discipline, Prentice-Hall of India, 2004.
2. Ian Gorton, Essential Software Architecture Springer International Edition -2006
3. Thomas Erl, "Service-Oriented Architecture: Concepts, Technology & Design", Pearson Education P Ltd 2008.

Reference Books:

1. Richard N. Taylor, Nenad Medvidovic, Eric Dashofy, "Software Architecture: Foundations, Theory, and Practice", Wiley, 2009.
2. Len Bass, Paul Clements, Rick Kazman: Software Architecture in Practice, 2/e, Pearson Education, 2003.
3. Thomas Erl, "SOA Principles Of Service Design" Pearson Exclusives 2007.
4. Tomas Erl and Grady Booch, "SOA Design Patterns" Printice Hall 2008.111


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SOFTWARE TESTING AND QUALITY ASSURANCE

Syllabus

Unit I

Introduction, Basics of Software Testing, Testing Principles, Goals, Testing Life Cycle, Phases of Testing, Defects, Defect Life Cycle, Defect Report, Test Plan(IEEE format), Importance of testing in software production cycle.

Unit II

Introduction, Need of black box testing, Black box testing Concept, Requirement Analysis, Test case design criteria, Testing Methods, requirement based testing, Positive & negative testing, Boundary value analysis, Equivalence Partitioning class, state based or graph based, cause effect graph based, error guessing, documentation testing & domain testing, design of test cases. Black-Box testing.

Unit III

Introduction, Need of white box testing, Testing types, Test adequacy criteria, static testing by humans, Structure - logic coverage criteria, Basis path testing, Graph metrics, Loop Testing, Data flow testing, Mutation Testing, Design of test cases. Testing of Object oriented systems, Challenges in White box testing.

Unit IV

Test organization, Structure of testing, Measurement tools, testing metrics: Type of metric – Project, Progress, Productivity, Metric plan, Goal Question metric model, Measurement in small & large system. Other Software Testing: GUI testing, Validation testing, Regression testing, Scenario testing, Specification based testing, Adhoc testing, Sanity testing, Smoke testing, Random Testing.

Unit V

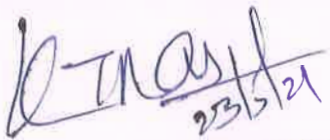
Software quality, Quality attribute, Quality Assurance, Quality control & assurance, Methods of quality management, Cost of quality, Quality management, Quality factor, Quality management & project management.

Text books:

1. Software Testing, Second Edition By: Ron Patton, Pearson Education ISBN-13: 978-0-672-32798-8
2. Software Testing Principles and Tools By M.G. Limaye TMG Hill Publication, ISBN 13:978-0-07-013990-9

References:

1. Metric and Model in Software Quality Engineering, By Stephen H Kan, Pearson Education ISBN 81-297-0175-8
2. Effective methods for software testing by William Perry , Willey Publication, ISBN 81-265-0893-0
3. Foundation of software testing by Dorothy Graham, Erik Van Veenendaal. CENGAGE learning , ISBN 978-81-315-0218-1


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Foundations of Data Science for Extensive Research

Unit I: Likelihood, Random variables, Random samples, Maximum likelihood estimation, likelihood profile, Rules for expectation and variance, Generating random variables, Empirical distribution, Monte Carlo estimation; law of large numbers, Central limit theorem.

Unit II: Inference: Estimation, confidence intervals, hypothesis testing, prediction. Bootstrap, Bayesianism. Regression (Linear and Multiple), Logistic regression, natural parameters.


Unit III: Feature spaces. Vector spaces, bases, inner products, projection. Model fitting as projection. Linear modeling. Choice of features.

Unit IV: Random processes. Markov chains. Stationarity and convergence. Drift models. Examples, including estimation and memory.

Unit V: Probabilistic modelling. Independence; joint distributions. Descriptive, discriminative, and causal models. Latent variable models. Random fields.

Reference Books :

1. Doing Data Science ,Straight talk from the front line- Rachel schutt&cathy o'neil ,o'reilly
2. Probability and Statistics for Data Science-Carlos Fernandez-Granda
3. Data Science and Big DataAnalytics: Discovering, Analyzing, Visualizing, and Presenting Data 1st Edition
4. Hands-On Exploratory DataAnalysis with Python, Suresh Kumar Mukhiya Usman Ahmed, Pack 5. Data Science & Big Data Analytics:Discovering, Analyzing, Visualizing and Presenting Data EMC Education Services, Willey


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ADVANCED DATA STRUCTURES

Syllabus

UNIT-I

Introduction: Algorithms, algorithms as a technology, Analyzing algorithms, Designing algorithms, Asymptotic notations, standard notations, common functions, Recurrences – substitution method, master method. **Sorting and order statistics:** Merge sort, Quick sort, Heap sort, sorting in linear time, Median and order statistics.

UNIT-II

Data structures: Elementary Data Structures – Linked lists, Stacks, Queues, Hash Tables – Direct address tables, Hash tables, Hash functions, Open addressing, Search Trees – Binary search trees, Red-Black Trees. **Advanced Data Structures:** B – Trees, Binomial Heaps, Fibonacci Heaps, Data Structures for Disjoint Sets

UNIT-III

Graph Algorithms: Elementary graph algorithms – Representation of graphs, BFS, DFS, Topological Sort, Strongly connected components, Minimum Spanning Trees – The algorithms of Kruskal and Prim's. Single-Source Shortest Paths: The Bellman-Ford algorithm, Single source shortest paths in DAG's, Dijkstra's algorithm, All-Pair Shortest paths – Shortest paths and Matrix multiplication, Floyd-Warshall algorithm. Maximum Flow: Flow networks, The Ford-Fulkerson method, Maximum Bipartite matching.

UNIT-IV

Advanced Design and Analysis Techniques: Greedy Algorithms – An activity – selection Problem, Elements of greedy strategy, Huffman codes. Dynamic Programming: Matrix Chain multiplication, Elements of dynamic programming, Optimal Binary Search Trees.

UNIT-V

String Matching: The naïve string matching algorithm, Rabin-Karp algorithm, Knuth-Morris-Pratt algorithm. **NP-Completeness:** Polynomial time, Verification, NP-Completeness and reducibility, NP-Completeness proofs, NP-Complete problems.

Textbooks:

1. Introduction to Algorithms, second edition, T.H.Cormen, C.E.Leiserson,R.L.Rivest, and C.Stein,PHI Pvt.Ltd./ Pearson Education

Reference Books:

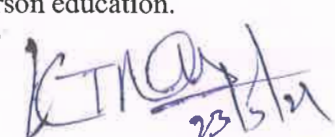
1. Algorithm Design: Foundations, Analysis and Internet examples, M.T.Goodrich and R.Tomassia, John wiley and sons.

2. Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahni and S.Rajasekharam, Galgotia publications pvt. Ltd.

3. Introduction to Design and Analysis of Algorithms A strategic approach, R.C.T.Lee, S.S.Tseng, R.C.Chang and T.Tsai, Mc Graw Hill.

4. Data structures and Algorithm Analysis in C++, Allen Weiss, Second edition, Pearson education.

5. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson education.


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DIGITAL IMAGE PROCESSING

UNIT I : Introduction :

Fundamental steps of image processing, components of an image processing of system. The image model and image acquisition, sampling and quantization, relationship between pixels, distance functions, scanner.

UNIT II : Transformation and Filtering :

Statistical and spatial operations, Intensity functions transformations, histogram processing, smoothing & sharpening, spatial filters Frequency domain filters, homomorphic filtering, image filtering & restoration. Inverse and weiner filtering, FIR weiner filter, Filtering using image transforms, smoothing splines and interpolation.

UNIT III : Segmentation and Edge Detection :

Segmentation and Edge detection region operations, basic edge detection, second order detection, crack edgedetection, gradient operators, compass and laplace operators, edge linking and boundary detection, thresholding, regionbased segmentation, segmentation by morphological watersheds.

UNIT IV : Pattern Recognition Fundamentals:

Basic Concepts of pattern recognition, Fundamental problems in pattern recognition system, design concepts and methodologies, example of automatic pattern recognitionsystems, a simple automatic pattern recognition model

UNIT V: Solar image processing and analysis


Automatic extraction of filaments-Local thresholding, global thresholding, feature extraction, experiment results, solar flare detection, future analysis and pre processing, classification rates, solar corona mass ejection detection.

TEXT BOOKS :

1. Digital Image Processing, 3/e,,Rafael C. Gonzalez, Richard E. Woods, PE
2. Fundamentals of Digital Image processing by Dr.Raju Anitha, Dr.Krishna Mohan & Mr.J.Satish Babu. Ed1, WN Publication.
3. Pattern recognition Principles, Julus T. Tou, and Rafel C. Gonzalez, Addison-Wesly
4. Image processing and pattern Recognition, Frank, Y.SHIH, Wiley publication

REFERENCE BOOKS:

5. Image Processing, Analysis and Machine Vision" by Milan Sonka and Vaclav Hlavac and Roger Boyle.
6. Principles of Digital Image Processing ,Wilhelm Burger, Mark J. Burge


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BIO-INFORMATICS

Syllabus

UNIT I:

INTRODUCTION: The Central Dogma, The Killer Application, Parallel Universes – Watson's Definition – Top Down Versus Bottom up – Information Flow , Convergence Databases , Data Management , Data Life Cycle , Database Technology , Interfaces Implementation.

UNIT II:

NETWORKS: Networks , Geographical Scope , Communication Models , Transmissions Technology , Protocols ,Bandwidth , Topology , Hardware , Contents , Security , Ownership Implementation , Management. **SEARCH ENGINES:** The search process , Search Engine Technology , Searching and Information Theory , Computational methods , Search Engines and Knowledge Management.

UNIT III:

DATA VISUALIZATION: Data Visualization , sequence visualization , structure visualization , user Interface , Animation Versus simulation , General Purpose Technologies. **STATISTICS:** Statistical concepts , Microarrays , Imperfect Data , Randomness Variability, Approximation , Interface Noise , Assumptions , Sampling and Distributions , Hypothesis Testing , Quant ifying Randomness , Data Analysis , Tool selection statistics of Alignment

UNIT IV:

DATA MINING: Clustering and Classification , Data Mining , Methods , Selection and Sampling , Preprocessing and Cleaning , Transformation and Reduction , Data Mining Methods , Evaluation , Visualization , Designing new queries , Pattern Recognition and Discovery , Machine Learning , Text Mining , Tools.


PATTERN MATCHING: Pairwise sequence alignment , Local versus global alignment Multiple sequence alignment ,Computational methods , Dot Matrix analysis , Substitution matrices , Dynamic Programming , Word methods , Bayesian methods , Multiple sequence alignment , Dynamic Programming , Progressive strategies , Iterative strategies , Tools Nucleotide Pattern Matching , Polypeptide pattern matching , Utilities , Sequence Databases.

UNIT - V:

MODELING AND SIMULATION: Drug Discovery , components , process , Perspectives, Numeric considerations , Algorithms , Hardware Issues , Protein structure , AbInitio Methods,Heuristic methods , Systems Biology , Tools , Collaboration and Communications, standards , Issues , Security , Intellectual property.

REFERENCE BOOKS

1. Bio Informatics Computing, Bryan Bergeron, PHI, 2003.
2. Introduction to Bio Informatics, Attwood, Smith, Longman, 1999. CSE / Pre PhD R1032
3. Bio-Informatics, D Srinivasa Rao, Biotech.
4. Bio Informatics Computing, Bergeron, PHI
5. Bio Informatics, Managing scientific Data, Lacroix, Terence Critchlow, Elsevier
6. Bio Informatics Methods and Applications, Rastogi, Mendiratta, Rastogi, PHI


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SOFTWARE RELIABILITY

Syllabus

UNIT - 1 INTRODUCTION TO RELIABILITY ENGINEERING

Reliability — Repairable and Non Repairable systems — Maintainability and Availability — Designing for higher reliability — Redundancy — MTBF — MTTF MDT - MTTR— k out of n Systems.

UNIT - 2 SOFTWARE RELIABILITY

Software reliability - Software reliability Vs Hardware reliability – Failures and Faults - Classification of Failures – Counting – System Configuration – Components and Operational Models – Concurrent Systems – Sequential Systems – Standby Redundant systems.

UNIT - 3 SOFTWARE RELIABILITY APPROACHES

Fault Avoidance — Passive Fault detection — Active Fault Detection — Fault Tolerance - Fault Recovery - Fault Treatment.

UNIT - 4 SOFTWARE RELIABILITY MODELING

Introduction to Software Reliability Modeling – Parameter Determination and Estimation - Model Selection – Markovian Models – Finite and Infinite failure category Models – Comparison of Models – Calendar Time Modeling.

UNIT - 5 SPECIAL TOPICS IN SOFTWARE RELIABILITY

Management Techniques for reliability - Organization and Staffing — Programming Languages and Reliability — Computer Architecture and Reliability — Proving Program correctness & Reliability Design - Reliability Testing – Reliability Economics.

TEXT BOOKS

1. John D. Musa, “ Software Reliability”, McGraHill, 1985
2. Glenford J. Myers, “Software Reliability “, Wiley Interscience Publication, 1976

REFERENCE BOOKS

1. Patric D. T.O connor,” Practical Reliability Engineering” , 4th Edition, John Wesley & sons , 2003.
2. Anderson and PA Lee : “ Fault tolerance principles and Practice “, PHI ,1981
3. Pradhan D K (Ed.): “ Fault tolerant computing – Theory and Techniques”, Vol1 and Vol 2 , Prentice hall, 1986.
4. E.Balagurusamy ,” Reliability Engineering”, Tata McGrawHill, 1994.



