B.Tech - Artificial Intelligence and Data Science

[Offered by KCT | Affiliated to Anna University, Chennai | Approved by AICTE, Govt. of India]

Awarded by

Curriculum & Syllabi

I & II Semesters

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Course Content for B.Tech AI & DS Program

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PROGRAM EDUCATIONAL OBJECTIVES:

The graduates of this program shall have:

1. A successful professional career in industry, government, and academia with capabilities to build innovative solutions using technology as a tool to solve real-world problems.
2. Research capabilities in advanced technologies and shall contribute to a new body of knowledge.
3. A learning mindset to continuously improve their knowledge, through on the job, formal and informal learning opportunities
4. An ethical attitude and shall exhibit effective skills in communication, management, teamwork and leadership.
5. Engineering, problem-solving and critical thinking skills to create social, economical and sustainable impact.

PROGRAM SPECIFIC OUTCOMES:

After completing their graduation, students of AI & DS will be able to:

1. Apply the principles of artificial intelligence and data science that require problem-solving, inference, perception, knowledge representation, and learning.
2. Demonstrate the ability to create innovative solutions from idea to product, applying scientific methods and tools
3. Exhibit strong professional skills to function effectively in multi-disciplinary and heterogeneous teams with a growth mindset.

PROGRAM OBJECTIVES:

Graduates of AI & DS programme will have the following abilities:

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:** Identity, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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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 modelling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply to reason 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 teamwork:** 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.

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Curriculum of B.Tech AI & DS Program

Knowledge Disciplines	I - Year		II - Year		III - Year		IV - Year	
	Bridge	Introduction	Foundation	Concentration	Specialization	ProtoSem	Fellowship	Fellowship
	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Sem VII	Sem VIII
Fundamental Science	Engineering Physics (Physics Practicum) (4)	Advanced Physics (3)				ProtoSem [Core] (9) [Advanced Technology Electives] (9) [Open Elective-II] (3) [Business & Entrepreneurship Electives] (3)	Fellowship (10) [Certification Courses] (4)	Fellowship (9) [Certification Courses] (4I
Math and Statistics	Linear Algebra and Calculus (MATLAB Practicum) (4)	Discrete Mathematics (3) Probability and Statistics (R Practicum) (4)	Multivariate Calculus and Forecasting (4)	Random Process and Optimization (4)				
Computer Science	Introduction to Python (Python Practicum) (3) Introduction to Computational Machines (HW Practicum) (3)	Object-Oriented Programming and Data Structures (Python Practicum) (3)	Algorithms and Optimization of Programs (Python Practicum) (4) Operating System (3)	Computer Networks (3)	Cloud Architecture (AWS Practicum) (4)			
Artificial Intelligence		Introduction to AI & ML (Python Practicum) (3)	Applied Machine Learning(PyTorch/ Tensorflow)(4)	Neural Networks and Deep Learnings (Keras and MXnet Practicum) (4)	AI/ML Elective - I (3)			
Data Science		Introduction to Data Science (Sheets Practicum) (3)	Data Collection & Data Management (Oracle and SQL Practicum) (3)	Data Mining & Modeling (Rapid Miner Practicum) (4)	Data Visualization (Power BI / Tableau Practicum) (3) Data Analysis & Decision (SaS Practicum) (3)			
Advanced Technology					Advanced Technology Electives -1 (3)			
Arts and Humanities	Fundamentals of Communication I (English Practicum) (3)	Growth Lab I (NC)	Growth Lab II (NC)	Growth Lab III (NC)	Open Elective - I (3)			

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	Introduction to Indic Culture and Sciences (1)	Externship I (NC)	Tools and Technologies for Wellness (1)	Externship II (NC)	Philosophy of Wellness (1)		Externship III (NC)	
Business & Entrepreneurship			Principles of Economics (2)	Finance for Engineers (2)	Marketing 101 (2)			
Innovation and Design	Engineering Sprints (3)	Innovation Sprints (3)	Design Sprints (3)	Ideation Sprints (3)				
	Credits: 21	**Credits: 22**	**Credits: 24**	**Credits: 20**	**Credits: 22**	**Credits: 24**	**Credits: 14**	**Credits: 13**

