RAMAIAH
Institute of Technology

CURRICULUM

Outcome Based Education

(Effective from the Academic Year 2024 – 2025)

INFORMATION SCIENCE AND ENGINEERING

VII & VIII SEMESTER B.E.

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 18 UG programs and 13 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^{+}' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute has also been conferred autonomous status for Ph.D. program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 70% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency Systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **Ramaiah Institute of Technology has obtained All India Rank 182 in "Scimago Institutions Rankings" for the year 2024.**

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. The Institute is a member of DELNET, CMTI and VTU E-Library Consortium. The Institute has a modern auditorium, recording studio, and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, Ramaiah Institute of Technology has achieved 75th rank among 1463 top Engineering Institutions & 21st Rank for School of Architecture in India among 115 Architecture Institutions, for the year 2024.

About the Department:

The Department of Information Science and Engineering (ISE) was established in the year 1992 with an objective of producing high quality professionals to meet the demands of the emerging field of Information Technology. Department offers Bachelor's program in Information Science and Engineering (B. E), Master's program in Data Science (MTech) and Doctoral program (Ph.D.). The Department of Information Science and Engineering, is a progressive department that has made significant contributions to Academics, Research and Innovation. Under Graduate (UG) is accredited by the National Board of Accreditation in 2001, 2004, 2010, 2015, 2018 and reaccredited in 2022 under Tier-1 till 2028. The department has highly qualified and competent faculty members committed to innovative teaching learning and quality research. Department has 8 well-equipped state of the art laboratories which meets the requirement of curriculum, innovation and research. Collaboration with industries such as Apple, Unisys, Mindtree, Intel, Google, SECO, IBM, NVIDIA etc, has a significant impact on the curriculum, computing infrastructure, teaching & learning and research. The curriculum is centered around Data Science, Artificial Intelligence, IOT, Cloud & Distributed Computing, System Programming, Computer Security and Software development. Curriculum and the teaching learning process ensure that the students demonstrate technical competence, ethical reasoning, creativity in identification & formulation of the problems and develop solutions by using appropriate tools & techniques. Department has established technical clubs/ professional student chapters to provide collaborative learning platform for the students. Echo system has been built to initiate start-ups/Innovation at the department level along with the mentorship program. The activities of the Department led to high profile placements, motivation to become an entrepreneur, and encouragement for higher learning.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

1. Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
2. Establishing research clusters in emerging areas in collaboration with globally reputed organizations
3. Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at MS Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To evolve as an outstanding education and research center of Information Technology to create high quality Engineering Professionals for the betterment of Society

MISSION OF THE DEPARTMENT

Department of Information Science and Engineering shall create high quality IT Engineering Professionals for the betterment of society by:

1. Providing education through an ever improving curriculum and effective pedagogy techniques.
2. Encouraging extra and co-curricular activities to develop their overall personality along with technical skills.
3. Collaborating with industry and academia for strengthening research, innovation and entrepreneurship ecosystem.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Become competent Information Technology professionals with continuous progress in career or learning.

PEO2: Productively engage with society by practicing research or entrepreneurship.

PEO3: Function effectively as professionals in a team environment or individually.

PROGRAM OUTCOMES (POs):

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

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

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

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

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

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

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

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

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

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Apply Mathematical models, programming paradigms and software development practices to solve real world problems

PSO2: Adopt computing and communication models for developing IT solutions.

PSO3: Acquire data engineering skills to develop intelligent systems in a multidisciplinary environment.

Semester-wise Credit Breakdown for B.E Degree Curriculum: Batch 2021-25

Course Category \ Semester	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Basic Sciences (BSC)	**08**	**08**	**03**	**03**	**--**	**--**	**--**	**--**	**22**
Engineering Sciences (ESC)	**09**	**11**	**--**	**--**	**--**	**--**	**--**	**--**	**20**
Humanities, Social Sciences and Management (HSMC)	**02**	**--**	**01**	**01**	**03**	**03**	**--**	**--**	**10**
Ability Enhancement Course (AEC)	**01**	**01**	**01**	**01**	**01**	**--**	**03**	**--**	**08**
Universal Human Values (UHV)	**--**	**--**	**02**	**--**	**--**	**--**	**--**	**--**	**02**
Professional Core Courses (PCC)	**--**	**--**	**11**	**12**	**11**	**05**	**04**	**--**	**43**
Integrated Professional Core Course (IPCC)	**--**	**--**	**03**	**03**	**03**	**--**	**04**	**--**	**13**
Professional Elective Courses (PEC)	**--**	**--**	**--**	**--**	**03**	**06**	**03**	**--**	**12**
Institutional Open Elective Courses (IOE)	**--**	**--**	**--**	**--**	**--**	**03**	**03**	**--**	**06**
Internship (INT)	**--**	**--**	**--**	**02**	**--**	**02**	**--**	**05**	**09**
Mini Project / Project Work (PW)	**--**	**--**	**--**	**--**	**--**	**03**	**--**	**12**	**15**
Non Credit Mandatory Courses (NCMC)	**--**	**--**	✔	**--**	✔	**--**	**--**	**--**	**--**
Total Credits	**20**	**20**	**21**	**22**	**21**	**22**	**17**	**17**	**160**

SCHEME OF TEACHING VII SEMESTER

VII SEMESTER									
Sl. No.	**Subject Code**	**Subject**	**Teaching Department**	**Category**	**Credits**				**Total contact hours /week**
					L	**T**	**P**	**Total**	
1	IS71	Distributed Computing	ISE	IPCC	3	0	1	4	5
2	IS72	Information Security	ISE	PCC	3	0	0	3	3
3	ISE73x	Program Elective Course-4	ISE	PEC	3	0	0	3	3
4	ISOE0*	Institutional Open Elective-2		IOE	3	0	0	3	3
5	ISL74	Data Visualization Laboratory Using PySpark and Tableau	ISE	AEC	0	1	2	3	6
6	ISL75	Big Data Lab	ISE	PCC	0	0	1	1	2
				Total	**12**	**1**	**4**	**17**	**22**

Programme Electives Course – 4

Sl.No	Code	Subject
1	ISE731	Deep Learning
2	ISE732	Predictive analytics
3	ISE733	Statistical Machine Learning
4	ISE734	Software Testing

Institutional Open Elective-2

Sl.No	Code	Subject
1	ISOE016	Introduction to Artificial Intelligence
2	ISOE017	Fundamental of Cloud Computing

Nomenclature: IPCC: Integrated Professional Core Course**, PCC:** Professional Core Course**, PEC:** Professional Elective Courses, **IOE:** Institutional Open Elective, **AEC–**Ability Enhancement Courses.