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Deep Learning

Syllabus:

Unit 1: Feed forward networks and training, Machine learning vs and Deep learning, Activation functions, initialization, regularization, batch normalization, model selection, ensemble techniques

Unit II: Convolutional neural networks , Fundamentals, architectures, pooling, visualization Deep learning for spatial localization, Transposed convolution, efficient pooling, object detection, semantic segmentation. Recurrent neural networks

Unit III: Recurrent neural networks (RNN), long-short term memory (LSTM), language models, machine translation, image captioning, video processing, visual question answering, video processing, and learning from descriptions

Unit IV: Deep generative models • Boltzmann Machine and Auto-encoders, variational auto-encoders, generative adversarial networks, autoregressive models, generative image models.

Unit V: Deep reinforcement learning, Temporal difference learning, Policy gradient methods, Q-learning, Deep Q-Learning

Textbook:

1. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016. <http://www.deeplearningbook.org>.

Reference Book:

1) François Chollet , Deep learning with Python, 2017 Manning publications



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DISTRIBUTED COMPUTING

Syllabus

Unit I: Introduction to distributed programming: Anatomy of a Distributed Application, Requirements for Developing Distributed Applications, What Does Java Provide? Introduction to sockets programming: Sockets and Streams, URLs, URL Connections, and Content Handlers, The Class Loader.

Unit II: Distributing Objects: Why Distribute Objects, What's So Tough About Distributing Objects?, Features of Distributed Object Systems, Distributed Object Schemes for Java, CORBA, Java RMI, RMI vs. CORBA Threads: Thread and Runnable, Making a Thread, Managing Threads at Runtime, Networked Threads

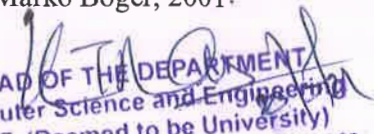
Unit III: Security: Security Issues and Concerns, The java.security Package, Identities and Access Control, Keys: Public, Private, and Secret, Digital Signatures, Data Encryption, Choosing a Cryptographic Algorithm. Message-Passing Systems: Messages Defined, Why Do We Need Messages?, Message Processing, Fixed Protocols, Adaptable Protocols, Message Passing with Java Events, Using Remote Objects Databases: An Overview of JDBC, Remote Database Applications, Multi-Database Applications.

Unit IV: RMI: The Basic Structure of RMI, The Architecture Diagram Revisited, Implementing the Basic Objects, The Rest of the Server, The Client Application The RMI Registry: Why Use a Naming Service? The RMI Registry, The RMI Registry Is an RMI Server, Examining the Registry, Limitations of the RMI Registry, Security Issues Naming Services: Basic Design, Terminology, and Requirements, Requirements for Our Naming Service, Federation and Threading, The Context Interface, The Value Objects, ContextImpl, Switching Between Naming Services, The Java Naming and Directory Interface (JNDI) The RMI Runtime: Reviewing the Mechanics of a Remote Method Call, Distributed Garbage Collection, RMI's Logging Facilities, Other JVM Parameters

Unit V: Service Oriented Architecture: Introduction, Defining a Service, Defining SOA, Identifying Service Candidates, Identifying Different Kinds of Services, Modeling Services, Making a Service Composable, Supporting Your SOA Efforts, Selecting a Pilot Project, Establishing Governance. Introduction to Web Services: Introduction, Using Publicly Available Web Services to Test Against, Installing Metro, Installing Oracle WebLogic, Creating and Deploying the Simplest Web Service, Creating and Deploying a Service to WebLogic, Setting Up a Maven 2 Service and Client Project, Understanding WSDL, Using References in NetBeans to Generate Web Service Clients, Monitoring SOAP Traffic with Metro, Monitoring SOAP, Traffic with TCPMon.

REFERENCE BOOKS:

1. Java Distributed Computing, Jim Farley, O'Reilly.
2. Java RMI Designing and Building, The Basics of RMI Applications, William Grosso, O'Reilly.
3. Java SOA Cookbook SOA Implementation Recipes, Tips, Techniques, Eben Hewitt, O'Reilly, 2009.
4. Service Oriented Architecture With Java, Malhar Barai, Vincenzo Caselli, Binildas A. Christudas, Packt Publishing, 2008.
5. Distributed Programming with Java, Qusay H. Mahmoud, Manning Publisher 2000.
6. Java in Distributed Systems, Concurrency, Distribution and Persistence, Marko Boger, 2001.


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MOBILE CLOUD

Syllabus

Unit-I

Mobile Connectivity Evolution: From Single to Multiple Air Interface Devices, Network Evolution: The Need for Advanced Architectures.

Unit-II

Mobile Clouds: An Introduction, Cooperation and Cognition in Mobile Clouds, Mobile Cloud Classification and Associated Cooperation Approaches.

UNIT-III

Sharing Device Resources in Mobile Clouds, Wireless Communication Technologies, Building Mobile Clouds.

UNIT-IV

Mobile Cloud Formation and Maintenance, Cooperative Principles by Nature, Social Mobile Clouds, Green Mobile Clouds: Making Mobile Devices More Energy Efficient.

UNIT-V

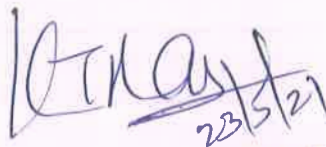
Mobile Clouds Applications, Future Developments of Mobile Clouds.

Text Book:

1. Frank H. P. Fitzek, Marcos D. Katz, Mobile Clouds: Exploiting Distributed Resources in Wireless, Mobile and Social Networks, Wiley Publications, ISBN: 978-0-470-97389-9, Jan 2014.

References

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, and Michael Morgano, Android for Programmers: An App-Driven Approach, Prentice Hall, November 3, 2011.


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Object Oriented Analysis and Design

Syllabus

UNIT I: Software engineering and failures, software engineering concepts, software engineering development activities, managing software development, ARENA case study

UNIT II: Project organization and communication: introduction, an overview of projects, project organization concepts, project communication concepts, organizational activities. Requirements Elicitation: Introduction, overview, concepts, activities, managing requirements Elicitation, ARENA case study

UNIT III: Analysis: Introduction, overview, concepts, activities, managing analysis, ARENA case study. System design: decomposing the system, Introduction, overview, concepts, activities, managing system design, ARENA case study. Object design: reusing pattern solutions- introduction, overview, reuse concepts, reuse activities, managing reuse, ARENA case study.

UNIT IV: Object design: specifying interfaces- introduction, overview, concepts, activities, managing object design, ARENA case study, Introduction to UML, Unified Process, Requirements: The Requirements overview, use case modeling, advanced use case modeling Analysis: The analysis workflow, Objects and classes, finding analysis classes, Relationships, inheritance and polymorphism, Analysis packages, use case realization, Activity diagrams.

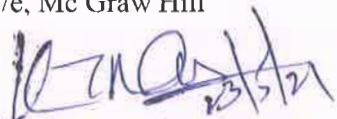
UNIT V: Design: The design workflow, design classes, refining analysis relationships, interfaces and components, use case realization - design, state machines. Implementation: The implementation workflow, deployment, mapping models to Code: introduction, overview, concepts, activities, managing implementation, ARENA case study. Testing: introduction, overview, concepts, activities, managing testing. Rationale managements: introduction, overview, concepts, activities, managing rationale, configuration management: introduction, overview, concepts, activities, managing configuration management.

TEXT BOOKS:

1. Bernd Bruegge Allen H. Dutoit " Object Oriented Software Engineering using UML, patterns and Java", Third Edition, Pearson Education
2. Jim Arlow, Ila Neustadt, " UML 2 and the Unified Process-Practical Object-Oriented Analysis and Design", Pearson Education, Second Edition.

REFERENCE BOOKS:

3. G. Booch, Object Oriented Analysis and Design with Applications 2/e Pearson
4. C. Larman, Applying UML and patterns, Pearson
5. R. Fairly, Software Engineering, Mc Graw Hill Publishing Co.
6. G. Booch, J. Rumbaugh, J. Jacobson, The Unified Modeling Language – User Guide Addison– Wesley
7. C. Ghezzi, M. Jazayeri and D. Mandrioli, Fundamentals of Software Engineering prentice Hall of India, Ltd.
8. R.S Pressman, Software Engineering: A Practitioner's Approach, 5/e, Mc Graw Hill International Edition


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ADVANCES IN COMPUTING

Syllabus

UNIT I:

Grid Computing: Data & Computational Grids, Grid Architectures and its relations to various Distributed Technologies. Autonomic Computing, Examples of the Grid Computing Efforts(IBM)

UNIT II:

Cluster Computing 1: Cluster setup & its Administration, Performance Models & Simulations; Networking, Protocols & I/O, Lightweight Messaging systems, Active Messages

UNIT III:

Cluster Computing 2: Distributed shared memory, parallel I/O Clusters, Jib and Resource management system, scheduling parallel jobs on clusters

UNIT IV:


Cluster Computing 3: Load sharing and Fault tolerance manager, parallel programming scheduling techniques, Dynamic load balancing, Example Cluster System – Beowlf, COMPaS and NanOS

UNIT V:

Pervasive Computing : Pervasive Computing concepts & Scenarios, Hardware & Software, Human - machine interface Device connectivity, Java for Pervasive devices, Application examples, Quantum Computing : Introduction to Quantum Computing, Qubits, Quantum Mechanics, Quantum gates, Applications of quantum computing.

REFERENCE BOOKS:

1. J. Joseph & C. Fellenstein, Grid Computing, PEA.
2. Raj Kumar Buyya, High performance cluster computing, PEA.
3. J.Burkhardt et .al, Pervasive computing, PEA.
4. Vishal Sahni, Quantum computing, TMH.
5. Marivesar, Approaching quantum computing, PEA.
6. Neilsen & Chung L, Quantum computing and Quantum Information, Cambridge University Press.
7. A networking approach to Grid Computing , Minoli, Wiley.


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BIG DATA ANALYTICS

Syllabus

Unit-1:

Big Data, Complexity of Big Data, Big Data Processing Architectures, Big Data Technologies, Big Data Business Value, Data Warehouse, Re-Engineering the Data Warehouse, Workload Management in the Data Warehouse, New Technology Approaches.

Unit-2: Integration of Big Data and Data Warehouse, Data Driven Architecture, Information Management and Lifecycle, Big Data Analytics, Visualization and Data Scientist, Implementing The "Big Data" Data. Choices in Setting up R for Business Analytics, R Interfaces, Manipulating Data, Exploring Data, Building Regression Models, Clustering and Data Segmentation, Forecasting and Time Series Models.

Unit-3: Writing Hadoop Map Reduce Programs, Integrating R and Hadoop, Using Hadoop Streaming with R, Learning Data Analytics with R and Hadoop, Understanding Big Data Analysis with Machine Learning. Big Data, Web Data, A Cross-Section of Big Data Sources and the Value They Hold, Taming Big Data, The Evolution of Analytic Scalability.

Unit-4: The Evolution of Analytic Processes, The Evolution of Analytic Processes The Evolution of Analytic Tools and Methods. Legacy Data, Hypothesis Testing, Prediction, Software, Complexity, Business problems suited to big data analytics.

Unit-5: High Performance Appliances for Big Data Management, Using Graph analytics, The New Information Management Paradigm, Big Data's Implication for Businesses, Big Data Implications for Information Management, Splunk's Basic Operations on Big Data.

Textbooks:

1. Data Warehousing in the Age of Big Data by Krish Krishnan, Morgan Kaufmann.
2. A. Ohri, "R for Business Analytics", Springer, 2012.

References:

1. Big Data Analytics with R and Hadoop by Vignesh Prajapati
2. Principles of Big Data Preparing, Sharing, and Analyzing Complex Information, 1st Edition, by J Berman, published by Morgan Kaufmann
3. "Big Data Analytics - From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph" By David Loshin, Morgan Kaufmann
4. Big Data Imperatives: Enterprise 'big Data' Warehouse, 'BI' Implementations and Analytics by Soumendra Mohanty, Apress
5. Big Data Analytics Using Splunk By Peter Zadrozny , Raghu Kodali, Apress 2013
6. Franks, Bill, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", Wiley, 1st Edition, 2012.
7. Big Data Application Architecture Q&A: a Problem - Solution Approach Nitin Sawant, Himanshu Shah
8. Big Data Now: Current Perspectives from O'Reilly Radar By O'Reilly Radar Team

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CLOUD COMPUTING

Unit-I

Overview of Computing Paradigm :Recent trends in Computing: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. Evolution of cloud computing: Business driver for adopting cloud computing.

Introduction to Cloud Computing :Cloud Computing (NIST Model): Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers; Properties, Characteristics & Disadvantages: Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing; Role of Open Standards

Unit-II

Cloud Computing Architecture:Cloud computing stack: Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services; Service Models (XaaS): Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS); Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud.

Unit-III

Infrastructure as a Service(IaaS): Introduction to IaaS, IaaS definition, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM). Resource Virtualization: Server, Storage, Network, Virtual Machine(resource) provisioning and manageability, storage as a service, Data storage in cloud computing(storage as a service); Examples: Amazon EC2, Renting, EC2 Compute Unit, Platform and Storage, pricing, customers, Eucalyptus.

Platform as a Service(PaaS):Introduction to PaaS: What is PaaS, Service Oriented Architecture (SOA), Cloud Platform and Management, Computation, Storage, Examples, Google App Engine, Microsoft Azure, SalesForce.com's Force.com platform.