Total Credits: 160

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Consolidated Course Information

Course Type : *Professional Core (PC), Professional Elective (PE), Humanities and Social Science (HS), Basic Science(BS), Engineering Science(ES), Open Elective(OE), Project Work(PW)*

	Semester I									
S.No	**Course Title**	**Course Code**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Prerequisite**
1	Engineering Physics	U18PHI1202	Embedded - Theory & Lab	BS	3	0	2	0	4	
2	Linear Algebra and Calculus	U18MAI1203	Embedded - Theory & Lab	BS	3	0	2	0	4	
3	Introduction to Computational Machines	U18AII1204	Embedded - Theory & Lab	ES	2	0	2	0	3	
4	Introduction to Python	U18AII1205	Embedded - Theory & Lab	ES	2	0	2	0	3	
5	Fundamentals Of Communication	U18ENI1202	Embedded - Theory & Lab	HS	2	0	2	0	3	
6	Introduction to Indic Culture and Technologies	U18AIC1006	One Credit Course	HS	2	0	0	0	1	
7	Engineering Sprints	U18AII1607	Embedded - Project & Lab	ES	0	0	4	2	3	
				Total Credits					**21**	

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Course Type : *Professional Core (PC), Professional Elective (PE), Humanities and Social Science (HS), Basic Science(BS), Engineering Science(ES), Open Elective(OE), Project Work(PW)*

	Semester II									
S.No	**Course Title**	**Course Code**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Prerequisite**
1	Advanced Physics	U18PHT2203	Theory	BS	3	0	0	0	3	
2	Discrete Mathematics	U18MAT2001	Theory	BS	3	0	0	0	3	
3	Probability and Statistics	U18MAI2203	Embedded - Theory & Lab	BS	3	0	2	0	4	
4	Object-Oriented Programming and Data Structures	U18AII2204	Embedded - Theory & Lab	PC	2	0	2	0	3	U18AII1205
5	Introduction to AI & ML	U18AII2205	Embedded - Theory & Lab	PC	2	0	2	0	3	U18AII1205
6	Introduction to Data Science	U18AII2206	Embedded - Theory & Lab	PC	2	0	2	0	3	
7	Growth Lab I	U18AII2607	Embedded - Project & Lab	HS	-	-	-	-	-	
8	Externship I	U18AIP2708	Project	PW	-	-	-	-	-	
9	Innovation Sprints	U18AII2609	Embedded - Project & Lab	ES	0	0	4	2	3	
	Total Credits				**22**					

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Course Type : *Professional Core (PC), Professional Elective (PE), Humanities and Social Science (HS), Basic Science(BS), Engineering Science(ES), Open Elective(OE), Project Work(PW)*

	Semester III									
S.No	**Course Title**	**Course Code**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Prerequisite**
1	Multivariate Calculus and Forecasting	U18MAI3201	Embedded - Theory & Lab	BS	3	0	2	0	4	U18MAI1203
2	Algorithms and Optimization of Programs	U18AII3202	Embedded - Theory & Lab	PC	3	0	2	0	4	U18AII2204
3	Operating System	U18AII3203	Embedded - Theory & Lab	PC	2	0	2	0	3	---
4	Applied Machine Learning	U18AII3204	Embedded - Theory & Lab	PC	3	0	2	0	4	U18AII2205
5	Data Collection & Data Management	U18AII3205	Embedded - Theory & Lab	PC	2	0	2	0	3	---
6	Tools and Technologies for Wellness	U18AIC3006	One Credit	HS	1	0	0	0	1	---
7	Growth lab II	U18AII3607	Embedded - Project & Lab	HS		-	-	-	-	---
8	Principles of Economics	U18AIT3008	Theory	ES	2	0	0	0	2	---
9	Design Sprints	U18AII3209	Embedded - Project & Lab	ES	0	0	4	2	3	---
	Total Credits								**24**	