L –Lecture, T – Tutorial, P- Practical/ Drawing

Note: ISE73x , where x=1,2,3,4,..

ISOE0x*, where x=1,2,… continued from previous

Professional Elective Courses: A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in Engineering and Technology curriculum. Multidisciplinary courses that are added to supplement the latest trend and advanced technology in the selected stream of engineering. Each group provides an option to select one course out of five courses. The minimum student's strength for offering professional electives is 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent department. However, they can take an elective offered by other departments, provided they satisfy the prerequisite condition, if any. Registration to open electives shall be documented under the guidance of the Proctor.

Selection of an open elective shall not be allowed if,

The candidate has studied the same course during the previous semesters of the program.

The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.

A similar course, under any category, is prescribed in the higher semesters of the program.

The minimum students' strength for offering open electives is 10.

AICTE Activity Points to be earned by students admitted to BE program:

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years Degree Program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII Semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. In case student fail to earn the prescribed activity points; VIII semester Grade Card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII Semester grade card.

SCHEME OF TEACHING VIII SEMESTER

Sl.no	Subject Code	Subject		Category	Credits				Total Contact hours/week
					L	T	P	Total	
1	ISP81	Project Work		PW	0	0	12	12	-
2	INT82	Research/Industrial Internship		INT	0	0	5	5	-
		Total						17	
3	PE83	Physical Education		NCMC	All Students have to register compulsorily for any one of the courses with the concerned coordinator (Yoga teacher/Physical Education Director/ NSS Coordinator) in the beginning of the III semester. Attending the registered course from III to VIII semesters. Qualifying is mandatory for the award of the degree				

Nomenclature: PW: Project Work, **NCMC**: Non-credit Mandatory Course**, INT –**Internship

L –Lecture, T – Tutorial, P- Practical/ Drawing

DISTRIBUTED COMPUTING	
Course Code: IS71	**Credits:3:0:1**
Pre – requisites: NIL	**Contact Hours:42L+14P**
Course Coordinator: Dr. Shashidhar H S	

Course Content

Unit I

Introduction to parallel programming, Parallel hardware and parallel software – Classifications of parallel computers, SIMD systems, MIMD systems, Interconnection networks, Cache coherence, Shared-memory vs. distributed-memory, Coordinating the processes/threads, Shared-memory, Distributed-memory

Unit II

GPU programming, Programming hybrid systems, MIMD systems, GPUs, Performance - Speedup and efficiency in MIMD systems, Amdahl's law, Scalability in MIMD systems, Taking timings of MIMD programs, GPU performance

Unit III

Distributed memory programming with MPI – MPI functions, The trapezoidal rule in MPI, Dealing with I/O, Collective communication, MPI-derived datatypes, Performance evaluation of MPI programs, A parallel sorting algorithm

Unit IV

Shared-memory programming with OpenMP – openmp pragmas and directives**,** The trapezoidal rule, Scope of variables, The reduction clause, loop carried dependency, scheduling, producers and consumers, Caches, cache coherence and false sharing in openmp, tasking, tasking, thread safety

Unit V

GPU programming with CUDA - GPUs and GPGPU, GPU architectures, Heterogeneous computing, Threads, blocks, and grids Nvidia compute capabilities and device architectures, Vector addition, Returning results from CUDA kernels, CUDA trapezoidal rule I, CUDA trapezoidal rule II: improving performance, CUDA trapezoidal rule III: blocks with more than one warp, Bitonic sort

Programs:

1. Write a program to sort an array on n elements using both sequential and parallel merge sort(using Section). Record the difference in execution time.
2. Estimate the value of pi using:
   a. $\Pi = 4 \sum_{k=0}^{\infty} \frac{(-1)^k}{2k+1}$
   b. Parallelize the code by removing loop carried dependency and record both serial and parallel execution times.
3. Write an OpenMP program that divides the Iterations into chunks containing 2 iterations, respectively (OMP_SCHEDULE=static,2). Its input should be the number of iterations, and its output should be which iterations of a parallelized for loop are executed by which thread. For example, if there are two threads and four iterations, the output might be the following:
   a. Thread 0 : Iterations 0 −− 1
   b. Thread 1 : Iterations 2 −− 3
4. Write a program to calculate n Fibonacci numbers using tasks.
5. Write a program to find the prime numbers from 1 to n employing parallel for directive. Record both serial and parallel execution times.
6. Demonstration of MPI_Send and MPI_Recv
7. Demonstration of deadlock using point to point communication
8. Avoidance of deadlock by altering the call sequence
9. Avoidance of deadlock by non-blocking calls
10. Demonstration of Broadcast operation
11. Demonstration of MPI_Scatter and MPI_Gather
12. Demonstration of MPI_Reduce and MPI_Allreduce (MPI_MAX, MPI_MIN, MPI_SUM, MPI_PROD)
13. Write CUDA program to print greetings from the threads in multiple blocks.
14. Write CUDA program to add 2 vectors.
15. Write CUDA program that implements vector addition without unified memory.
16. Write CUDA program that finds distance between two vectors.
17. Write CUDA program to find the area under the curve using the trapezoidal rule.