Unit-IV

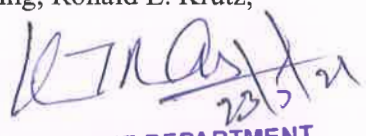
Software as a Service(PaaS):Introduction to SaaS, Web services, Web 2.0, Web OS, Case Study on SaaS. Service Management in Cloud Computing: Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously, Managing Data, Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud, Large Scale Data Processing.

Unit-V

Cloud Security: Infrastructure Security: Network level security, Host level security, Application level security, Data security and Storage: Data privacy and security Issues, Jurisdictional issues raised by Data location, Identity & Access Management, Access Control, Trust, Reputation, Risk, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations.

Reference Books:

1. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010


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DISTRIBUTED DATABASES

Syllabus

UNIT I

Introduction: Distributed Data Processing, Distributed Database System, Promises of DDBSs, Complicating Factors, Problem Areas Distributed DBMS Architecture DBMS Standardization, Architectural Models for Distributed DBMSs, Distributed DBMS Architecture, Global Directory Issues

UNIT II

Distributed Database Design: Alternative Design Strategies, Distribution Design Issues, Fragmentation, Allocation. Semantic Data Control: View Management, Data Security, Semantic Integrity Control.

UNIT III

Overview of Query Processing: Query Processing Problem, Objectives of Query Processing, Complexity of Relational Algebra Operations, Characterization of Query Processing, Layers of Query Processing Query Decomposition and Data Localization: Query Decomposition, Localization of Distributed Data Optimization of Distributed Queries Query Optimization, Centralized Query Optimization, Join Ordering in Fragment Queries, Distributed Query Optimization Algorithms

UNIT IV

Introduction to Transaction Management: Definition of a Transaction, Properties of Transactions, Types of Transactions, Architecture Revisited Distributed Concurrency Control Serializability Theory, Taxonomy of Concurrency Control Mechanisms, Locking-Based Concurrency Control Algorithms, Timestamp based Concurrency Control algorithms, Optimistic Concurrency Control Algorithms, Deadlock Management, Relaxed Concurrency Control

UNIT V

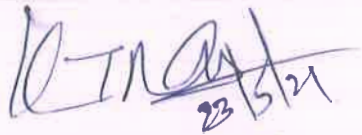
Distributed DBMS Reliability: Reliability Concepts and Measures, Failures and Fault Tolerance in Distributed Systems, Failures in Distributed DBMS, Local Reliability Protocols, Distributed Reliability Protocols, Dealing with site failures, Network Partitioning, Architectural Considerations Parallel Database Systems Database Servers, Parallel Architectures, Parallel DBMS Techniques, Parallel Execution Problems

Textbook:

1. Principles of Distributed Database Systems, Second Edition, M.Tamer Ozsu, Patrick Valduriez, Pearson Education, 1999.

Reference Book:

1. Distributed Database Management Systems: A Practical Approach] Saeed K. Rahimi ,Frank S. Haug , Wiely,2010


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Research Foundations for Pattern Recognition

Unit-1: Introduction, Features, feature vectors, classifiers, Supervised, semi-supervised and unsupervised learning, Classifiers based on bayes decision theory, estimation of unknown probability density functions, Nearest neighbour rule, Bayesian networks.

Unit-II : Linear classifiers, Perceptron algorithm, least square methods, logistic discrimination, support vector machines, Non-linear classifiers, The XOR problem, 2-layer and 3-layer perceptrons, Beyond SVM paradigm, decision trees, combining classifiers.

Unit-III : Feature Selection, Preprocessing, feature selection based on statistical hypothesis testing, ROC Curve, data transformation and dimensionality reduction, K-L Transform, SVD, ICA, Kernel PCA, DFT, all Transforms, Regional features, features for text, shape and size characterization, Fractals, features for speech and audio classification.

Unit-IV : Template matching, context dependent classification, supervised learning, clustering basic concepts, proximity measures, sequential algorithms, modification of BSAS, neural network implementation, hierarchical clustering algorithms.


Unit-V : Schemes based on function optimization, fuzzy clustering algorithms, possibilistic clustering, hard clustering algorithms, vector quantization, clustering algorithms based on graph theory, competitive learning algorithms, binary morphology clustering algorithms, boundary detection algorithms, valley – seeking clustering algorithms, kernel clustering methods, density-based algorithms for large data sets, cluster validity.

Text book: -

1. Pattern recognition, Sergios Theodoridis, Konstantinos Koutroumbas, 4th edition, Academic press [Elsevier], ISBN- 978-1-59749-272-0.

References: -

1. Pattern Recognition and Machine Learning, Book by Christopher Bishop, ISBN 978-0-387-31073-2, Springer, 2006.
2. Handbook of Pattern Recognition and Image Processing, Tzay Y. Young, ISBN-13: 978-0123954701, Academic press. Pattern Recognition and Computational Intelligence Techniques Using Matlab Transactions on Computational Science and Computational Intelligence), ISBN-13 : 978-3030222727, Springer, 2020, first edition.
3. Pattern Recognition, A Quality of Data Perspective by Wladyslaw Homenda, Witold Pedrycz
9781119302858, Wiley publishers, 2018.


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SOFT COMPUTING

Syllabus

UNIT-I:

Introduction to Neuro-Fuzzy and soft computing: computing constituents and conventions, characteristics. **Fuzzy set theory:** basic definitions and terminology, set-theoretic operations, MF formulation and parameterization. **Fuzzy rules and reasoning:** extension principles and fuzzy relations, fuzzy if-then rules, fuzzy reasoning. Fuzzy inference systems: mamdani fuzzy models, sugeno fuzzy models, Tsukamoto fuzzy models, other considerations.

UNIT-II

Regression and optimization: least-squares methods for system identification. Introduction, basics of matrix manipulation and calculus, least-square estimator, geometric interpretation of LSE, recursive least squares estimator, recursive LSE for time varying systems, statistical properties and maximum likelihood estimator, LSE for nonlinear models. **Derivative-based optimization:** introduction, descent methods, the method of steepest descent, newton's methods, step-size determination, conjugate gradient methods, analysis of quadratic case, non linear least square problems, incorporation of stochastic mechanisms. **Derivative-free optimization:** introduction, genetic algorithms, simulated annealing, random search, downhill simple search.

UNIT-III

Neural Networks: Adaptive networks, supervised learning neural networks, unsupervised learning and other neural networks. neuro-fuzzy modeling: ANFIS, **Coactive Neuro-Fuzzy Modeling:** Towards Generalized ANFIS. **Advanced Neuro-Fuzzy modeling:** classification and regression trees, data clustering algorithms, rule based structure identification.

UNIT-IV

Neuro Fuzzy control: ANFIS: introduction, architecture, hybrid learning algorithm, learning methods that cross fertilize ANFIS and RBFN, ANFIS as a universal approximation. Simulation examples: example 1. Modeling a two-input sinc function, Example 2. Modeling a three input non-linear function, example 3. On-line identification in control systems, example 4. Predicting chaotic time series. coactive neuro-fuzzy modeling: Towards Generalized ANFIS: introduction, framework, neuron functions for adaptive networks, neuro-fuzzy spectrum, analysis of adaptive learning capability.

NEURO-FUZZY CONTROL-I

Introduction, framework, control systems and neuro-fuzzy control, expert control, inverse learning, specialized learning, back-propagation through time and real-time recurrent learning.

NEURO-FUZZY CONTROL-II

Introduction, Reinforcement learning control, Gradient-free optimization, Gain Scheduling, Feedback Linearization and Sliding Control.

UNIT-V


GENETIC ALGORITHMS: A Genetic Introduction to Genetic Algorithms: What are Genetic Algorithms, Robustness of Traditional Optimization and search methods, goals of Optimization, How genetic algorithms differ from traditional methods, A Simple Genetic Algorithm, Genetic Algorithms at work.

Genetic Algorithms Revisited: Mathematical Foundations Computer implementation of a genetic algorithm.

Advanced Operations and Techniques in Genetic Search: Introduction to Genetics based Machine Learning, Applications of Genetics based Machine Learning.

Text Books:

1. Neuro-Fuzzy And Soft Computing BY "J-S.R.Jang, Ct. Sun, E.Mizutani" Prentic-Hall Of India Private Limited Publications.


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2. Genetic Algorithms BY "David E. Goldberg" Pearson Education.

REFERENCES:

1. Neural Networks and Learning Machines By "Simon Haykin"3rd Edition, Phi Publication.

2. Fuzzy Sets and Fuzzy Logic By "George J. Klir|Bo|Yuan" In Phi Publications.



Handwritten signature of K. N. Rao, dated 23/5/21.

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SOFTWARE ENGINEERING

Syllabus

Unit – I

Software and Software Engineering: Nature of software, software application domains, unique nature of web applications, software engineering, software process, software engineering practice, software myths. Process Models: Generic process model, prescriptive process models, specialized process models, unified process, personal and team process models, product and process. Agile development: Agility, agile process, extreme programming and other agile process models.

Unit – II

Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management. System models: Context Models, Behavioral models, Data models, Object models, structured methods.

Unit – III

Design concepts: Design process, Design concepts, design model. Architecture Design: Software architecture, architectural styles, architectural design, assessing alternative architectural designs, architectural mappings using data flow. Component-level design: Designing class based components, conducting component level design.

Unit – IV

User interface design: The golden rules, user interface analysis and design, interface analysis, interface design steps. Quality concepts: software quality, software quality dilemma, achieving software quality. Software quality assurance: Elements of software quality assurance, sqa tasks, goals. Formal approaches.

Unit – V

Software testing strategies: A strategic approach to software testing, strategic issues, test strategies for conventional software, validation testing, system testing.

Text book:

1. Roger S.Pressman, "Software Engineering – A Practitioner's Approach 7th Edition 2010, Mc Graw Hill.

Reference Book:

1) Ian Sommerville, 'Software Engineering', Sixth Edition, 2001, Pearson Education.



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Cryptography & Network Security

Syllabus

UNIT –I:

Introduction to Security: Security Concepts, Security Attacks, Security Services and Mechanisms, A model for network Security, **Classical Encryption Techniques:** Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor machines, steganography

UNIT –II:

Block Ciphers and DES: Traditional Block Cipher Structure, DES, DES Example, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles. **AES:** Finite Field Arithmetic, AES Structure, AES Transformation Functions, AES Example, AES Implementation. **Block Cipher Operation:** Multiple Encryption and Triple DES, electronic code book mode, cipher block chaining mode, cipher feedback mode, output feed back mode, counter mode, **Pseudorandom Number Generation and Stream Ciphers:** Principles and Pseudorandom Number Generation, Pseudorandom Number, Generators, Pseudorandom Number Generation using a Block Cipher, Stream, Ciphers, RC4.

UNIT –III:

Public-key Cryptography and RSA: Principles of Public-Key Cryptosystems, the RSA algorithm. Attacks and counter measure on RSA, Improvements on RSA, **Other Public-key Cryptosystems:** Diffie-Hellman Key Exchange, ElGamal Cryptosystem, Elliptic Curve Arithmetic Elliptic Curve Cryptography, **Cryptographic Hash Functions:** Applications of Cryptographic Hash functions, Two Simple Hash Functions, Requirements and Security, Hash Functions based on Cipher Block Chaining, SHA.

UNIT –IV:

Message authentication codes: Requirements, functions, MACs, security of MACs, HMAC. **Digital Signatures:** ElGamal Digital Signature, Schnorr digital signature, DSS. **Key management and distribution:** Symmetric key distribution using symmetric encryption, symmetric key distribution using asymmetric encryption, distribution of public keys, X.509 Certificates, Public-Key Infrastructure, **User Authentication protocols:** Remote User Authentication Principles, Remote User Authentication using Symmetric Encryption, Kerberos, Remote User Authentication Using Asymmetric Encryption

UNIT –V:

Transport-Level Security: Web Security issues, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH), **Electronic Mail Security:** Pretty Good Privacy, S/MIME, Domain Keys Identified Mail, **IP Security:** IP Security Overview. IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange, Cryptographic Suites

Books:

1. Cryptography and Network Security Principles and Practice, by William Stallings, Pearson, 7th edition, 2017.

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2. William Stallings, "Network Security Essentials: Applications and standards", Pearson Education, 7th Edition, 2017.
3. Applied Cryptography: Protocols, Algorithms and Source Code in C, by Bruce Schneier, Second Edition, John Wiley & Sons, Inc., 2015
4. Applied Cryptography for Cyber Security and Defense: Information Encryption and Cyphering, by Hamid R. Nemati and Li Yang, IGI Global, 2011



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WEB SECURITY

Syllabus

UNIT I

Introduction: The Web Security Landscape, Architecture of the World Wide Web, Cryptography basics, Cryptography and the web, Understanding SSL and TLS, Digital Identification: Passwords, Biometrics and Digital Signatures.

UNIT II

Digital Certificates, CAs and PKI, Web's war on privacy, privacy protecting techniques, privacy protecting technologies

UNIT III

Web Server Security: Physical security for servers, Host security for servers, securing web applications.

UNIT IV


Web Server Security: Deploying SSL server certificates, securing your web service, computer crime Security for content providers: Controlling access to web content, Client-side digital certificates, code signing and Microsoft's Authenticode .

UNIT V

Security for content providers: Pornography, Filtering software, Censorship, privacy policies, legislation, P3P, Digital Payments, Intellectual property and actionable content.