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Course Type : *Professional Core (PC), Professional Elective (PE), Humanities and Social Science (HS), Basic Science(BS), Engineering Science(ES), Open Elective(OE), Project Work(PW)*

	Semester IV									
S.No	**Course Title**	**Course Code**	**Course Type**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Prerequisite**
1	Random Process and Optimization	U18MAT4105	Theory	BS	3	1	0	0	4	---
2	Computer Networks	U18AII4201	Embedded - Theory & Lab	PC	2	0	2	0	3	---
3	Neural Networks and Deep Learning	U18AII4202	Embedded - Theory & Lab	PC	3	0	2	0	4	U18AII2205
4	Data Mining & Modeling	U18AII4203	Embedded - Theory & Lab	PC	3	0	2	0	4	U18MAI2203
5	Growth Lab III	U18AII4604	Embedded - Project & Lab	HS	-	-	-	-	-	---
6	Externship II	U18AIP4705	Project	HS	-	-	-	-	-	---
7	Finance for Engineers	U18AIT4006	Theory	ES	2	0	0	0	2	---
8	Ideation Sprints	U18AII4607	Embedded - Project & Lab	ES	0	0	4	2	3	---
	Total Credits								**20**	

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Course Type : *Professional Core (PC), Professional Elective (PE), Humanities and Social Science (HS), Basic Science(BS), Engineering Science(ES), Open Elective(OE), Project Work(PW)*

	Semester V									
S.No	**Course Title**	**Course Code**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	Elective 1	U18XXE5XXX	Theory	OE	3	0	0	0	3	---
2	Elective 2	U18XXE5XXX	Theory	OE	3	0	0	0	3	---
3	Cloud Architecture	U18AII4201	Embedded - Theory & La	PC	3	0	2	0	4	---
4	AI/ML Elective	U18AIE4XXX	Theory	PE	3	0	0	0	3	---
5	Data Visualization	U18AII5201	Embedded - Theory & La	PC	2	0	2	0	3	U18AII3205
6	Data Analysis	U18AII5202	Embedded - Theory & La	PC	2	0	2	0	3	U18MAI2803
7	Marketing 101	U18AIT5003	Theory	ES	2	0	0	0	2	---
8	Philosophy of Wellness	U18AIC5104	Theory	ES	0	1	0	0	1	---
			Total Credits						**21**	

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Course Type : *Core (C), Elective (E), Bootcamp (B), Certificate (Cer) and Diploma (D), Sprints (S), Externship (ES) & Fellowship(F)*

	Semester VI									
S.No	**Course Title**	**Course Code**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	ProtoSem	U18AIXXXX		D					24	
				Total Credits					**24**	

	Semester VII									
S.No	**Course Title**	**Course Code**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	Fellowship	U18AIXXXX		F					10	
2	Advanced Technology Certification	U18AIXXXX		Cer					4	
3	Externship III	U18AIXXXX		ES						
				Total Credits						**14**

	Semester VIII									
Course Discipline	**Course Title**	**Course Code**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
Innovation and Design	Fellowship	U18AIXXXX		F					9	
Innovation and Design	Advanced Technology Certification	U18AIXXXX		Cer					4	
				Total Credits					**13**	

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List of Electives and Certification Courses

III year - V Sem

AI/ML Elective

1. Natural Language Processing with Deep Learning
2. Introduction to Spatial Computing
3. Computer Vision with Convolution Neural Networks
4. Recommendation system for e-commerce
5. Mining Massive Data Sets
6. Neural Computation
7. Human-Centred Systems
8. Speech Processing

III Year - VI Sem (ProtoSem)