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Understand the need for parallel programming (PO – 1, 2, PSO - 1)
2. Understand GPU programming and explain performance (PO - 1, 2, 4, 5, PSO - 1)
3. Apply MPI library and parallelize the suitable programs (PO – 1, 2, 3, 4, 5, PSO - 1)
4. Apply OpenMP pragma and directives to parallelize the suitable programs (PO - 1, 2, 3, PSO - 1)
5. Apply CUDA library and parallelize the given serial code (PO - 1, 2, 3, 4, 5, PSO - 1)

Suggested Learning Resources:

Text Books:

1. Peter S Pacheco, Matthew Malensek – An Introduction to Parallel Programming, second edition, Morgan Kauffman
2. Michael J Quinn – Parallel Programming in C with MPI and OpenMp, McGrawHill

References:

1. Calvin Lin, Lawrence Snyder – Principles of Parallel Programming, Pearson
2. Barbara Chapman – Using OpenMP: Portable Shared Memory Parallel Programming, Scientific and Engineering Computation
3. William Gropp, Ewing Lusk – Using MPI:Portable Parallel Programing, Third edition, Scientific and Engineering Computation

Web links and Video Lectures (e-Resources):

- Introduction to parallel programming: https://nptel.ac.in/courses/106102163

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Lab exercises

INFORMATION SECURITY	
Course Code: IS72	**Credits:3:0:0**
Pre – requisites: NIL	**Contact Hours:42**
Course Coordinator: Evangeline D and Dr. Geetha V	

Course Content

Unit I

Symmetric Ciphers: Symmetric cipher model, cryptography, cryptanalysis, Substitution techniques, Transposition Techniques. **Block Ciphers and the Data Encryption Standard:** Simplified DES, Block Cipher Principles, DES, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles, Block Cipher modes of operation.

Unit II

Public Key Algorithms: Introduction, Modular Arithmetic, RSA, Diffie-Hellman, Digital Signature Standards, How Secure are RSA and Diffie-Hellman, Elliptic Curve Cryptography. **Hash and MAC Algorithms:** Secure Hash Algorithm, Whirlpool, HMAC and CMAC.

Unit III

Detecting Live Systems: Detecting Active Systems, Port Scanning, OS fingerprinting, Scanning countermeasures.
Entity Authentication: Password based Authentication, Challenge Response Protocols, Zero Knowledge Protocols.
Key Management: Symmetric key Distribution, Kerberos, Symmetric Key Agreement, Public Key Distribution.

Unit IV

Automated Attack and Penetration Tools: Why attack and penetration Tools are Important, Automated Exploit Tools, Determining Which Tools to use
Defeating Malware: Evolving threat, viruses, and Worms, Trojans.
Malicious Software: Viruses and Related Threats, Virus Countermeasures, DDoS Attacks
Firewalls: Firewall Design Principles, Trusted Systems

Unit V

Securing Wireless Systems: Wi-Fi Basics, Wi-Fi Security, Wireless LAN threats, Exploiting wireless networks, Securing wireless Networks
Intrusion Detection: Overview ID detection and Prevention, IDS Types and Components, an overview of Snort, Installing Snort on windows System, and Building snort rules and interface.

Course Outcomes (COs):

At the end of the course, students will be able to-

1. Apply symmetric and block cipher technique to provide message confidentiality. (PO-1,2) (PSO-2)
2. Apply asymmetric key algorithms to preserve message authentication and confidentiality. (PO-1,2) (PSO-2)
3. Understand the concepts of live systems, entity authentication and key management. (PO-1) (PSO-2)
4. Use the automated tools to detect various types of attacks. (PO-1,2,3,4,5,9,10,12) (PSO-2)
5. Understand the security concepts of wireless networks. (PO-1) (PSO-2)

Suggested Learning Resources:

Text Books:

1. William Stallings, "Cryptography and Network Security principles and practices" 4th Edition PHI.
2. Michael Gregg, "Building your own Security LAB, A field Guide for Network Testing" Wiley India 2012.
3. Behrouz Forouzan, "Introduction to Cryptography and Network Security", McGraw Hill, 2nd edition.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=Q-HugPvA7GQ&list=PL71FE85723FD414D7
- https://www.youtube.com/watch?v=9X1rSWLFhLY&list=PL9FuOtXibFjV77w2eyil4Xzp8eooqsPp8
- https://www.youtube.com/watch?v=j_8PLI_wCVU
- https://guides.library.cmu.edu/c.php?g=572612&p=3948772
- https://library.educause.edu/topics/cybersecurity/network-security

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning:

- Case study on Network & Security tools.
- Project based learning

DEEP LEARNING	
Course Code: ISE731	**Credits: 3:0:0**
Prerequisites: Machine Learning	**Contact Hours: 42L**
Course Coordinator: Dr. VijayKumar BP	

Course Content

Unit I

Introduction: Human brain, neuron models, Neural nets as directed graphs, Feedback, Neural architectures, Knowledge representation, Connection to artificial intelligence.

Unit II

Learning Algorithms: Error-correction learning, Memory based learning, Hebbian learning, Competitive learning, Boltzmann learning, Credit assignment, Learning with and without a teacher, Learning tasks, Memory and statistical learning theory

Unit III

Deep neural networks: Deep feedforward networks, Regularization for deep learning, convolutional Networks, Neuro-scientific basis for convolutional operation.

Unit IV

Sequence Modelling: Recurrent and recursive nets - Unfolding Computational Graphs, Recurrent neural Networks (RNN), Bidirectional RNNs, Encoder-Decoder, Deep recurrent networks, Recursive neural networks. Practical Methodology, Applications of Deep learning.

Unit V

Deep Learning Techniques: Linear factor models, Autoencoders - Under complete, Regularized, De-noising Autoencoders, Manifolds with Auto encoders; Stochastic encoder and decoder; Deep generative models: Restricted Boltzmann machine, Generative adversarial networks.