Textbook

1. Web Security, Privacy and Commerce, Simson Garfinkel, Gene Spafford, 2nd Edition, O'REILLY, 2002. Pvt. Ltd.


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WIRELESS SENSOR NETWORKS

SYLLABUS

UNIT I : Basics of Wireless Sensors and Applications, The Mica Mote, Sensing and Communication Range, Design Issues, Energy consumption, Clustering of Sensors, Applications

UNIT II: Data Retrieval in Sensor Networks, Classification of WSNs, MAC Layer, Routing Layer, High-Level Application Layer Support, Adapting to the Inherent Dynamic Nature of WSNs

UNIT III: Sensor Network Platforms and Tools, Sensor Network Hardware, Sensor Network Programming Challenges, Node-Level Software Platforms.

UNIT IV: Operating System: TinyOS, Imperative Language: nesC, Dataflow Style Language: TinyGALS, Node-Level Simulators, ns-2 and its Sensor Network Extension, TOSSIM.-

UNIT V: Sensor Network Databases : Challenges ,Query Interfaces, High level Database Organization, In-Network Aggregation, Data-centric Storage, Temporal Data.

TEXT BOOKS:

1. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science Imprint, Morgan Kauffman Publishers, 2005, rp2009.


REFERENCES:

1. Adhoc Wireless Networks: Architectures and Protocols, C.Siva Ram Murthy, B.S.Murthy, Pearson Education, 2004

2. Wireless Sensor Networks: Principles and Practice, Fei Hu, Xiaojun Cao, An Auerbach Book, CRC Press, Taylor & Francis Group, 2010

3. Wireless Ad hoc Mobile Wireless Networks: Principles, Protocols and Applications, Subir Kumar Sarkar et al., Auerbach Publications, Taylor & Francis Group, 2008.

4. Wireless Sensor Networks: Signal Processing and Communications Perspectives, Ananthram Swami et al., Wiley India, 2007, rp2009.


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SOFTWARE PROJECT MANAGEMENT

Syllabus

Unit-1 Introduction to software project management

Project Stakeholders, Project Management Knowledge Areas, Project Management Tools and Techniques, Program and Project Portfolio Management, the Role of the Project Manager, the Project Management Profession, Project Phases and the Project Life Cycle.

Unit-2 software project Time and Cost management

Time management: The Importance of Project Schedules, Estimating Activity Resources, Estimating Activity Durations, Developing the Schedule, Controlling the Schedule, Using Software to Assist in Project Time Management. Cost management: The Importance of Project Cost Management, Basic Principles of Cost Management, Estimating Costs, Types of Cost Estimates, Cost Estimation Tools and Techniques, Determining the Budget, Controlling Costs.

Unit-3 Human Resources Management

The Importance of Human Resource Management, Keys to Managing People, Developing the Human Resource Plan, Acquiring the Project Team, Developing the Project Team, Managing the Project Team, Using Software to Assist in Human Resource Management.

Unit-4 Risk Management


Planning Risk Management, Common Sources of Risk on Information Technology Projects, Identifying Risks, Performing Qualitative Risk Analysis, Performing Quantitative Risk Analysis, Planning Risk Responses, Monitoring and Controlling Risks, Using Software to Assist in Project Risk Management.

Unit-5 procurement Management

Strategic Planning and Project Selection, Developing a Project Charter, Developing a Project Management Plan, Directing and Managing Project Execution, Monitoring and Controlling Project Work, Performing Integrated Change Control, Closing Projects or Phases.

Textbook:

1. "INFORMATION TECHNOLOGY PROJECT MANAGEMENT", Kathy Schwalbe, 6th edition, Cengage Learning, 2011.


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ARTIFICIAL INTELLIGENCE

Syllabus

Unit-1

Introduction to Artificial Intelligence: AI Problems, The underlying Assumption, AI Techniques, Level of the Model Problems, Problem spaces & Search: Defining the Problem as a state space search, Production System, Problem Characteristics, Production System Characteristics.

Unit-2

Heuristic Search Techniques: Generate and Test, Hill Climbing, Best first Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.

Unit-3

Knowledge Representation Issues: Representation and Mapping, Approaches to Knowledge Representation, Issues in Knowledge Representation, The Frame Problem Predicate Logic: Representing simple facts in logic, Computable Functions and Predicates, Resolution, Natural Deduction.

Unit-4

Representing Knowledge using rules : Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning, Matching, Control Knowledge

Unit-5

Common Sense: Qualitative Physics, Common Sense Ontologies, Memory Organization Expert Systems: Representing and Using Domain Knowledge, Expert System Shells, Knowledge Acquisition

Text Book:

Elaine Rich & Kevin Knight," Artificial Intelligence ", 2nd Edition ,(Tata McGraw Hill Edition)

Reference Books:

Patrick Henry Winston, 'Artificial Intelligence', Pearson Education,2003



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VIRTUAL AND AUGMENTED REALITY

SYLLABUS

UNIT I INTRODUCTION

Introduction to VR, Historical perspective, Birds-eye view: general, Hardware, software, Sensation and perception. Geometry of Virtual Worlds: Geometric modeling, Transforming models, Matrix algebra, 2D and 3D rotations, Homogeneous transforms, The chain of viewing transforms, Eye transforms, Canonical view transform, Viewport transform. Light and Optics, Visual Physiology, Visual Perception, Tracking Systems, Visual Rendering,

UNIT II VISUAL PHYSIOLOGY AND PERCEPTION

Parts of the human eye, photoreceptors and densities, scotopic and photopic vision, display resolution requirements, eye movements, neural vision structures, sufficient display resolution, other implications of physiology on VR. Photoreceptors, Sufficient resolution for VR, Light intensity, Eye movements, Neuroscience of vision. Depth perception, Motion perception, Frame rates and displays

UNIT III TRACKING

Overview, Orientation tracking, Tilt drift correction, Yaw drift correction, Tracking with a camera, Perspective n-point problem, Filtering, Lighthouse approach, Velocities, acceleration, vestibular system, virtual world physics, simulation, collision detection, avatar motion

UNIT IV RENDERING

Visual Rendering: Visual Rendering-Overview, Shading models Rasterization, Pixel shading, VR-specific problems, Distortion shading, Post-rendering image warp

UNIT V AUDIO AND INTERFACES

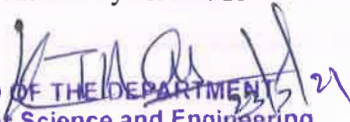
Audio: Physics and physiology, Auditory perception, Auditory localization, Rendering, Spatialization and display, Combining other senses. Interfaces: Locomotion, Manipulation, System control, Social interaction, Evaluation of VR Systems.

Text Books:

1. C. Burdea and Philippe Coiffet, Virtual Reality Technology, Second Edition, Gregory, John Wiley and Sons, Inc., 2008
2. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan and Claypool, New York, NY, USA.

References

1. Future Cyborgs: Human-Machine Interface for Virtual Reality Applications by Robert R Powell. 2012.


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2. George Mather, Foundations of Sensation and Perception: Psychology Press; 2 edition, 2009
3. Peter Shirley, Michael Ashikhmin, and Steve Marschner, Fundamentals of Computer Graphics, A K Peters/CRC Press; 3 edition, 2009.
4. The history of the future: Oculus, Facebook and the Revolution that swept Virtual Reality, by Blake J. Harris, 2019.
5. Virtual Reality by Steven M. LaValle. Cambridge University Press. 2019.

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DATA SECURITY & PRIVACY

Unit I

Introduction to Databases Security Problems in Databases Security Controls, Security Models – 1: Introduction Access Matrix Model Take-Grant Model! Acl on Model PN Model Hartsor and Hsiao's Model Fernandez's Model Bussolati and Martella's Model for Distributed databases - Security Models – 2: Bell and LaPadula's Model Biba's Model Dion's Model Sea View Model Jajodia and Sandhu'r Model The Lattice Model for the Flow Control conclusion.

Unit II

Security Mechanisms: Introduction User Identification/Authentication Memory, Memory Protection Resource Protection Control Flow Mechanisms Isolation Security Functionalities in Some Operating Systems Trusted Computer System Evaluation Criteria - Security Software Design: Introduction A Methodological Approach to Security Software Design Secure Operating System Design Secure DBMS Design Security Packages Database Security Design.

Unit III

Statistical Database Protection & Intrusion Detection Systems: Introduction Statistics Concepts and Definitions Types of Attacks Inference Controls evaluation Criteria for Control Comparison. Introduction IDES System RETISS System ASES System Discovery.

Unit IV


Enterprise Security Architecture - Security as a Process-Security Data- Enterprise Security as a Data Management Problem- Tools for Data Management- David Isenberg and the “Stupid Network”-Extensible Markup Language- The XML Security Services Signaling Layer-XML and Security Standards- The Security Pattern Catalog Revisited-XML-Enabled Security Data-HGP: A Case Study in Data Management. Business Cases and Security: Building Business Cases for Security.

Unit V

Security – Encryption – Digital Signatures – Authorization – Authenticated RPC - Integrity - Consistency - Database Tuning - Optimization and Research Issues. Case Studies Security – Encryption – Digital Signatures – Authorization – Authenticated RPC - Integrity - Consistency - Database Tuning - Optimization and Research Issues. Case Studies.

References:

1. Database Security by Castano, Silvana; Fugini, Maria Grazia; Martella, Giancarlo, Pearson Edition, 1994
2. Database Security and Auditing: Protecting Data Integrity and Accessibility 1st Edition, Hassan Afyouni Thomos Edition, 2006
3. Philip M. Lewis, Arthur Bernstein and Michael Kifer, “Databases and Transaction Processing: An Application-Oriented Approach”, Addison-Wesley, 2002.
4. R. Elmasri and S.B. Navathe, “Fundamentals of Database Systems”, 3rd Edition, Addison Wesley, 2004.
5. Abraham Silberschatz, Henry. F. Korth and S.Sudharsan, “Database System Concepts”, 4th Edition, Tata McGraw Hill, 2004.
6. Raghu Ramakrishnan and Johannes Gehrke, “Database Management Systems”, 3rd Edition, TMH, 2003.


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WIRELESS COMMUNICATIONS AND MOBILE COMPUTING

Syllabus

UNIT -I:

The Cellular Concept-System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies- Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference , Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring .

UNIT -II:

Mobile Radio Propagation: Large-Scale Path Loss: Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection-Reflection from Dielectrics, Brewster Angle, Reflection from perfect conductors, Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models- Longley- Ryce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models- Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Models

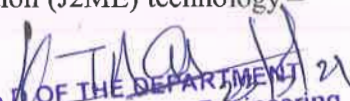
UNIT -III:

Introduction to Mobile Computing Architecture: Mobile Computing – Dialog Control – Networks –Middleware and Gateways – Application and Services – Developing Mobile Computing Applications –Security in Mobile Computing – Architecture for Mobile Computing – Three Tier Architecture – Design considerations for Mobile Computing – Mobile Computing through Internet – Making existing Applications Mobile Enabled.

Cellular Technologies: GSM, GPS, GPRS, CDMA and 3G: Bluetooth – Radio Frequency Identification – Wireless Broadband – Mobile IP – Internet Protocol Version 6 (IPv6) – Java Card –GSM Architecture – GSM Entities – Call Routing in GSM – PLMN Interfaces – GSM addresses and Identifiers – Network aspects in GSM – Authentication and Security – Mobile computing over SMS –GPRS and Packet Data Network – GPRS Network Architecture – GPRS Network Operations – Data Services in GPRS – Applications for GPRS – Limitations of GPRS – Spread Spectrum technology –Is-95 – CDMA Versus GSM – Wireless Data – Third Generation Networks – Applications on 3G

UNIT -IV:

Wireless Application Protocol (WAP) and Wireless LAN: WAP – MMS – Wireless LAN Advantages – IEEE 802.11 Standards – Wireless LAN Architecture –Mobility in wireless LAN
Intelligent Networks and Interworking : Introduction – Fundamentals of Call processing –Intelligence in the Networks – SS#7 Signaling – IN Conceptual Model (INCM) – soft switch – Programmable Networks – Technologies and Interfaces for IN. **Client Programming, Palm OS, Symbian OS, Win CE Architecture:** Introduction – Moving beyond the Desktop – A Peek under the Hood: Hardware Overview – Mobile phones – PDA – Design Constraints in Applications for Handheld Devices – Palm OS architecture – Application Development – Multimedia – Symbian OS Architecture – Applications for Symbian, Different flavors of Windows CE -Windows CE Architecture **J2ME:** JAVA in the Handset – The Three-prong approach to JAVA Everywhere – JAVA 2 Micro Edition (J2ME) technology –


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Programming for CLDC–GUI in MIDP–UI Design Issues–Multimedia–Record Management System – Communication in MIDP – Security considerations in MIDP – Optional Packages

UNIT –V:

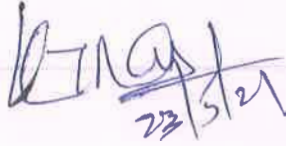
Voice Over Internet Protocol and Convergence: Voice over IP- H.323 Framework for Voice over IP – Session Initiation Protocol– Comparison between H.323 and SIP – Real Time protocols –Convergence Technologies – Call Routing – Voice over IP Applications – IP multimedia subsystem (IMS) – Mobile VoIP **Security Issues in Mobile Computing:** Introduction – Information Security – Security Techniques and Algorithms – Security Protocols – Public Key Infrastructure – Trust – Security Models – Security

TEXT BOOKS:

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Mobile Cellular Communication – Gottapu Sasibhushana Rao, Pearson Education, 2012.
4. Mobile Computing – Technology, Applications and Service Creation – Asoke K Talukder, Roopa R Yavagal, 2009, TATA McGraw Hill
5. Mobile Communications – Jochen Schiller – 2nd Edition – Pearson Education

REFERENCE BOOKS:

1. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE.
2. Wireless Digital Communications – Kamilo Feher, 1999, PHI.
3. Wireless Communication and Networking – William Stallings, 2003, PHI.
4. Wireless Communication – Upen Dalal, Oxford Univ. Press.
5. Wireless Communications and Networking – Vijay K. Gary, Elsevier.
6. The CDMA 2000 System for Mobile Communications – Vieri Vaughi, Alexander Damn Jaonvic – Pearson
7. Adalestein : Fundamentals of Mobile & Parvasive Computing, 2008, TMH


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PARALLEL ALGORITHMS

Syllabus

UNIT I:

Introduction: Computational demand in various application areas, advent of parallel processing, terminology pipelining, Data parallelism and control parallelism-Amdahl's law. Basic parallel random access Machine Algorithms-definitions of P, NP and NP-Hard, NP-complete classes of sequential algorithms-NC –class for parallel algorithms.