Advanced Technology Electives

- **Future Mobility Cluster**
    1. Vehicle Architecture
    2. Battery Management Systems
    3. Autonomous Technology
    4. Sensor Design and Dynamics
    5. Power Drive Trains
    6. Energy Storage Technology
    7. Fuel Cell & Hybrid Power Technology
    8. Intelligent Vehicle Technology
- **Industry AIoT Cluster**
    1. IoT and Security
    2. Sensor Networks
    3. Autonomous Flying Robots
    4. Robotics
    5. Additive Manufacturing and Tooling
    6. Industrial Automation using AI
- **Advanced Computer Science Cluster**
    1. Ethical Hacking
    2. Game Development
    3. Cryptography and Network Security
    4. Blockchain Technology
    5. Graphics and Multimedia
    6. Information Coding Techniques
    7. Advanced DBMS
    8. UI/UX Design
    9. Web Application Development
    10. Applied AR/VR
    11. Advanced C and C++
    12. Mainframe Technology

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13. Software Architecture
14. Parallel & Distributed Systems

- **Electronics & Design Cluster**
    1. Fundamentals of Nanoscience and Nanotechnology
    2. System on Chip
    3. MEMS and NEMS
    4. Advanced Image Processing and Pipelining
    5. Sensors for Engineering Applications
    6. Integrated Control Systems
    7. Advanced Embedded System Design
    8. Smart Grid Engineering
    9. Flexible and Wearable Electronics
    10. Assistive Technology
- **Smart City**
    1. Risk-informed infrastructure asset management
    2. Sustainable urban transport management
    3. Decision-Making for uncertainty
- **Other Technology Cluster**
    1. Neurobiology and Cognitive Sciences
    2. Geographical Information System
    3. Bio Information
    4. Quantum Computing
    5. Renewable Energy
    6. Advanced Materials

III Year - VI Sem (ProtoSem)

Business & Entrepreneurship Electives

1. Technology Entrepreneurship
2. Product Management
3. AI in Business
4. Budgeting & Costing
5. Project Management
6. Business Intelligence
7. IPR and Patent Drafting

Certification Courses

1. IBM Cyber Security Analyst Professional Certificate
2. Deeplearning.ai TensorFlow Developer Professional Certification
3. Google IT Automation with Python Professional Certification
4. Cloud Architecture with Google Cloud Professional Certification
5. IBM AI Engineering Professional Certification
6. IBM Applied AI Professional Certification
7. Data Engineering with Google Cloud Professional Certification
8. SAS Programmer Professional Certification
9. Cloud Engineering with Google Cloud Professional Certification

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10. SAS Visual Business Analytics Professional Certificate
11. Professional Certificate program in Digital Transformation
12. Professional Certificate Program in Innovation & Technology
13. Professional Certificate Program in Legal Tech in the Digital Era
14. AWS Certified Cloud Practitioner
15. AWS Certified Solution Architect (Associate)
16. AWS Certified Developer (Associate)
17. AWS Certified Data Analytics (Speciality)
18. AWS Certified Database (Specialty)
19. AWS Certified Machine Learning (Specialty)
20. Tensorflow Certification (TF)

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Syllabi - 1st Year
Semester I

U18PHI1202	ENGINEERING PHYSICS	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To explain principles of optics.
- To make students understand the basic concepts of Principles of Physics in a broader sense
- To enable a view to lay the foundation for the various engineering courses
- To demonstrate competency and understanding of the concepts found in quantum mechanism, laser, Optical fiber, Waves in one dimension, Wave Optics, Lasers, Fiber Optics and a broad base of knowledge in physics.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Enhance the fundamental knowledge in properties of matter and its applications relevant to various applications of Engineering
CO 2:	Understanding the phenomenon of heat transfer mechanisms in engineering systems.
CO 3:	Acquire knowledge in the basic concepts of quantum mechanics and electron microscopy.
CO 4:	Imbibe the concept of lasers, optical fibers and their applications in engineering.
CO 5:	Introduce and provide a broad view of acoustics.
CO 6:	Apply the NDT techniques and modern engineering tools necessary for Engineering practice.