Text Book:

1. Simon Haykin, Neural networks: A comprehensive foundation, Second Edition, Prentice Hall, New Delhi, 1999, ISBN-81-203-2373-4.
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016

Reference:

1. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
2. Josh Patterson & Adam Gibson, Deep Learning – A Practitioners Approach, O'Reilly, 1st Edition 2017.

Course Outcomes (COs):

At the end of the course, student will be able to -

1. Analyze and interpret the concepts of neural networks relating to artificial intelligence. (PO-1,2) (PSO-1, 3)
2. Illustrate the learning processes and their statistical properties. (PO-1, 2) (PSO-1, 3)
3. Build deep learning models using regularization and convolutional operations. (PO-1,2,3,5,9,10,11,12) (PSO 1-3)
4. Analyze sequential data to build recurrent and recursive models. (PO-1,2,3,5,9,10,11,12) (PSO-1, 3)
5. Develop and analyze the applications using Autoencoders. (PO-1,2,3,5,9,10,11,12) (PSO-1,3)

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=5tvmMX8r_OM Introduction to DL
- https://www.youtube.com/watch?v=eBA6vDR4w84 Error correction, Memory based learning;
- https://www.youtube.com/watch?v=XXMF_uCupOA Competitive, Hebbian learning; https://www.youtube.com/watch?v=5L9ElIcmoqM Boltzmann learning
- https://www.youtube.com/watch?v=AjtX1N_VT9E CNN
- https://www.youtube.com/watch?v=qjrad0V0uJE Recurrent NN
- https://www.youtube.com/watch?v=q222maQaPYo Auto encoder
- https://www.youtube.com/watch?v=3G5hWM6jqPk&list=PLtBw6njQRU-rwp5__7C0oIVt26ZgjG9NI&index=4 Deep generative models

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning):

- In Each Unit Assignment Experiments

PREDICTIVE ANALYTICS	
Course Code: ISE732	**Credits: 3:0:0**
Prerequisites: Machine Learning	**Contact Hours: 42L**
Course Coordinator: Dr. Anitha P	

Course Content

Unit I

Overview of Predictive Analytics: What is Analytics and Predictive Analytics? Business Intelligence, Difference between Predictive Analytics and Business Intelligence, Predictive analytics vs Data mining, who uses predictive analytics? Challenges in predictive analytics.

Unit II

Setting up the problem: Predictive Analytics Processing steps: CRISP-DM, Business understanding, Defining data for predictive model and target variable, defining measures of success for predictive models, Doing predictive modeling out of order, case study on fraud detection. **Data understanding:** Data visualization in one dimensions.

Unit III

Data Preparation: Variable Cleaning, Feature creation. **Descriptive Modeling**: Data Preparation with Descriptive Modeling, Principal Component Analysis.

Unit IV

Item sets and Association rules: Terminology, Parameter settings, How the data is organized, deploying association rules, problems with association rules, Building classification rules from association rules.

Unit V

Assessing Predictive models: Batch approach to model assessment, assessing regression models.
Text Mining: A predictive modeling approach to text mining, Data preparation steps, Text mining features

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Understand the basic concepts and challenges in Predictive Analytics(PO-1,2)(PSO-3).
2. Analyze the working of the predictive model with a case study(PO-1,2,3,5)(PSO-3).
3. Describe the concepts of Data Preparation and Modeling(PO-1,2,3,5)(PSO-3).
4. Examine the predictive modeling algorithms(PO-1,2,3,5)(PSO-3).
5. Describe the assessment of Predictive models(PO-1,2,3,4,5)(PSO-3).

Suggested Learning Resources:

Text Book:

1. Abbott, D. (2014). Applied predictive analytics: Principles and techniques for the professional data analyst. John Wiley & Sons.

References:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman , The Elements of Statistical Learning-Data Mining, Inference, and Prediction ,Second Edition , Springer Verlag, 2009.
2. G.James, D.Witten, T.Hastie, R.Tibshirani - An introduction to statistical learning with applications in R,Springer,2013.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=Kd0C-8q0HkI
- https://www.youtube.com/watch?v=JmI0B-kh5BY

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning:

- Case study
- Problem Solving

STATISTICAL MACHINE LEARNING	
Course Code: ISE733	**Credits:3:0:0**
Pre – requisites: NIL	**Contact Hours:42**
Course Coordinator: Dr. Sumana M	

Course Content

Unit I

Statistics and Engineering, Basic Concepts—Population and Sample, Pareto Diagrams and Dot Diagrams, Frequency Distributions, Graphs of Frequency Distributions, Stem-and-Leaf Displays, Descriptive Measures, Quartiles and Percentiles, calculation of X bar and S, Problems with aggregating data, Sample Spaces and Events, Counting, Probability, The Axioms of Probability, Some Elementary Theorems, Conditional Probability, Bayes' Theorem.

Unit II

Random Variables, The Binomial Distribution, The Hypergeometric Distribution, The Mean and the Variance of a Probability Distribution, Chebyshev's Theorem, The Poisson Distribution and Rare Events, Poisson Processes, The Geometric and Negative, Binomial Distribution, The Multinomial Distribution, Simulation, Bootstrap: Introduction and the idea, Theoretical Support, Primary applications of bootstrap, Some real data Example

Unit III

Continuous Random Variables, The Normal Distribution, The Normal Approximation to the Binomial Distribution, Other Probability Densities, The Uniform Distribution, The Log-Normal Distribution, The Gamma Distribution, The Beta Distribution, The Weibull Distribution, Continuous Random Variables, The Normal Approximation to the Binomial Distribution

Unit IV

Statistical approaches for Generalizations, Point Estimation, Interval Estimation, Maximum Likelihood Estimation, Tests of Hypotheses, Null Hypotheses and Tests of Hypotheses, Hypotheses Concerning One Mean, The Relation between Tests and Confidence Intervals, Power, Sample Size, and Operating Characteristic Curve, The Estimation of Variances, Hypotheses Concerning One Variance, Hypotheses Concerning Two Variances.