UNIT II:

Organizational features of Processor Arrays, Multi processors and multicomputers. Mapping and scheduling aspects of algorithms. Mapping into meshes and hyper cubes-Load balancing-List scheduling algorithm Coffman-graham scheduling algorithm for parallel processors.

UNIT III:

Elementary Parallel algorithms on SIMD and MIMD machines, Analysis of these algorithms. Matrix Multiplication algorithms on SIMD and MIMD models. Fast Fourier Transform algorithms. Implementation on Hyper cube architectures. Solving linear file - system of equations, parallelizing aspects of sequential methods back substitution and Tri diagonal.

UNIT IV:

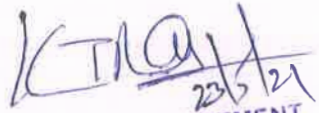
Parallel sorting methods---Odd-even transposition Sorting on processor arrays. Biotonic – merge sort on shuffle –exchange ID –Array processor, 2D-Mesh processor and Hypercube Processor Array. Parallel Quick-sort on Multi processors. Hyper Quick sort on hypercube multi computers. Parallel search operations. Ellis algorithm and Manber and Ladner's Algorithms for dictionary operations.

UNIT V:

Parallel algorithms for Graph searching— All Pairs shortest paths and minimum cost spanning tree. Parallelization aspects of combinatorial search algorithms with Focus on Branch and Bound Methods and, Alpha-beta Search methods.

REFERENCE BOOKS:

1. Parallel computing theory and practice, MICHAEL J. QUINN
2. Programming Parallel Algorithms, Guy E. Blelloch, Communications of the ACM
3. Algorithms for Parallel processing, Michael T Heath, Abhiram Ranad, Schreiber(Ed), Springer.
4. Handbook of Parallel Computing Models, algorithms and applications, Samgithevar Rajasekharan, John Reif(Ed), Taylor and Franics group.
5. Parallel Processing and Parallel Algorithms: Theory and Computation, Seyed H. Roosta, Springer


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Blockchain and Cryptocurrencies

Syllabus:

Unit I:

Introduction to Cryptography: Structure of cryptosystem – symmetric key cryptography – asymmetric key cryptography – types of attacks – authentication models – SHA-256 Hash algorithm – RSA algorithm – Elliptic Curve cryptography – Digital signature standards. **Basics of Blockchain concepts:** Architecture – Properties of Blockchain – Distributed ledger – Merkle tree – structure of a block – Smart contract – Crowd funding – Transaction – Double spending – Block propagation.

Unit II:

Types of Blockchain: Blockchain Components – Permissioned Blockchain – Permissionless Blockchain – Consortium Blockchain – Consensus – Proof of Work, Proof of Stack, Proof of Burn, Proof of Elapsed Time – Mining – **Consensus Algorithms:** PAXOS consensus Algorithm – RAFT consensus Algorithm – Byzantine general problem – Practical Byzantine fault tolerance Algorithm – Three phase commit Protocol.

Unit III:

Blockchain Components and Concepts – **Hyperledger Fabric:** Transaction Flow – **Fabric Details:** Ordering Services, Channels (Single and Multiple Channels), Peer, Client Applications, Certificate Authority – Membership and Identity Management – Hyperledger Fabric Network Setup. **Hyperledger Composer:** Application Development, Network Administration.

Unit IV:


Applications: Financial Services: Cross border payments, KYC, international trade - **Health Care:** Food safety - **Supply chain and Logistics:** Trade logistics supply chain, diamond provenance, addressing supply chain fraud - **Public Sector:** Energy, Govt. applications (passport, audit and compliance, digital identity) - **Retail:** Hyperledger Indy, GST – **Insurance:** Claims Processing, Risk Provenance - **Security:** Open Network security properties, membership and access control architecture, privacy using channels in hyperledger fabric, Ledger in hyperledger fabric.

Unit V:

Smart Contract Programming (Solidity): Global variable and functions – expressions and control structures – arrays, enums, structs, mappings, special variables – **Functions:** function modifiers, view function, pure functions, fallback function, function overloading, mathematical and cryptographic functions – **common pattern:** withdrawal pattern, restricted access – contracts, inheritance, constructors, abstract contracts, interfaces, libraries, assembly, exceptions, events, and logging – truffle basics and unit testing.

Reference Books:

1. William Stallings, "Cryptography and Network Security: Principles and Practice", 7th Edition, Pearson Education, 2017.
2. Chandramouli Subramanian, Asha A George, Abhilash K A, Meena Karthikeyan, "Blockchain Technology", University Press (India) Private Limited, 2021
3. Ritesh Modi, "Solidity Programming Essentials: A beginners guide to build smart contracts for Ethereum and blockchain", Packt publishing Ltd, UK, 2018


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4. Behrouz A. Forozan and Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, McGraw Hill Education (India) Private Limited, 2015.

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CLLOUD SECURITY

Syllabus Unit-I

Security Concepts: Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defence in depth, least privilege, how these concepts apply in the cloud, what these concepts mean and their importance in PaaS, IaaS and SaaS. e.g. User authentication in the cloud;

Cryptographic Systems: Symmetric cryptography, stream ciphers, block ciphers, modes of operation, public-key cryptography, hashing, digital signatures, public-key infrastructures, key management, X.509 certificates, OpenSSL.

Unit-II

Multi-tenancy Issues: Isolation of users/VMs from each other. How the cloud provider can provide this; **Virtualization System Security Issues:** e.g. ESX and ESXi Security, ESX file system security, storage considerations, backup and recovery;

Unit-III

Virtualization System Vulnerabilities: Management console vulnerabilities, management server vulnerabilities, administrative VM vulnerabilities, guest VM vulnerabilities, hypervisor vulnerabilities, hypervisor escape vulnerabilities, configuration issues, malware (botnets etc).

Unit-IV

Virtualization System-Specific Attacks: Guest hopping, attacks on the VM (delete the VM, attack on the control of the VM, code or file injection into the virtualized file structure), VM migration attack, hyperjacking. **Technologies for Virtualization-Based Security Enhancement:** IBM security virtual server protection, virtualization-based sandboxing;

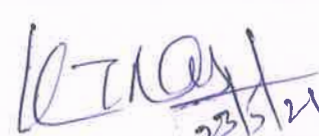
Unit-V

Storage Security: HIDPS, log management, Data Loss Prevention. Location of the Perimeter.

Legal and Compliance Issues: Responsibility, ownership of data, right to penetration test. local law where data is held, examination of modern Security Standards (eg PCIDSS), how standards deal with cloud services and virtualization, compliance for the cloud provider vs. compliance for the customer.

Reference Books:

1. Tim Mather, SubraKumaraswamy, ShahedLatif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance [ISBN: 0596802765]
2. Ronald L. Krutz, Russell Dean Vines, Cloud Security [ISBN: 0470589876]
3. John Rittinghouse, James Ransome, Cloud Computing [ISBN: 1439806802]
4. J.R. ("Vic") Winkler, Securing the Cloud [ISBN: 1597495921]


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Machine Learning

SYLLABUS:

Unit-1

Introduction and Decision Trees: Well-posed Learning problems. Designing a Learning System: Choosing the Training Experience, Choosing the Target Function, Choosing a Representation for the Target function, Choosing a Function Approximation Algorithm, The final Design. Perspective and Issues in Machine Learning: Issues in Machine Learning.

Decision Tree Learning: Introduction, Decision Tree Representation, Appropriate Problems for Decision Tree Learning. The Basic Decision Tree Learning Algorithm: Which attribute is the Best classifier, an Illustrative example, Hypothesis Space Search in Decision Tree Learning? Inductive Bias in Decision Tree Learning: Restriction Biases and preference Biases, why prefer short Hypotheses. Issues in Decision Tree Learning: Avoiding Over fitting the Data, Incorporating Continuous-valued Attributes, Alternative Measures for Selecting Attributes, Handling Training Examples with Missing Attribute Values, Handling Attributes with Differing Costs.

Unit-2

Bayesian Learning: Introduction, Bayes Theorem. Bayes Theorem

Concept Learning: Brute-Force Bayes Concept Learning, MAP Hypothesis and Consistent Learners. Maximum Likelihood and Least-squared Error Hypotheses, Maximum Likelihood Hypothesis for predicting probabilities: Gradient Search to Maximize Likelihood in a Neural Net. Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naive Bayes Classifier, and An Example: Learning to classify Text.

Unit-3


Bayesian Belief Networks: Conditional Independence, Representation, Inference, Learning Bayesian Belief Networks, Gradient Ascent Training of a Bayesian Networks, Learning the structure of Bayesian Networks. The EM Algorithm: Estimate Means of K Gaussians, General Statement of EM Algorithm, Derivation of the K Means Algorithm.

Artificial Neural Networks: Introduction, Neural Network Representations, Appropriate Problems for Neural Network Learning, Perceptrons, Multi Layer Networks and BACK PROPAGATION Algorithm, Remarks on the BACK PROPAGATION Algorithm, An Illustrative Example: Advanced Topics in Artificial Neural Networks.

Unit-4

Genetic Algorithms: Motivation, Genetic Algorithms, An illustrative Example, Hypothesis Space Search, Genetic programming, Models of Evolution and Learning, Parallelizing Genetic Algorithms

Learning Sets of Rules: Introduction, Sequential Covering Algorithms, Learning Rule Sets: Summary, Learning First-Order Rules, Learning Sets of First-order Rules: FOIL, Induction as Inverted Deduction, Inverting Resolution. Introduction to Analytical Learning, Inductive and Analytical Learning Problems, Learning with Perfect Domain Theories: PROLOG-EBG, Remarks on Explanation Based Learning, Explanation Based Learning of Search Control Knowledge.


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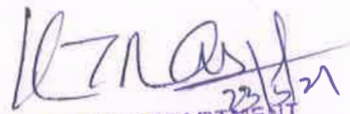
Text Books: 1. Tom M.Mitchell ,”Machine Learning”,McGraw Hill,1997

2. Peter Flach, Machine Learning, The and Science of Algorithms that make sense of data, Cambridge University Press, 2012.

Reference Books:

1. Ethem Alpaydin, ”Introduction to Machine Learning”,The MIT Press, (2010)

2.Stephen Marsland, ”Machine Learning an Algorithmic Perspective”, CRC Press,(2009)


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Quantum Computing

Syllabus

Unit-I: Introduction, Overview of classical mechanics, limitations, Need for quantum mechanics, Advantages and risks involved with quantum mechanics, Evolution of quantum computing, Quantum processors, Quantum architecture and explanation of various components. Applications.

Unit-II: QISKit, Awesome SDK for Quantum Programming in Python - Installing the QISKit, Setting Up in Windows, Setting Up in Linux CentOS, Qubit 101: It's Just Basic Algebra, Algebraic Representation of a Quantum Bit, Changing the State of a Qubit with Quantum Gates, Universal Quantum Computation Delivers Shortcuts over Classical, Computation -Your First Quantum Program, SDK Internals: Circuit Compilation and QASM, Running in a Real Quantum Device, Quantum Assembly: The Power Behind the Scenes, Quantum entanglement

Unit-III: Quantum random number generation, Super dense coding, Quantum teleportation, Deutsch-Jozsa algorithm, Bernstein-Vazirani, Simons algorithm, Boson sampling problem, Grover and Shors algorithm, Quantum approximate optimization algorithm.

Unit-IV: Quantum circuits, quantum fourier transforms and its applications, quantum search algorithms, quantum computers- physical realization, Quantum meta-heuristics and its applications.

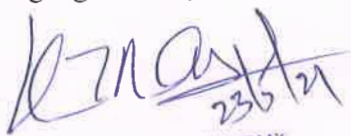
Unit-V: Quantum noise and quantum operations, Distance measures for quantum information, Quantum error-correction, Entropy and information, Quantum information theory, Overview of quantum machine learning, Roadmap to Quantum deep learning.

Textbooks: -

1. Quantum Computation and Quantum Information, Michael A. Nielsen, Isaac L. Chuang, ISBN 978-1-107-00217-3, Cambridge University Press.
2. Practical Quantum Computing for Developers Programming Quantum Rigs in the Cloud using Python, Quantum Assembly Language and IBM QExperience, Vladimir Silva, 978-1-4842-4217-9, <https://doi.org/10.1007/978-1-4842-4218-6>, Apress.

Reference books: -

1. Quantum computing for everyone, Bernhardt, Chris, 9780262350914, The MIT Press, 2019.
2. Mathematics of Quantum Computing: An Introduction, Wolfgang Scherer, 9783030123581, Springer, 2019.