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Pre-requisite courses: Not applicable

CO/PO Mapping (S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcomes (POs)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M									M
CO2	S	M	M									M
CO3	S	M		M								M
CO4	S	M		M								M
CO5	S	M										M
CO6	S	M	M									M

Course Assessment Methods:

DIRECT

1.Continuous Assessment Test I, II (Theory component)
2.Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3.Demonstration etc (as applicable) (Theory component)
4.Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5.Model Examination (lab component)
6.End Semester Examination (Theory and lab components)

INDIRECT

1. Course-end survey

Topics covered:

PROPERTIES OF MATTER	**9 Hours**

Hooke's Law - Elastic moduli - Relation between elastic constants - Poisson's Ratio – Stress - Strain Diagram and its uses – factors affecting elastic modulus – Bending of beams – Expression for bending moment and depression -

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Cantilever - Depression of a cantilever - experimental determination of Young's modulus by Non uniform bending – I shape girders

THERMAL PHYSICS	**9 Hours**

Transfer of heat energy – conduction, convection and radiation – thermal expansion of solids and liquids – expansion joints – bimetallic strips – theory of heat conduction in solids – rectilinear flow of heat – determination of thermal conductivity of a bad conductor - Lee's & Charlton's disc method - Thermal Insulation – classification and properties – heat exchangers - applications – domestic refrigerator – microwave oven.

MODERN PHYSICS	**9 Hours**

Planck's concept (hypothesis) - Compton effect - Expression for Compton shift - Concept of matter waves - Physical significance of wave function - Schrödinger's wave equation - Time independent and time dependent equation - Eigenvalues and Eigenfunction - Particle in a box (one dimension)- Scanning electron microscope (SEM)- Transmission electron microscope (TEM).

APPLIED OPTICS	**9 Hours**

LASERS: Absorption and emission - Spontaneous emission - Stimulated emission - Population inversion - Sources of excitation - Active medium - Resonant cavity - Einstein's theory of stimulated emission - Nd-YAG laser - CO_2 laser - Semiconductor lasers - Applications – holography, cutting welding , drilling.
Fibre optics: Structure of optical fiber -principle and propagation of light in optical fibers - Numerical aperture and acceptance angle - - Types of optical fibers - Applications - Fiber optic communication system, Fiber endoscope.

ACOUSTICS AND ULTRASONICS	**9 Hours**

Acoustics: Sound basic definitions - Reverberation - Reverberation time - Sabine's formula - Absorption coefficient and its determination - Factors affecting the acoustics of the buildings and their remedies.
Ultrasonics: Production of ultrasonic waves- Magneto-striction and Piezoelectric methods - Properties -Detection - Thermal and Knut's methods, Determination of velocity of ultrasonic waves in liquids using acoustic grating – applications - A, B, C scan.

Theory: 30 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

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Lab component Contents:

LIST OF EXPERIMENTS

1. Non-uniform bending – Determination of Young's modulus
2. Compound Pendulum – Determination of acceleration due to gravity
3. Spectrometer – Determination of wavelength of mercury source using grating
4. Air wedge - Determination of thickness of thin sheet
5. Semiconductor Laser:
    a. Determination of wavelength of laser
    b. Determination acceptance angle and numerical aperture of an optical fibre.
    c. Determination of particle size
6. Melde's string – Determination of frequency of a tuning fork
7. Determination of band gap of a semiconductor
8. Luxmeter – Determination of efficiency of solar cell
9. Lee's disc – Determination of thermal conductivity of a bad conductor
10. B-H Curve apparatus – Determination of magnetic susceptibility of a solid material.