Unit V

Single-Factor ANOVA, Multiple Comparisons in ANOVA, More on Single-Factor ANOVA, Two-Factor ANOVA, Three-Factor ANOVA. Distribution free procedures: Wilcoxon single rank test, distribution-free confidence intervals, distribution-free ANOVA.

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Understand the concepts of Statistics and Engineering. (PO-1,8,9,10,11,12) (PSO-1)
2. Analyze the distributions for the given machine learning problem (PO-1,2,9,10,11,12) (PSO-1)
3. Apply distribution approaches for the given type of data. (PO-1,2, 3,9,10,11,12) (PSO-1)
4. Analyze various inferencing concerns with respect to mean. (PO-1, 9,10,11,12) (PSO-1)
5. Analyze the variance and interpret the results. (PO-1,2,11) (PSO-1)

Suggested Learning Resources:

Text Books:

1. Richard A. Johnson, "Probability and Statistics for Engineers ", 9th Edition, Pearson Education, 2014.
2. Jason Brownlee, Statistical Methods for Machine Learning, 2019

References:

1. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.
2. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=PQGTCckCdVo
- https://www.youtube.com/watch?v=twcACSPWBFM
- https://www.youtube.com/watch?v=DmZJ1blQOns
- https://www.youtube.com/watch?v=vEM4YnRFGoA
- https://nptel.ac.in/courses/106105239

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning:

- Case study based Statistical Approaches in Machine Learning
- Problem Solving for Analysis

SOFTWARE TESTING	
Course Code: ISE734	**Credits:3:0:0**
Pre – requisites: NIL	**Contact Hours:42**
Course Coordinator: Dr. Krishna Raj PM	

Course Content

Unit I

Basics of software testing: Definition, objectives, types of testing, importance of testing. Software development life cycle (SDLC) and its role in testing: Different phases, testing activities in each phase. Testing methodologies: Black-box testing, white-box testing, gray-box testing. Testing tools and techniques: Manual testing, automation testing, unit testing,integration testing, system testing, acceptance testing.

Unit II

Equivalence partitioning: Basic concepts, guidelines, examples. Boundary value analysis: Basic concepts, guidelines, examples. Decision table testing: Basic concepts, guidelines, examples. Error guessing: Techniques and applications. Test case design approaches: Data-driven testing, keyword-driven testing, behavior-driven testing.

Unit III

Test execution process: Planning, setup, execution, reporting. Defect management: Bug reporting, tracking, and resolution. Testing tools and automation frameworks: Introduction to popular tools and frameworks for test execution and automation. Non-functional testing: Performance testing, security testing, usability testing.

Unit IV

Agile testing principles and practices: Test-driven development (TDD),continuous integration and continuous delivery (CI/CD), exploratory testing. API testing: Concepts, tools, and techniques. Mobile testing: Challenges and best practices for mobile app testing.
Security testing: OWASP Top 10, common vulnerabilities, and testing methodologies.

Unit V

Effective communication in testing: Reporting test results, defect documentation, communication with stakeholders. Test plan and test case documentation: Importance, structure, best practices.
Quality assurance metrics and reporting: Code coverage, defect tracking metrics, test effectiveness reports.

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Understand the software development lifecycle (SDLC) and its relation to testing (PO -1, 4, 5; PSO- 1,2)
2. Apply various testing techniques and methodologies to different software types. (PO -1, 2, 3, 5; PSO- 1,2)
3. Analyze test results and identify potential defects. (PO -1, 2, 3, 5 ; PSO- 1,2)
4. Evaluate the effectiveness of different testing strategies. (PO -1, 2, 3, 5 ; PSO- 1,2)
5. Create test plans and documentation based on project requirements. (PO - 5,10 ; PSO- 1,2)

Suggested Learning Resources:

Text Books:

1. Rex Black, "Software Testing: A Guide to Effective Test Design", 4th Edition,Addison-Wesley, 2014.
2. Lisa Crispin and Janet Gregory, "Agile Testing: A Practical Guide for Testers and Agile Teams", Addison-Wesley, 2009.
3. Glenford J. Myers, "The Art of Software Testing", 3rd Edition, John Wiley & Sons,2004.

References:

1. Paul C. Jorgensen, Software Testing, A Craftsman‟s Approach, 4th Edition, Auerbach Publications, 2017.
2. Phillip Amman and Paul Underwood, Foundations of Software Testing, 6th Edition , Pearson Education, 2010
3. Lisa Crispin and Janet Gregory, Agile Testing: A Practical Guide for Testers and Agile Teams, Addison-Wesley Professional, 2009

Web links and Video Lectures (e-Resources):

1. https://onlinecourses.nptel.ac.in/noc23_cs38/preview
2. https://www.edx.org/learn/software-testing
3. https://www.coursera.org/courses?query=software%20testing
4. https://ocw.mit.edu/ans7870/6/6.005/s16/classes/03-testing/
5. https://www.youtube.com/watch?v=IPlP2R7l-Nc&t=2s
6. https://www.youtube.com/watch?v=wEr6mwquPLY
7. https://www.youtube.com/watch?v=Q50ZyydS7pI

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Case Study based learning using Testing tools
- Learning using Gamification

DATA VISUALIZATION LABORATORY USING PYSPARK AND TABLEAU	
Course Code: ISL74	**Credits: 0:1:2**
Pre – requisites: Nil	**Contact Hours: 14T + 28P**
Course Coordinator: Mrs. Kavya K S	

Course Content

- Introduction to Big Data and Analytics
- Introduction to PySpark
- PySpark Basics
- Advanced PySpark Techniques
- PySpark Machine Learning
- Introduction to Tableau
- Advanced Tableau Techniques
- Integrating PySpark with Tableau
- Creating Visualizations from PySpark Data and Building Dashboards using PySpark Data)
- Case Studies and Real-World Examples and Practical Applications and Projects
- Capstone Project.