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NATURAL LANGUAGE PROCESSING

Syllabus

Unit I: Introduction: overview of NLP. Statistical machine translation. Language models and their role in speech processing. The problem of ambiguity. NLP tasks in syntax, semantics, and pragmatics. **Words:** Structure, Semantics, Parts of Speech, Sentences: Basic ideas in compositional semantics, Classical Parsing (Bottom up, top down, Dynamic Programming: CYK parser). Sentences: Parsing using Probabilistic Context Free Grammars and EM based approaches for learning PCFG parameters.

Unit II: N-gram Language Models and Information Theory: The role of language models. Simple N-gram models, Entropy, relative entropy, cross entropy. Statistical estimation and smoothing for language models. Part Of Speech Tagging and Sequence Labeling. Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training). n-gram models.

Unit III: Syntactic-parsing: Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Top-down and bottom-up parsing, empty constituents, left recursion. Modern Statistical Parsers Search methods in parsing: Agenda-based chart, A*, and "best-first" parsing. Discriminative parsing. Discourse: Reference resolution and phenomena, syntactic and semantic constraints on Coreference, pronoun resolution algorithm, text coherence, discourse structure.

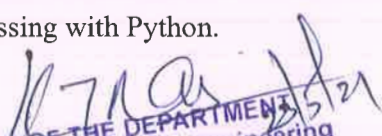
Unit IV: Semantic Analysis: Lexical semantics and word-sense disambiguation. Dependency parsing. Semantic Role Labeling and Semantic Parsing. Information Extraction (IE): Named entity recognition and relation extraction. IE using sequence labelling. Information sources, rule-based methods, evaluation (recall, precision). Additional topics: Advanced Language Modelling (including LDA), other applications like summarization.

Unit V: Statistical Machine Translation (MT), Alignment Models. Statistical Alignment Models and Expectation Maximization (EM) EM and its use in statistical MT alignment models. The EM algorithm. Machine Translation (MT): Basic issues in MT. Rule based Techniques, Statistical Machine translation (SMT), word alignment, phrase-based translation, and synchronous grammars, case study: IBM models.

Text books:

1. Daniel and James H. Martin "An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Second Edition.
2. Bird, S., Klein, E., Loper, E. (2009). Natural Language Processing with Python. Sebastopol, CA: O'Reilly Media.

Reference Books:


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1. James A.. Natural language Understanding 2e, Pearson Education, 1994
2. Bharati A., Sangal R., Chaitanya V.. Natural language processing: a Paninian perspective, PHI, 2000
3. Siddiqui T., Tiwary U. S.. Natural language processing and Information retrieval, OUP, 2008.
4. Manning, Christopher D.; Hinrich Schuetze; Foundations of Statistical Natural Language Processing Cambridge, MIT Press, 1999.
5. Kiraz, George Anton; Computational Nonlinear Morphology: With Emphasis on Semitic Languages Cambridge University Press, 2001, 171 pages



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Speech Processing

UnitI: Overview of speech communication, Speech signal to symbol (sound unit) transformation, nature of speech signal, Speech Production and Perception, Phonetics and Phonology, Acoustics Phonetics, Speech Prosody, Different types of Speech Sound units.

UnitII: Time and frequency domain analysis, Review of DSP techniques, z-transform, Discrete Fourier transform, short-time analysis of speech, linear prediction analysis, Linear prediction cepstral coefficients (LPCC), Cepstral analysis, Mel frequency cepstral coefficients (MFCC), spectrograms, Segmental analysis of speech,


UnitIII: Traditional Approaches: Dynamic time warping (DTW), Gaussian mixture models (GMM), hidden Markov models (HMM), Neural network models, Support vector machines

UnitIV: State of the Art Models: Deep Neural Networks, LSTM Recurrent neural networks, Convolutional neural networks, Reinforcement learning

UnitV: Speech recognition, Speaker recognition, Speech synthesis, Speech enhancement, Language identification, Emotion recognition, Prosody manipulation.

PREFERRED TEXT BOOKS:

1. L. R. Rabiner, B. H. Juang, and B. Yegnanarayana, "Fundamental of Speech Recognition", Pearson Education Inc., New Delhi, India, 2009
2. L.R.Rabiner and R.W.Schafer, Digital processing of speech signals, Pearson LPE (1993).
3. Douglas O'Shaughnessy, "Speech Communication, Human and Machine", IEEE Press, 2000.
4. T.F Quatieri, "Discrete-Time Speech Signal Processing- Principles and Practice", Pearson, 2002.
5. J R Deller, J H L Hansen, J G Proakis, "Discrete-time Processing of Speech Signals, IEEE, Wiley. 1999.
6. Machine Learning, Tom M. Mitchell, Mg-Graw Hill, Indian Edition, 2019
7. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, The MIT Press, November 2016.
8. Springer Handbook of Speech Processing, J. Benesty, 2008.


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Signal Processing

Syllabus

Unit I: Introduction to Signals and Systems-Types of Signals: Analog signals, deterministic, non-deterministic, random signals, periodic, aperiodic signals, sampling, Nyquist theorem, Quantization, discrete time signals, digital signals, Systems: properties of systems, linearity, super position principles, shift invariance, causality and stability, impulse response,

Unit II: Difference Equations, Convolution, Phase and group delays. Fourier- series for periodic signals, Fourier transforms, properties of Fourier transform, DTFT, Discrete Fourier transforms, Fast Fourier Transforms,

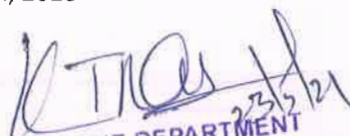
Unit III: Transforms & Filter Design: Z-Transforms, Region of Convergence: Properties of Z-Transforms. Causality and stability of filters, FIR, IIR, Pole, Zero representation, Digital filter design: FIR filter design - low pass, high-pass, band-pass and band-reject filters, IIR filter design, Frequency response of filters, All pass filters, Filter realizations.

Unit IV: 1D, 2D & 3D Signal Processing: Windowing techniques, Short-term processing, enhancement techniques, Video signal processing with techniques for denoising, feature extraction. Codecs: for Speech, image and video signals. Acquisition, enhancement techniques, feature extraction, analysis & synthesizing techniques for audio, image and video signals.

Unit V: Signal Processing for Intelligent Systems: DNN, RNN, CNN, GAN, Capsule, Siamese & Residual Networks based tool kits for Speech and Image processing—pre-processing, data augmentation, feature extraction, recognition, classification, and synthesis.

Reference Books:

1. J. G. Proakis and M G , Monolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", PHI,
2. V. Oppenheim and R. W. Schaffer. discrete time signal processing, Prentice hall, MIT press
3. Discrete-Time Speech Signal Processing: Principles and Practice by Thomas F. Quatieri
4. R. Gonzalez and R. Woods, "Digital Image Processing", 4 th Ed., Pearson, 2018
5. Handbook of Image and Video Processing by Alan C. Bovik


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Artificial Neural Networks (ANN)

Basics of Artificial Neural Networks: Historical perspective; Characteristics of Neural Networks; Artificial Neural Networks (ANN) terminology; Neuron Models; Topology; Basic learning laws

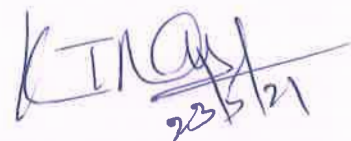
Pattern Recognition Tasks by ANNs: Activation dynamics models; Synaptic dynamics models; Learning methods; Stability and convergence; Recall; Functional Units for Pattern Recognition Tasks

Feedforward Neural Networks: Analysis of Pattern association; pattern classification and pattern mapping by feedforward neural networks (FFNNs); Hebbian Rule; Perceptron learning; Delta rule; Backpropagation Algorithm; Gradient descent and its variants

Feedback Neural Networks: Analysis of linear autoassociative networks; Hopfield model for pattern storage; Stochastic networks and Simulated annealing; Restricted Boltzmann machine.

Reference Books:

1. B. Yegnanarayana "Artificial Neural Networks", PHI, 2006.
2. Simon Haykin, "Neural Networks: A Comprehensive Foundation", Pearson Prentice Hall, 2008.
3. Christopher M Bishop, "Neural networks for Pattern Recognition", Oxford, Indian Edition, 2010.



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FINANCIAL ENGINEERING & BUSINESS INTELLIGENCE

Syllabus

Unit-1 Introduction to analytics for business, predicting outcomes, statistical learning Linear regression models, quality of predictions, resampling methods: Cross-validation and the bootstrap, subset selection, ridge and lasso regressions, financial analytics

Unit-2 Classification models: logistic regression and linear discriminant analysis, k-nearest neighbors and tree based methods, support vector machines

Unit-3 Unsupervised learning methods: clustering, principal component analysis and partial leastsquares Predictions and skill versus luck, Difference-in-differences method, Matched pairs and causal inference

Unit-4 Predictive financial analytics: Identifying trends and signals in financial data
Prescriptive analytics: Simulating complex scenarios, optimizing critical decisions, optimization with multiple objectives, simulation and optimization in R, applications in retailing and e-commerce

Unit-5 Prescriptive financial analytics: Algorithmic trading, portfolio optimization

Textbooks

1. Ledolter, J. (2013). Data Mining and Business Analytics with R. Wiley. Reference Books 1. Lawrence C. Galtiz, Irwin. Financial Engineering
2. Marshall, J. F. and Bansal, V. K. 2006. Financial Engineering: A Complete Guide to Financial Innovation, Prentice Hall of India.
3. Paul Glasserman, Monte Carlo Methods in Financial Engineering, Springer.
4. Edwards, F. R. and Ma, C. W. 1992, Futures and Options, McGraw-Hill International.
5. Rebonato, R. Interest Rate Option Models: Understanding, Analyzing and Using Models for Exotic Interest Rate Options, John Wiley and Sons

K. T. N. S.
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COGNITIVE COMPUTING

Syllabus

Unit-I: Overview of Nervous System: Cellular components of Nervous system; Organizational Principles of Neural System: Organelles and Their Functions; Membrane Potential and Action Potential; Synaptic transmission and Cellular signalling (Basic Neurochemistry). Introduction to Cognitive Neuroscience: General Introduction and philosophy of Mind; Cellular/Molecular Basis of Cognition; Visual perception and Object recognition; Spatial Processing and Attention; Concept Formation, Logic and Decision Making; Problem Solving, Creativity and Intelligence; Learning Memory (I)- Memory Models and Short-Term Memory; Learning Memory (II)- Long term potentiation and Long-Term Memory.

Unit-II: Functional neuro-imaging of cognition and Image processing: PET(Positron Emission Tomography); Concepts of NMR (Nuclear Magnetic Resonance) and fMRI (Functional MRI); DTI(Diffusion Tensor Imaging); Image processing for brain functioning
Signal Processing and Neural engineering: Physiological signals– Generation and Sensing; Bio-signal acquisition; Data pre-processing; Feature Extraction; Applications:-Brain Computer Interface and Neuro-feedback


Unit-III: Naturalistic Decision Making: Skills-Rules-Knowledge, Abstraction Hierarchy, Decision Ladder, Mental Models, Recognition-Primed Decisions, Knowledge-based expert systems, Team performance, Domain characteristics and constraints, Strategies, Heuristic Reasoning, Problem-solving as search through a problem-space.

Unit-IV: Cognitive Task Analysis: Cognitive Work Analysis, Knowledge Acquisition, Information Flow, Communication Paths, Tools used, Constraints, Distributed cognition - "knowledge in the head" and "knowledge in the world", Field studies and observation, Disturbance Management, Alarm Management, Latent Errors, Human Errors, Usability Testing.

Unit-V: Problem Types: Problem Solving, Information Retrieval, Diagnosis, Planning, Scheduling, Resource Allocation. Domains: Aviation, Driving, Trains, Dispatching, Emergency Management, Health Care, Process Control, Military Command and Control, Sports.