Experiments for Demonstration:

1. Hall effect
2. Hardness Test
3. Four probe experiment
4. Ultrasonic interferometer

Practical: 30 hrs	**Tutorial: 0**	**Total Hours : 30 Hrs**

Textbooks:

1. Kumar Senthil G, Revised Edition 2020-21, Engineering Physics, VRB Publishers Pvt Ltd., Chennai.
2. Arthur Besier, Shobhit Mahajan, S. Rai Choudhury, 7th Edition, 2015, Concepts of Modern Physics, Mcgraw Hill Education, New Delhi.

Reference Books:

1. Avadhanulu M N , 1992, A textbook of Engineering Physics, S. Chand Publishing
2. Dr. Aparna Y & Dr. Venkateswara Rao K, Laboratory Manual of Engineering Physics, V.G.S Publishers.
3. Brijlal and Subharamaniam, 2004, Properties of matter, S. Chand & Co Ltd., New Delhi.
4. Prakash Satya , 2015, Quantum Mechanics, Pragati Prakashan Publishers.
5. Thyagarajan K, Ghatak Ajoy, 2010, Lasers: Fundamentals and Applications, Springer Science & Business Media.
6. Introduction to Fiber Optics, K. Thyagarajan, Ajoy Ghatak, Second Edition, Springer New York Dordrecht Heidelberg London, 2010.
7. Dale Ensminger and Leonard J. Bond, Ultrasonics: Fundamentals, Technology, Applications, Second Edition, 1988, Marcel Dekker, New York.
8. C. C. Ouseph, U. J. Rao, V. VijayendranS, Practical Physics and Electronics, Viswanathan (Printers & Publishers), Pvt., Ltd.

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U18MAI1203	LINEAR ALGEBRA AND CALCULUS	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To explain the main concepts of linear algebra that are used in data analysis and machine learning.
- To improve the student's practical skills of using linear algebra methods in machine learning and data analysis.
- To learn the fundamentals of working with data in vector and matrix form, acquire skills for solving systems of linear algebraic equations and finding the basic matrix decompositions and general understanding of their applicability.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Identify eigenvalues and eigenvectors, apply Cayley Hamilton theorem to Matrix Manipulation and apply orthogonal diagonalization to convert quadratic form to canonical form which will form the basis for Principal Component Analysis.
CO 2:	Understand the concept of vector spaces and perform LU Decomposition and Singular Value Decomposition, that are essential for dimensionality reduction.
CO 3:	Apply suitable techniques of differentiation and integration to various functions and identify the maxima and minima of functions of one variable.
CO 4:	Solve first order ordinary differential equations and apply them to certain physical situations.
CO 5:	Solve higher order ordinary differential equations arising in real world situations.
CO 6:	Determine Rank, Inverse, Eigenvalues, Eigenvectors of the given matrix, solve Differential equations and locate Maxima-Minima of the function using MATLAB

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Pre-requisite courses: Nil

CO/PO Mapping (S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcomes (POs)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S										M
CO2	M	M										
CO3	W	W										
CO4	W	W										
CO5	W	W										
CO6					S							S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

MATRICES	**12 Hours**

Rank of a matrix – Consistency of a system of linear equations - Rouche's theorem -Solution of a system of linear equations - Linearly dependent and independent vectors–Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley Hamilton theorem (excluding proof) - Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

VECTOR SPACES	**12 Hours**

Vector spaces and subspaces – Linear independence and dependence – Basis and Dimension - Null spaces, column spaces and Linear transformations - LU decomposition method - Singular Value Decomposition method.