List of Experiments:

Part A: PySpark

1. Write a PySpark program to create a DataFrame with four columns: “name”, “age”, “city”, and “gender” and perform the following operations:

- Insert minimum 10 values for the given columns.
- Filter rows with age greater than 30.
- Add a new column named it “tax”.
- Rename the “age” column to “years”.
- Drop Multiple Columns from the given data frame.

2. Write a PySpark program to create a DataFrame containing information about various products, including ProductID, ProductName, Category, Price, StockQuantity, & Rating and perform the following operations:

- Insert minimum 10 values for the given columns.
- Sort the DataFrame first by Price in descending order and then by Category in ascending order.
- Find the total sales amount for each product by category.
- Find the total sales amount and the total quantity sold for each product.

3. Using PySpark, analyze airline flight data (e.g., departure and arrival times, delays, carrier information) and perform the following operations:

- Load a CSV file containing airline flight data
- Filter flights that were more than 15 minutes delayed.
- Analyze whether there is any correlation between the flight length and the likelihood of a delay. ***Dataset***:https://drive.google.com/drive/folders/1KTpKBf5w8VOyPNTTIniM9oN-pwaIgjqf?usp=drive_link

4. Consider airline flight data, given in the previous question. Perform the following operation using PySpark

- Group the data by airline carrier and compute the average delay for each one.
- Determine the top five routes (origin-destination) with the highest average delay.

5. Given a Movie dataset containing user ratings for movies, using PySpark SQL perform the following operations

- Load a CSV file containing movie data
- Create temporary views for movies and ratings.
- Write queries to find the top 10 highest-rated movies with at least 10 ratings.
  Dataset:https://drive.google.com/file/d/17PFBafCd0J8brMNjdVV-NyNCBI01-7fr/view?usp=drive_link

6. Consider the movie dataset provided in the previous question. Perform the given operation using PySpark

- Find the most active users (users who have rated the most movies).
- Short the movies name in alphabetic order
- Calculate the average rating per genre.

7. Create a DataFrame containing real estate data with the following columns: HouseID, Location, Size, Bedrooms, Bathrooms, Price etc. Use the given dataset to build a linear regression model using PySpark's MLlib to predict the Price of a house based on the other features.

- Preprocess the data by handling missing values, encoding categorical variables (Location), and normalizing numerical features (Size, Bedrooms, Bathrooms, etc).
- Split the data into training and testing sets.
- Train a linear regression model on the training data.
- Evaluate the model's performance on the test data using the root mean square error (RMSE)
- Display the feature importances and interpret the results.
  Dataset: https://www.kaggle.com/datasets/sukhmandeepsinghbrar/house-prices-india/data

Part B: Tableau

1. Retrieve the sales dataset available in https://www.kaggle.com/datasets/kyanyoga/sample-sales-data in tableau and implements 1 and 2.

i. Create a bar chart to compare sales across different product categories. Use color coding to highlight the highest and lowest sales categories.

ii. Use a line chart to plot monthly sales over time. Highlight any seasonal trends or significant peaks.

iii. Create a heatmap to compare profit margins across products or categories. Use color gradients to differentiate between high and low-margin items.

2. Refer to the dataset in (1),

i. Create a dashboard that segments customers based on purchase frequency, average order value, and total revenue. Use clustering or grouping features in Tableau to identify different customer segments.

ii. Use Tableau's forecasting feature to predict future sales based on historical trends. Display the forecast in a line chart alongside past sales data.

3. Retrieve the market basket analysis dataset available in https://www.kaggle.com/datasets/aslanahmedov/market-basket-analysis in tableau and implement 3,4 and 5.

i. Create a bar chart or tree map in Tableau to show the top 10 items based on the frequency of purchases.

ii. Use a heatmap or matrix to visualize the co-occurrence of items in transactions, showing the most common pairs of items bought together.

iii. Identify frequent item sets and visualize them using a tree map or a bar chart, showing the most common bundles of items purchased together.

4. Refer to the dataset in (3) ,

i. Create a histogram to display the distribution of basket sizes across all transactions.

ii. Create a time series line chart or heatmap to analyze how the purchase frequency of specific items changes based on the day of the week or time of day.

iii. Perform a lift analysis and visualize it using a scatter plot to identify item pairs with the highest lift, indicating strong associations.

5. Refer to the dataset in (3) ,

i. Create a line chart to analyze how the purchase frequency of certain items varies across different seasons or months.

ii. Use conditional filtering and a bar chart to visualize how the inclusion of one item in a basket affects the probability of purchasing other items.

iii. Segment customers based on purchase behavior and use a tree map or bubble chart to show the likelihood of different customer segments purchasing specific product bundles.

6. Retrieve the employee performance prediction dataset from https://kaggle.com/datasets/gauravduttakiit/employee-performance-prediction in tableau .

i. Create a bar chart or treemap showing total sales revenue by product and region.

ii. Create a scatter plot with discount rates on one axis and sales volume or revenue on the other. Add trend lines to identify correlations.

iii. Use a dual-axis chart or side-by-side bar charts to compare sales and return rates across regions.

iv. Use a heatmap or line chart to analyze monthly or quarterly sales and returns.