Textbooks:

1. Hutchins, E. (1995). Cognition in the Wild. Cambridge, MA: MIT Press.
2. Montgomery, D. C. (1991). Design and Analysis of Experiments, Third Edition. New York: John Wiley & Sons.
3. A Brief Introduction to Neural Networks, <http://www.dkriesel.com/>, 2009 by David Kriesel
4. Reinforcement Learning: An Introduction online: <http://webdocs.cs.ualberta.ca/~sutton/book/the-book.html>?, Second Edition by Richard S. Sutton and Andrew G. Barto
5. Artificial Intelligence and Soft Computing: Behavioral and Cognitive Modeling of the Human Brain, CRC Press, 2018 by Amit Konar


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Annexure-X

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Pre-Ph.D - Computer Science and Engineering 2021-22 Syllabus Revision

Course Code	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed /Replaced	Change in Unit	Justification for the Modification	*Overall Revision Percentage
21CS201	INFORMATION RETRIEVAL SYSTEMS	<p>Unit I : Introduction to Information storage and retrieval systems: Domain Analysis of IR systems, IR and other types of Information Systems, IR System Evaluation Introduction to Data structures and algorithms related to Information Retrieval: Basic Concepts, Data structures, Algorithms.</p> <p>Unit II: Inverted Files: Introduction, Structures used in Inverted Files, Building an Inverted file using a sorted array, Modifications to the Basic Techniques. Signature Files : Introduction, Concepts of Signature files, Compression, Vertical Partitioning, Horizontal Partitioning.</p> <p>Unit III: New Indices for Text: PAT Trees and PAT Arrays: Introduction, PAT Tree structure, Algorithms on the PAT Trees, Building PAT Trees as PATRICA Trees, PAT representation as Arrays. Lexical Analysis and Stoplists: Introduction, Lexical Analysis, Stoplists.</p>	<p>Unit-1: Introduction to Information Retrieval: The nature of unstructured and semi-structured text. Inverted index and Boolean queries. Text Indexing, Storage and Compression:Text encoding: tokenization, stemming, stop words, phrases, index optimization. Index compression: lexicon compression and postings lists compression. Gap encoding, gamma codes, Zipf's Law. Index construction. Postings size estimation, merge sort, dynamic indexing, positional indexes, n-gram indexes.</p> <p>Unit-2: Retrieval Models: Boolean, vector space, TFIDF, Okapi, probabilistic, language modeling, latent semantic indexing. Vector space scoring. The cosine measure.</p>	80 % Syllabus replaced	All Units	<ol style="list-style-type: none"> Understand how to store and process text efficiently. Improve the accuracy and efficiency of search and retrieval systems. Develop better text mining and analysis algorithms. 	80%

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Course Code	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed /Replaced	Change in Unit	Justification for the Modification	*Overall Revision Percentage
		<p>Unit IV: Stemming Algorithms: Introduction, Types of Stemming algorithms, Experimental Evaluations of Stemming, Stemming to Compress Inverted Files. Thesaurus Construction: Introduction, Features of Thesauri, Thesaurus Construction, Thesaurus construction from Texts, Merging existing Thesauri.</p> <p>Unit V: String Searching Algorithms: Introduction, Preliminaries, The Naive Algorithm, The Knutt-Morris-Pratt Algorithm, The Boyer-Moore Algorithm, The Shift-Or Algorithm, The Karp-Rabin Algorithm.</p>	<p>Efficiency considerations. Document length normalization. Relevance feedback and query expansion. Rocchio.</p> <p>Unit-3: Performance Evaluation: Evaluating search engines. User happiness, precision, recall, Fmeasure. Creating test collections: kappa measure, interjudge agreement. Text Clustering: Clustering versus classification. Partitioning methods. k-means clustering. Mixture of gaussians model. Hierarchical agglomerative clustering. Clustering terms using documents.</p> <p>Unit-4: Text Categorization and Filtering: Introduction to text classification. Naive Bayes models. Spam filtering. Vector space classification using hyperplanes; centroids; k Nearest Neighbors. Support vector machine classifiers. Kernel functions. Boosting.</p> <p>Unit-5: Web Information Retrieval: Hypertext, web crawling, search engines, ranking, link analysis, PageRank, HITS. Retrieving Structured Documents: XML retrieval, semantic web</p>				
21CS210	DIGITAL IMAGE PROCESSING	UNIT I: Introduction: Digital Image Processing, Fundamental steps in Digital Image	UNIT I : Introduction : Fundamental steps of image processing, components of an image processing of system. The	Added: Unit II: Frequency domain filters,	Unit 2,3,4,5	1. Develop better image processing	60%

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Course Code	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed /Replaced	Change in Unit	Justification for the Modification	*Overall Revision Percentage
		<p>Processing, Components of an Image Processing System. Digital Image Fundamentals: Visual Perception, Image sensing & Acquisition, Image Sampling & Quantization, Some Basic Relationships between Pixels.</p> <p>UNIT II: Image Enhancement in the Spatial Domain: Some basic Gray level Transformations, Histogram Processing, Enhancement using Arithmetic/Logic Operations, Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement methods.</p> <p>UNIT III: Image Enhancement in the Frequency Domain: Fourier Transform and the Frequency Domain, Smoothing Frequency-Domain Filters, Sharpening Frequency Domain Filters, Homomorphism Filtering, Implementation.</p> <p>UNIT IV: Image Restoration: Image Degradation/Restoration Process, Linear, Position-Invariant Degradations, Inverse Filtering, Minimum, Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.</p>	<p>image model and image acquisition, sampling and quantization, relationship between pixels, distance functions, scanner.</p> <p>UNIT II : Transformation and Filtering : Statistical and spatial operations, Intensity functions transformations, histogram processing, smoothing & sharpening, spatial filters Frequency domain filters, homomorphic filtering, image filtering & restoration. Inverse and weiner filtering, FIR weiner filter, Filtering using image transforms, smoothing splines and interpolation.</p> <p>UNIT III : Segmentation and Edge Detection : Segmentation and Edge detection region operations, basic edge detection, second order detection, crack edge detection, gradient operators, compass and laplace operators, edge linking and boundary detection, thresholding, region based segmentation, segmentation by morphological watersheds.</p> <p>UNIT IV : Pattern Recognition Fundamentals: Basic Concepts of pattern recognition, Fundamental problems in pattern recognition system, design concepts and methodologies, example of automatic pattern recognition systems, a simple automatic pattern recognition model</p> <p>UNIT V: Solar image processing and analysis Automatic extraction of</p>	<p>homomorphic filtering, image filtering & restoration. Inverse and weiner filtering, FIR weiner filter, Filtering using image transforms, smoothing splines and interpolation. Replaced: Unit III, IV, V</p>		<p>and computer vision algorithms.</p> <p>2. Improve the performance of machine learning models that use image data.</p> <p>3. Build more powerful applications that can understand and interact with the visual world.</p>	

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Course Code	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed /Replaced	Change in Unit	Justification for the Modification	*Overall Revision Percentage
		Wavelets and MultiResolution Processing : MultiResolution Expansions, Wavelet Transforms in One dimension, The Fast Wavelet Transform, Wavelet Transforms in Two Dimensions. UNIT V: Image Compression: Image Compression Models, Error-Free Compression, Lossy Compression, Image Compression Standards. Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation.	filaments-Local thresholding, globalthresholding, featureextraction, experimentresults, solar flare detection, future analysis and pre processing, classificationrates, solar corona mass ejection detection.				
21CS304	RESEARCH FOUNDATIONS FOR PATTERN RECOGNITION	UNIT I : Introduction: Basic concepts, Applications, Fundamental problems in pattern Recognition system design, Design concepts and methodologies, Examples of Automatic Pattern recognition systems, Simple pattern recognition model. UNIT II: Decisions and Distance Functions: Linear and generalized decision functions, Pattern space and weight space, Geometrical properties, implementations of decision functions, Minimum distance pattern classifications. Probability - Probability of events:	Unit-1: Introduction, Features, feature vectors, classifiers, Supervised, semi-supervised and unsupervised learning, Classifiers based on bayes decision theory, estimation of unknown probability density functions, Nearest neighbour rule, Bayesian networks. Unit-II : Linear classifiers, Perceptron algorithm, least square methods, logistic discrimination, support vector machines, Non-linear classifiers, The XOR problem, 2-layer and 3-layer perceptrons, Beyond SVM paradigm, decision trees, combining classifiers. Unit-III : Feature Selection, Preprocessing, feature selection based	80 % Syllabus replaced	All Units	1. Feature selection and preprocessing can be used to improve the accuracy of spam filters. 2. Fuzzy clustering algorithms can be used to detect fraudulent transactions. 3. Template matching can be used to	80%

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Course Code	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed /Replaced	Change in Unit	Justification for the Modification	*Overall Revision Percentage
		<p>Random variables, Joint distributions and densities, Movements of random variables, Estimation of parameter from samples.</p> <p>STATISTICAL UNIT - III:</p> <p>DECISION MAKING - Introduction, Baye's theorem, Multiple features, Conditionally independent features, Decision boundaries, Unequal cost of error, estimation of error rates, the leaving-one-out-techniques, characteristic curves, estimating the composition of populations. Baye's classifier for normal patterns.</p> <p>Non Parametric Decision Making: Introduction, histogram, kernel and window estimation, nearest neighbour classification techniques. Adaptive decision boundaries, adaptive discriminant functions, Minimum squared error discriminant functions, choosing a decision making techniques.</p> <p>UNIT IV:</p> <p>Clustering and Partitioning: Hierarchical Clustering: Introduction, agglomerative clustering algorithm, the single-linkage, complete linkage and average-linkage algorithm .Ward's method Partition clustering-Forg's algorithm, K-means's algorithm, Isodata algorithm. Pattern Preprocessing and Feature selection: Introduction, distance</p>	<p>on statistical hypothesis testing, ROC Curve, data transformation and dimensionality reduction, K-L Transform, SVD, ICA, Kernel PCA, DFT, all Transforms, Regional features, features for text, shape and size characterization, Fractals, features for speech and audio classification.</p> <p>Unit-IV : Template matching, context dependent classification, supervised learning, clustering basic concepts, proximity measures, sequential algorithms, modification of BSAS, neural network implementation, hierarchical clustering algorithms.</p> <p>Unit-V : Schemes based on function optimization, fuzzy clustering algorithms, possibilistic clustering, hard clustering algorithms, vector quantization, clustering algorithms based on graph theory, competitive learning algorithms, binary morphology clustering algorithms, boundary detection algorithms, valley – seeking clustering algorithms, kernel clustering methods, density based algorithms for large data sets, cluster validity</p>			<p>detect tumors and other abnormalities in medical images.</p> <p>4. Context-dependent classification can be used to improve the accuracy of machine translation and text summarization systems.</p>	

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Course Code	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed /Replaced	Change in Unit	Justification for the Modification	*Overall Revision Percentage
		measures, clustering transformation and feature ordering, clustering in feature selection through entropy minimization, features selection through orthogonal expansion, binary feature selection.					
		UNIT V: Syntactic Pattern Recognition and Application of Pattern Recognition: Concepts from formal language theory, formulation of syntactic pattern recognition problem, syntactic pattern description, recognition grammars, automata as pattern recognizers, Application of pattern recognition techniques in bio-metric, facial recognition, IRIS scan, Finger prints, etc.,					
21CS307	CRYPTOGRAPHY AND NETWORK SECURITY	UNIT –I: Understanding Computer Network Security: Securing the Computer Network Forms of Protection, Security Standards. Security Threats to Computer Networks: Sources of Security Threats, Security Threat Motives, Security Threat Management, Security Threat Correlation, Security Threat Awareness. Computer Network Vulnerabilities: Sources of Vulnerabilities, Vulnerability Assessment. Cyber Crimes and Hackers: Cyber Crimes, Hackers, Dealing with the Rising Tide of Cyber Crimes. Hostile Scripts: Introduction to the Common Gateway Interface (CGI), CGI Scripts in a	UNIT –I: Introduction to Security: Security Concepts, Security Attacks, Security Services and Mechanisms, A model for network Security, Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor machines, steganography UNIT –II: Block Ciphers and DES: Traditional Block Cipher Structure, DES, DES Example, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles. AES: Finite Field Arithmetic, AES Structure, AES Transformation Functions, AES	80 % Syllabus replaced	All Units	1. Learning about hash functions based on CBC, SHA, and TLS can help you to improve the security of applications and systems. 2. Cryptographic algorithms help to better understand	80%

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Course Code	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed /Replaced	Change in Unit	Justification for the Modification	*Overall Revision Percentage
		<p>Three-Way Handshake, Server-CGI Interface, CGI Script Security Issues, Web Script Security Issues, Dealing with the Script Security Problems, Scripting Languages. Security Assessment, Analysis, and Assurance: System Security Policy, Building a Security Policy, Security Requirements Specification, Threat Identification, Threat Analysis, Vulnerability Identification and Assessment, Security Certification, Security Monitoring and Auditing, Products and Services. UNIT - II: Disaster Management: Disaster Prevention, Disaster Response, Disaster Recovery, Make your Business Disaster Ready, Resources for Disaster Planning and Recovery. Access Control and Authorization: Access Rights, Access Control Systems, Authorization, Types of Authorization Systems, Authorization Principles, Authorization Granularity, Web Access and Authorization. Authentication: Multiple Factors and Effectiveness of Authentication, Authentication Elements, Types of Authentication, Authentication Methods, Developing an Authentication Policy. UNIT -III: Firewalls: Types of Firewalls, Configuration and Implementation of a Firewall, The Demilitarized Zone (DMZ), Improving Security Through the Firewall, Firewall Forensics, Firewall Services and Limitations. System Intrusion Detection and Prevention: Intrusion Detection n, Intrusion Detection</p>	<p>Example, AES Implementation. Block Cipher Operation: Multiple Encryption and Triple DES, electronic code book mode, cipher block chaining mode, cipher feedback mode, output feed back mode, counter mode, Pseudorandom Number Generation and Stream Ciphers: Principles and Pseudorandom Number Generation, Pseudorandom Number, Generators, Pseudorandom Number Generation using a Block Cipher, Stream, Ciphers, RC4. UNIT -III: Public-key Cryptography and RSA: Principles of Public-Key Cryptosystems, the RSA algorithm. Attacks and counter measure on RSA, Improvements on RSA, Other Public-key Cryptosystems: Diffie-Hellman Key Exchange, ElGamal Cryptosystem, Elliptic Curve Arithmetic Elliptic Curve Cryptography, Cryptographic Hash Functions: Applications of Cryptographic Hash functions, Two Simple Hash Functions, Requirements and Security, Hash Functions based on Cipher Block Chaining, SHA. UNIT -IV: Messageauthenticationcodes:Requirements,functions,MACs,securityofMACs, HMAC.Digital Signatures:ElGamalDigitalSignature,Sc hnoordigitalsignature,DSS.Keymanage mentand distribution: Symmetric key distribution using symmetric encryption, symmetric key distribution using asymmetric</p>			<p>how they work and how to use them effectively.</p>	