DIFFERENTIAL AND INTEGRAL CALCULUS	**9 Hours**

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Representation of functions -Limit of a function-Continuity -Derivatives -Differentiation rules - Maxima and Minima of functions of one variable - Definite and Indefinite integrals - Techniques of Integration: Substitution rule, Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS	**3 Hours**

Linear differential equations (Leibnitz equation and Bernoulli's equation)

HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS	**9 Hours**

Linear, homogeneous and non- homogeneous differential equations of second and higher order with constant coefficients - Non-homogeneous term of the type e^{ax}, sin ax, cos ax, and x^n, e^{ax} V(x)

Theory: 45 Hrs	**Tutorial: 0 Hrs**	**Total Hours: 45 Hrs**

Lab component Contents:

List of MATLAB Programmes:

1. Introduction to MATLAB.
2. Matrix Operations - Addition, Multiplication, Transpose, Inverse
3. Rank of a matrix and solution of a system of linear equations
4. Characteristic equation of a Matrix and Cayley-Hamilton Theorem.
5. Eigenvalues and Eigenvectors of Higher Order Matrices
6. Curve tracing
7. Differentiation and Integration
8. Solving first and second order ordinary differential equations.
9. Determining Maxima and Minima of a function of one variable.

Practical: 30 Hrs	**Tutorial: 0**	**Total Hours : 30 Hrs**

Textbooks:

1. Grewal B.S., , 41st Edition, 2011, "Higher Engineering Mathematics", Khanna Publishers, New Delhi.
2. Ramana B.V., 11th Reprint, 2010, "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi
3. David C. Lay, "Linear Algebra and its Applications", Pearson Education Asia, New Delhi, 5 th Edition, 2016.

Reference Materials:

1. Kreyzig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley and sons, 2011
2. Venkataraman M.K., "Engineering Mathematics", The National Publishing Co., Chennai, 2003

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3. Weir, MD, Hass J, Giordano FR, 12th Edition, 2015, Thomas' Calculus, Pearson education.
4. Thomas G.B. and Finney R.L., "Calculus and Analytic Geometry", 11th Edition, Pearson Education, 2006.
5. Seymour Lipschutz , Marc Lipson, "Schaum Outline of Linear Algebra", McGraw Hill Trade; New Delhi, 6th Edition, 2017

Crafted By **:** Dr. Vijeta Iyer, M.Sc., PhD., Department of Mathematics, KCT & Gokul Kumar M.Sc (BITS Pilani),
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U18AII1204	INTRODUCTION TO COMPUTATIONAL MACHINES	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

- To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits
- To prepare students to perform the analysis and design of various digital electronic circuits
- To introduce students to the design issues of embedded systems.
- To provide experience to integrate hardware and software for an embedded system

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Understand the basics of combinational and sequential circuits
CO 2:	Explain the hardware and software architecture of embedded systems
CO 3:	Understand the network operations and the transport protocols
CO 4:	Demonstrate the I/O operations from the basic embedded systems hardware

Pre-requisite courses:

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S									M	M
CO2	S	M	S	M	M	M					M	M
CO3	S		S	S	S	M					M	M
CO4	S		M	S	S	M					M	M

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Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

BASICS OF DIGITAL ELECTRONICS	**7 Hours**
Introduction to logic gates: Boolean Algebra Theorems - De Morgan's theorem - Logic Gates-Design procedure of Combinational circuits: Adders- Subtractors - Design of sequential circuits, Asynchronous/Ripple counters- Shift registers	
EMBEDDED SYSTEM AND ITS ARCHITECTURE	**8 Hours**
Introduction to Embedded Systems- Architecture of Embedded Systems- Programming for Embedded Systems- The Process of Embedded System Development - Hardware Platforms- Communication Interfaces- Future Trends	
RASPBERRY PI	**7 Hours**
Hardware aspects- Board details - Operating systems - Programming the Pi : Compilers - Python programming for Pi - Hardware interfacing: GPIO interfacing through Python - LED, buzzer, switch and Sensors Interfacing: Pressure, Temperature, Speed	
NETWORKS AND PROTOCOL	**8 Hours**
Introduction to Networks –Components, Categories and Types of Connections – Topologies- ISO/OSI model- Comparison of the OSI and TCP/IP Reference Model- Protocol- Internet Transport (IP)- IP addressing- Transport layer protocols : TCP and UDP-Duties of TCP & UDP-TCP Connection Management-Congestion Control- Quality of Services- Real Time Transport Protocols - Raspberry Pi Interface: Ethernet.	