7. Refer to dataset in (6) and implement the following

i. Use a scatter plot to analyze the relationship between product price and return rate.

ii. Obtain the following KPI's

a)What percentage of total sales are returned, and how does this vary by product category?(return rate KPI)

b) What is the year-over-year or month-over-month growth rate of sales? (sales growth KPI)

Text Books:

1. Tomasz Drabas, Denny Lee, Learning PySpark. O'Reilly, February 2017
2. Wenqiang Feng. Learning Apache Spark with Python, 2021. https://runawayhorse001.github.io/LearningApacheSpark/pyspark.pdf
3. Daniel G. Murray and the InterWorks BI Team, Tableau Your Data! Fast and Easy Visual Analysis with Tableau Software®, WILEY

Course Outcomes (COs):

At the end of the course, the student should be able to:

1. Understand the capabilities of PySpark for handling and processing large datasets. (PO-1,2,3, PSO-2)
2. Design and implement a variety of visualizations and interactive dashboards using Tableau. (PO- 1, 2,3, PSO-3)
3. Design and implement an end-to-end data visualization application by using PySpark to efficiently handle, clean, and transform large datasets (PO- 1,2,3,5-PSO-3)

BIG DATA LAB	
Course Code: ISL75	**Credits: 0:0:1**
Prerequisites: Nil	**Contact Hours: 14**
Course Coordinator: Dr S R Mani Sekhar	

Course Content

Part A

1. Implement the following file management tasks in Hadoop:
   - Adding files and directories
   - Retrieving files
   - Deleting files [Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.]
2. Write a Matrix Multiplication program using Hadoop Map Reduce.
3. Develop a Word Count program using Map Reduce Paradigm.
4. Develop a MapReduce program to analyze Titanic ship data and to find the average age of the people (both male and female) who died in the tragedy. How many persons are survived in each class. The titanic data should contain the following fields: PassengerId; Survived (survived=0 &died=1); Pclass; Name; Sex; Age; sibsp(siblings); Parch(parents); Ticket; FareCabin; Embarked (port) [dataset: https://github.com/datasciencedojo/datasets /blob/master/titanic.csv]
5. An e-Commerce company in Europe is analyzing the online retail sales. The name of the sales data file is" online_retail_data.csv". The schema of this data set is (Record No, Invoice No, StockCode, Description, Quantity, InvoiceDate, Price, Customer ID, Country). Some of the fields in some records may be blank. The analysis should be carried out using Hadoop eco system Hive. You need to perform analysis of the data to find out the following parameters for finalizing the sales strategy of the company for next year:

- Total number of unique customers in the "given country".
- Country from which the maximum revenue was collected from sales in the month of March 2010.
- Month of 2010 in which maximum number of items were sold.
- In the month of January 2010, find the country in which maximum number of items were sold
- The StockCode of the item with the highest number of sales in the "given country" in the year 2010

Dataset: https://docs.google.com/spreadsheets/d/10XBgqzKMcLGLRs95xXpdhWhtSa-w-ljL/edit?usp=drive_link&ouid=105051976182146717446&rtpof=true&sd=true

Part B

1. Implement a mini project using Big Data concepts.

Course Outcomes (COs):

1. Configure Hadoop and perform File Management Tasks (PO1,2,3, 5,9,10,12) (PSO 3)
2. Apply MapReduce programs to real time issues like word count, weather dataset and sales of a company. (PO1,2,3, 5,9,10,12) (PSO 3)
3. Analyse data set using Spark, Hadoop distributed file systems and MapReduce. (PO1,2,3, 5,9,10,12) (PSO 3)

Text Books:

1. Tom White, “Hadoop: The Definitive Guide” Fourth Edition, O’reilly Media, 2015.
2. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007.
3. Jules S. Damji, Brooke Wenig, Tathagata Das, and Denny Lee. Learning Spark Lightning-Fast Data Analytics, O’Reilly,2020

Reference:

1. https://spark.apache.org/docs/latest/streaming-programming-guide.html
2. Nick Pentreath, Machine Learning with Spark. Packt Publishing, 2015.

INTRODUCTION TO ARTIFICIAL INTELLIGENCE	
Course Code: ISOE016	**Credits:3:0:0**
Pre – requisites: NIL	**Contact Hours:42**
Course Coordinator: Dr. Lincy Meera Mathews	

Course Content

Unit I

Introduction: What is AI? Foundations of AI **Intelligent Agents:** Agents and environment, Concept of Rationality, The nature of environment, The structure of agents.

Unit II

Problem-solving: Problem-solving agents, Example problems, Searching for Solutions **Uninformed search strategies:** breadth-first search, depth-first search, iterative search, Bi directional Search **Informed search and exploration:** Heuristic functions, greedy algorithms, A* algorithm.

Unit III

Knowledge representation using logic: Knowledge-based agents, The Wumpus world, Propositional logic, Reasoning patterns in Propositional Logic **Interference in First-order Logic:** Propositional vs. First-Order Inference, Unification and Lifting, forward chaining – First order Definite clauses, A simple forward chaining algorithm Backward chaining - A Backward Chaining Algorithm. Resolution

Unit IV

Forms of Learning, Supervised learning, Learning Decision trees, Evaluating and choosing the Best hypothesis, The Theory of Learning, Regression and Classification with linear models, Artificial neural Networks, Support Vector Machine, Ensemble Learning.

Unit V

Philosophical Foundations: Weak AI, Strong AI, Ethical considerations in AI: bias, privacy, accountability. AI, the Present and the Future, Future trends in AI and emerging technologies.

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Understand the fundamental knowledge of artificial intelligence. (PO-1,2 ,7,9,10,11,12 & PSO-2)
2. Analyze different search strategies and their applications in AI world. (PO-1,2,7,9,10,11,12 & PSO-2)
3. Apply basic principles of logical inference to AI problems (PO-1,2,5,7,9,10,11,12 & PSO-2).
4. Distinguish between different types of learning and algorithms (PO-1,2,5,7,9,10,11,12 & PSO-2).
5. Recognize ethical implications and challenges in AI development. (PO-1,2,5,7,9,10,11,12 & PSO-2).