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Course Code	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed /Replaced	Change in Unit	Justification for the Modification	*Overall Revision Percentage
		Systems (IDSs), Types of Intrusion Detection Systems, The Changing Nature of IDS Tools, Other Types of Intrusion Detection Systems, Response to System Intrusion, Challenges to Intrusion Detection Systems, Implementing an Intrusion Detection System, Intrusion Prevention Systems (IPSS), Intrusion Detection Tools. UNIT –IV: Computer and Network Forensics: Computer Forensics, Network Forensics, Forensics Tools. Virus and Content Filtering: Scanning, Filtering, and Blocking, Virus Filtering, Content Filtering, Spam. Computer Network Security Protocols: Application Level Security, Security in the Transport Layer, Security in the Network Layer, Security in the Link Layer and over LANS. Security in Wireless Networks and Devices: Cellular Wireless Communication Network Infrastructure. Wireless LAN (WLAN) or Wireless Fidelity (WiFi), Standards for Wireless Networks, Security in Wireless Networks. Security in Sensor Networks: The Growth of Sensor Networks, Design Factors in Sensor Networks, Security in Sensor Networks, Security Mechanisms and Best Practices for Sensor, Trends in Sensor Network Security Research. UNIT –V: Security Beyond Computer Networks: Information Assurance: Collective Security Initiatives and Best Practices. Network Perimeter Security: General Framework, Packet Filters, circuit Gateways, Application Gateways,	encryption, distribution of public keys, X.509 Certificates, Public-Key Infrastructure, User Authentication protocols:RemoteUserAuthenticationPrinciples,RemoteUserAuthentication usingSymmetricEncryption, Kerberos, Remote User Authentication Using Asymmetric Encryption UNIT –V: Transport-Level Security: Web Security issues, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH),Electronic Mail Security: Pretty Good Privacy, S/MIME, Domain Keys Identified Mail, IP Security: IP Security Overview. IP SecurityPolicy,EncapsulatingSecurityPayload,CombiningSecurityAssociations ,InternetKeyExchange, Cryptographic Suites				

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Course Code	Course Name	Existing Syllabus	New Syllabus	Topics Added/Removed /Replaced	Change in Unit	Justification for the Modification	*Overall Revision Percentage
		Trusted Systems and Bastion Hosts, Firewall Configurations, Network Address Translations, Setting Up Firewalls. The Art of Anti Malicious Software: Viruses, Worms, Virus Defence, Trojan Horses, Hoaxes, Peer-toPeer Security, Web Security, Distributed Denial of Service Attacks. The Art of Intrusion Detection: Basic Ideas of Intrusion Detection, Network-Based Detections and Host-Based Detections, Signature Detections, Statistical Analysis, Behavioural Data Forensics, Honeypots.					


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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Annexure-XI

Report- Analysis of Feedback on curriculum - received from the stake holders prior to the commencement of the Academic Year 2021-22

Feedback from different stake holders has been collected in respect of the curriculum offered for the academic year 2021-22

S. No.	Type of Stake holder	Number of feedbacks
1	Students	858
2	Parents	47
3	Alumni	17
4	Faculty	122
5	Academic peers	12
6	Industry persons	12
Total		1068

Name of the Programme	Stakeholder Feedback / Recommendation	Action Taken in BOS
Academic Peer		
B. Tech	Dr V K Gnanavel, Academic Peer, highly recommended this course to anyone looking to develop essential skills for employability. It's a valuable investment in personal and professional growth.	It is resolved to approve introducing a new course "Essential Skills for Employability" for 2021-22 admitted batch students.
B. Tech	Dr.P Manivannan, Academic Peer suggested that the inclusion of the "Computational Thinking for Object-Oriented Design (CTOD)" course is highly recommended, as it will empower students with essential problem-solving skills and a strong foundation in object-oriented design, aligning with the evolving demands of the tech industry.	It is resolved to approve introducing a new course "Computational Thinking For Object Oriented Design (CTOD)" for 2021-22 admitted batch students.
B.Tech, Pre-Ph.D	Dr Ohm Prakash SRM University, Associate Professor Chennai, Integrating Quantum Computing into our curriculum is crucial for empowering students with the skills and knowledge needed to harness the potential of cutting-edge technology and address intricate computational challenges. Suggest to introduce the course for both B.Tech & Ph.D batch.	It is resolved and approved to introduce a new course "Quantum Computing" for 2021-22 admitted batch B.Tech and Ph.D students.
B.Tech	Dr.C Siva Sankar Associate professor, Academic Peer suggested a revision for the DESIGN THINKING & INNOVATION course is highly recommended to incorporate the latest trends and case studies, ensuring students remain at the forefront of innovative problem-solving methodologies.	It is resolved to approve the revision of syllabus in Design Thinking & Innovation course to 2021-22 admitted batch.

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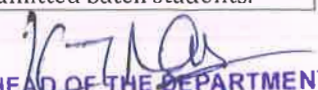
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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Name of the Programme	Stakeholder Feedback / Recommendation	Action Taken in BOS
B.Tech	Dr.R Venkata Ratnam, Academic Peer suggested a revision of the Mathematical Programming course is advisable to incorporate modern optimization techniques and real-world applications, ensuring students gain relevant skills for today's problem-solving challenges.	It is resolved to approve the revision of syllabus in Mathematical Programming course to 2021-22 admitted batch.
M.Tech	Dr.Bala Krishna, Hod of computer Science & Engineering Veltech university Avadi Chennai, Associate Professor , i suggested to revise the "Data Mining" course as it is vital to ensure that students are equipped with the latest data warehousing and data mining techniques and tools, enabling them to uncover valuable insights from large datasets and address contemporary data mining challenges.	It is resolved to approve the revision of syllabus of Data Mining course and title is changed as Data Warehousing & Mining to 2021-22 admitted batch.
M.Tech	Dr.Md.Mujahid, Associate Professor King Khalid University Saudi Arabia, suggested to enhance the "Cryptography & Network Security" course, consider integrating the latest cryptographic algorithms, cybersecurity best practices, and real-world case studies to address evolving threats	It is resolved to approve the revision of syllabus in Cryptography & Network Security course to 2021-22 admitted batch.
M.Tech	Dr. K. Raghava Rao, Professor in CSE, PI - KLIPFC and MSME-BI Projects , suggested that revising the "Continuous Delivery & DevOps" course is essential to equip students with the latest practices and tools in DevOps and continuous delivery	It is resolved to approve the revision of syllabus in Continuous Delivery & Devops course to 2021-22 admitted batch.
Pre-Ph.D	N Padmavati , Academic Peer suggested revising our Information Retrieval System course to ensure it remains current with the latest industry trends and technologies, enhancing our students' knowledge and employability in this critical field.	It is resolved to approve the revision of syllabus in Information Retrieval System course to 2021-22 admitted batch.
Pre-Ph.D	Dr.CH Rami Reddy VIT AP, I strongly recommend revising the course 'Research Foundations for Pattern Recognition' to enhance its practical applications and industry relevance, ensuring students gain both theoretical knowledge and hands-on skills vital in today's data-driven world	It is resolved to approve the revision of syllabus "Research Foundations for Pattern Recognition" course to 2021-22 admitted batch.
Pre-Ph.D	Dr. Sri Vani Associate Professor MRECW, I suggest revising the Cryptography & Network Security curriculum to ensure it remains aligned with the latest cybersecurity threats and technologies, equipping students with the most relevant and up-to-date knowledge to protect digital assets and privacy	It is resolved to approve the revision of syllabus "Cryptography & Network Security" course to 2021-22 admitted batch.
FACULTY		
B.Tech	Dr.T.S.RAJESHWARI, recommended Problem Solving Skills - 1 and Problem Solving Skills - 2 courses to be introduced into the curriculum as both courses enhance students' problem-solving capabilities and prepare them for real-world challenges.	It is resolved to approve introducing a new course "Problem Solving Skills - 1" and "Problem Solving Skills - 2" for 2021-22 admitted batch students.


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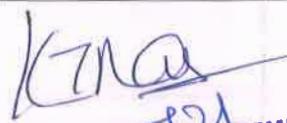
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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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B.Tech	Mr.T.RAVI KUMAR, Faculty, strongly recommended the addition of the 'Advanced Object-Oriented Programming' course to our curriculum, as it addresses the growing demand for advanced coding proficiency and design pattern expertise, crucial for students to excel in contemporary software development roles.	It is resolved to approve introducing a new course "Advanced Object Oriented Programming" for 2021-22 admitted batch students.
B.Tech	Dr. PRAGNYABAN MISHRA, Professor, CSE, I recommend adding the course "Multimodal Information Processing" to our curriculum, as it addresses critical skills needed in the contemporary data-driven landscape and enhances our students' competitiveness in various fields.	It is resolved to approve introducing a new course "Multimodal Information Processing" for 2021-22 admitted batch students.
B.Tech	Mr.SK.MOHAMMED GOUSE, Assistant Professor, Faculty recommended revising the Technical Skilling - 2 (MERN Stack Web Development) course to stay up-to-date with the rapidly evolving web development landscape, thereby providing students with the most relevant and practical skills for their future careers.	It is resolved to approve the revision of syllabus in Technical Skilling - 2 (Mern Stack Web Development) course to 2021-22 admitted batch.
Pre-Ph.D	Dr. C.KARTHIKEYAN, Associate Professor, Faculty recommended considering inclusion of "Evolution of Software Architectures" course as it is crucial to keep software systems relevant, efficient, secure, and adaptable to the ever-changing technological and business landscape. It ensures that software remains a valuable asset rather than becoming a liability.	It is resolved to approve introducing a new course "Evolution of Software Architectures" for 2021-22 admitted batch students.
Pre-Ph.D	Dr. CHAYAN PAUL, Associate Professor, Faculty suggested to introduce "Foundations of Data Science for Extensive Research" course that incorporates advanced data analysis techniques, machine learning, and big data technologies.	It is resolved to approve introducing a new course "Foundations of Data Science for Extensive Research" for 2021-22 admitted batch students.
Pre-Ph.D	Dr.Y.PRASHANTH, Professor, Faculty suggested Object-Oriented Analysis and Design course as it provides a solid foundation for designing robust and maintainable software systems, a crucial skill in today's software development industry.	It is resolved to approve introducing a new course "Object Oriented Analysis and Design" for 2021-22 admitted batch students.
Pre-Ph.D	Imran Rasheed, Faculty recommend including "Artificial Neural Networks" in the curriculum as it offers students invaluable insights into cutting-edge machine learning techniques, fostering their ability to tackle complex real-world problems	It is resolved to approve introducing a new course "Artificial Neural Networks" for 2021-22 admitted batch students.
Pre-Ph.D	P Ramya, faculty, suggested including Virtual and Augmented Reality into our program enriches the learning experience, fostering innovation and preparing students for the forefront of technology-driven industries.	It is resolved to approve introducing a new course "Virtual and Augmented Reality" for 2021-22 admitted batch students.


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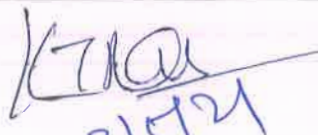
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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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Pre-Ph.D	Mohan Kumar, Faculty, recommended enthusiastically endorse the inclusion of 'Blockchain and Cryptocurrencies' in the curriculum, as it empowers students with crucial expertise in an emerging and transformative domain, fostering a wide array of career prospects.	It is resolved to approve introducing a new course "Blockchain and Cryptocurrencies" for 2021-22 admitted batch students.
Pre-Ph.D	Dr. Syamsundaraao, Faculty, highly recommended incorporating Speech Processing into the curriculum, as it empowers students to harness the power of human language in cutting-edge AI applications, fostering innovation and problem-solving in diverse fields.	It is resolved to approve introducing a new course "Speech Processing" for 2021-22 admitted batch students.
M.Tech	Ms. Naga Malleswari, Faculty Suggested to revise the "Compiler Design" course where it incorporate modern compiler construction techniques	It is resolved to approve the revision of syllabus in Compiler Design course to 2021-22 admitted batch.
Industry Person		
B.Tech	Murali Mohan Setty, Industry Personel highly recommended Probability, Statistics & Queueing Theory course to students seeking a strong foundation in data analysis and mathematical modeling, as it is invaluable for various academic and professional pursuits.	It is resolved to approve introducing a new course "Probability, Statistics & Queueing Theory" for 2021-22 admitted batch students.
M.Tech	Jack Ilamaran, Industry Person suggested to enhance the "Principles of Programming Languages" course, consider incorporating contemporary programming languages and paradigms, emphasizing practical application and industry relevance	It is resolved to approve the revision of syllabus in Principles of Programming Languages course to 2021-22 admitted batch.
Pre-Ph.D	Eugine Akash Industry Personnel strongly endorse the Financial Engineering & Business Intelligence program for its unique blend of quantitative analysis and advanced data-driven strategies, making it an ideal choice for individuals seeking a competitive edge in today's finance sector	It is resolved to approve introducing a new course "Financial Engineering & Business Intelligence" for 2021-22 admitted batch students.
Pre-Ph.D	Bandaru Ravi Teja, Industry Personnel highly recommend including Signal Processing in the curriculum as it is a fundamental skill for understanding and advancing technology in fields such as communications, healthcare, and audio processing.	It is resolved to approve introducing a new course "Signal Processing" for 2021-22 admitted batch students.
Pre-Ph.D	Kowndanya ,Technical Lead Cognizant, I requested to revises Digital Image Processing in our curriculum as it is a fundamental skill in today's data-driven world, to meet industry requirements, enabling students to excel in fields like computer vision and image analysis	It is resolved to approve the revision of syllabus "Digital Image Processing System" course to 2021-22 admitted batch.


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