Suggested Learning Resources:

Text Books:

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence, 3rd Edition, Pearson,2015

References:

1. Elaine Rich, Kevin Knight: “Artificial Intelligence”, 3rd Edition, Tata McGraw Hill, 2018,

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=GHpchgLoDvI&list=PLp6ek2hDcoNB_YJCruBFjhF79f5ZHyBuz
- https://www.youtube.com/watch?v=fV2k2ivttL0&list=PLCD819D1E1C4F91C3
- https://www.youtube.com/watch?v=R3nqhDIEyMg&list=PLaatXkJEXKyJjYYOrWrmVPNbWvs_sRgmm

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning:

- Problem Solving through Application Based Questions

FUNDAMENTAL OF CLOUD COMPUTING	
Course Code: ISOE017	**Credits: 3:0:0**
Pre - requisites: Nil	**Contact Hours: 42**
Course Coordinator: Dr S R Mani Sekhar	

Course Content

Unit I

Cloud computing, cloud computing reference model, Characteristics and benefits, Challenges
Historical developments: Distributed systems, Virtualization, Web 2.0, Service-oriented computing, Utility-oriented computing
Building cloud computing environments: Application development, Infrastructure and system development, Computing platforms and technologies

Unit II

Principles of Parallel and Distributed Computing: Eras of computing, Parallel vs. distributed computing, Elements of parallel computing, parallel processing, Hardware architectures for parallel processing, Approaches to parallel programming, Levels of parallelism
Elements of distributed computing: Components of a distributed system, Architectural styles for distributed computing, Models for interprocess communication, Technologies for distributed computing

Unit III

Virtualization: Characteristics of virtualized environments, virtualization techniques, Execution virtualization, Other types of virtualization , Virtualization and cloud computing, Pros and cons of virtualization, Advantages and disadvantages of virtualization. Technology examples: Xen: paravirtualization, VMware: full virtualization

Unit IV

Cloud Computing Architecture : The cloud reference model, Architecture , Infrastructure- and hardware-as-a-service , Platform as a service, Software as a service. Types of clouds: Public clouds , Private clouds, Hybrid clouds, Community clouds, Economics of the cloud.
Open challenges: Cloud interoperability and standards, Scalability and fault tolerance , Security, trust, and privacy .

Unit V

Storage systems: evolution of storage technology, storage models, file systems, database, distributed file systems, general parallel file system, google file system, BigTable, Megastore.

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Apply the concepts of cloud delivery models and services. (PO-1,2,3,5,7,9,10,12) (PSO-2,3)
2. Build various cloud based applications. (PO-1,2,3,5,7,9,10,12) (PSO-2,3)
3. Illustrate different cloud resource virtualization strategies with case studies. (PO-1,7) (PSO-2,3)
4. Describe cloud resource management and scheduling policies (PO-1 ,7) (PSO-2,3)
5. Create cloud instances by applying storage models and security aspects. (PO-1,2,3,5,7,9,10,12) (PSO-2,3)

Suggested Learning Resources:

Text Book:

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi. Mastering Cloud Computing Foundations and Applications Programming, MK publications
2. Dan C. Marinescu,"Cloud Computing Theory and Practice", Second Edition Copyright, Elsevier

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_cs14/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning:

- Case Studies

VIII SEMESTER

PROJECT WORK	
Course Code: ISP81	**Credits: 0:0:12**
Pre - requisites: Nil	**Contact Hours:**
Course Coordinator: Dr Lincy Meera Mathews	

Course Content

Project Work-flow:

1. Students submit the initial details including broad area of work and choice of guide in a prescribed format.
2. The Project coordinators along with Head of the department finalize the guide allocation process.
3. Students are given an option to change the guide with mutual consent by applying through prescribed form.
4. Students submit the Project Work Book to guide on the day of registration.
5. Problem statement is submitted to Project Co-ordinator within one week of registration.
6. Students maintain a blog and update it on weekly basis about their work.
7. Weekly meeting with guide is recorded in the workbook.
8. Guide evaluates the student on a regular basis according to the rubrics defined in the workbook for total of 50 marks which constitutes the final CIE score.
9. At the end of the semester, an exam is conducted with one internal and one external examiner for 50 marks which constitutes the final SEE score.

Course Outcomes (COs):

At the end of the course, students will be able to

1. Formulate the problem and schedule milestones & deliverables using appropriate project management techniques. (PO-2,9,11,12) (PSO-1)
2. Compare and contrast the available literature in the context of the project. (PO-2,4,9,12) (PSO-3)
3. Design and Develop the solution by applying the relevant guidelines (PO-1,2,3,4,5,6,7,9,11,12) (PSO-1,2,3)
4. Evaluate the quality of the solution with existing solutions. (PO-4,9) (PSO-1,2)
5. Document & demonstrate the solution and appraise its effectiveness (PO-8,9,10,11) (PSO-3)
6. Work effectively which contributes to team success. (PO-9,10) (PSO-3)

RESEARCH / INDUSTRIAL INTERNSHIP	
Course Code: INT81	**Credits: 0:0:5**
Pre - requisites: Nil	**Contact Hours:**
Course Coordinator: Dr Rajeshwari S B	

Course Content

Guidelines:

- The student can do the Internship during the summer semester between 4^{th}-5^{th} semesters or between 6^{th}-7^{th} semesters.
- The student should take prior permission from the department committee before carrying out the internship.
- The duration of the Internship is one month.
- The report of the Internship needs to be submitted to the department in the 8^{th} semester.
- The department will constitute a committee for the evaluation of Internship of student.

Course Outcomes (COs):

At the end of the course, students will be able to-

1. Schedule milestones of deliverables and formulate the requirements of the proposed work. (PO-2,9,11,12) (PSO-1)
2. Apply the engineering knowledge to develop Solution in an industry environment (PO-1,2,3,4,5,6,7,9,12) (PSO-1,2,3)
3. Develop the inter-personal skills required to work in a professional team. (PO-8,9, 10, 11,12) (PSO-2, 3)
4. Engage in independent study of technology required for development of software. (PO-9,12) (PSO-2, 3)
5. Demonstrate and document the project and appraise its effectiveness (PO-8,9,10,12) (PSO-3)