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Theory: 30 Hrs	Tutorial: 0	Total Hours: 30 Hrs

Lab Component:

List of Experiments:

1. Realization of logical expression using gates
2. Verification of Half adder and Full adder
3. Verification of Half Subtractor and Full Subtractor
4. Asynchronous Decade Counter
5. Interfacing Input & Output devices with RPi
6. Interfacing sensors with RPi
7. Serial Communication using RPi
8. Ethernet Communication using RPis
9. Network Protocol packet Analysis

Practical: 30 Hrs	Tutorial: 0	Total Hours : 30 Hrs

Textbooks:

1. Mano Morris M, 2008, "Digital Design", 4th Edition, Pearson Education.
2. Dr. K.V.K.K. Prasad, 2003, “Embedded/Real Time Systems Programming Black Book”Behrouz A. Forouzan, 2013, "Data Communications and Networking", 5th Edition, TMH.

Reference Materials:

1. Andrew S Tanenbaum, 4th Edition, 2003, "Computer Networks" Pearson Education.
2. Wolfram Donat, , 2014, "Learn Raspberry Pi Programming with Python", Technology in Action Publications.
3. Alex Bradbury and Ben Everard, 2014, "Learning Python with Raspberry Pi",Wiley Publications Pvt., Ltd..

Crafted By : Vivek Poovalingam, B.E (GCT), Program Manager, Forge

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U18AII1205	INTRODUCTION TO PYTHON	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

- To learn core Python scripting elements such as variables and flow control structures
- To learn how to use lists, tuples, and dictionaries in Python programs.
- To learn how to identify Python object types.
- To learn how to use indexing and slicing to access data in Python programs.

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Understand the basics of algorithm building for computing and programming
CO 2:	Understand the basics of python programming language
CO 3:	Apply modularization techniques for problem solving through python
CO 4:	Outline the concepts of Lists, Dictionaries and Files

Pre-requisite courses:

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M									
CO2	S	S	S		S	M			M		M	S
CO3	S	S	S	S	S	M			M		S	S
CO4	S	S	S	S	S						S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)

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5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

INTRODUCTION TO COMPUTING	**6 Hours**

Algorithms, Building blocks of algorithms (Instructions/statements, state, control flow, functions), Notation (pseudo code, flow chart, programming language), Algorithmic problem solving.

INTRODUCTION TO PYTHON	**8 Hours**

Python programming language - Debugging - Variables, expressions and statements - Input/Output Statements - Conditional operators and statements - Looping statements - for - while- break and continue statement - Iterations - Strings - String manipulations: subscript operator, indexing, slicing a string

MODULAR PROGRAMMING	**8 Hours**

Functions- function call- Flow of execution- Parameters and Arguments- Return values - Incremental development - Composition - Recursion - Boolean functions - Checking types - Case study-Interface Designing -Word Play.

LISTS, DICTIONARIES AND FILES	**8 Hours**

Lists - Basic list operators- Replacing- inserting- removing an element- searching and sorting lists- Dictionaries dictionary literals- adding and removing keys- accessing and replacing values - traversing dictionaries - Tuples - tuples as lists and dictionaries - Comparing tuples - Files - Reading and Writing - Format operator - Filenames and Paths - Catching Exceptions

Theory : 30 Hrs	**Tutorial: 0**	**Total Hours: 30 Hrs**

Lab Component:

List of Experiments:

1. Introduction to Algorithms, flowcharts and pseudocode
2. Programs for variables and expressions
3. Programs using conditional statements and iterations
4. Programs using string operations
5. Programs using functions with parameters
6. Programs using recursion and Boolean functions
7. Programs using list operations
8. Programs using dictionaries & tuples

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9. Programs using files
10. Programs using exceptions

Practical: 30 Hrs	Tutorial: 0 Hrs	Total Hours : 30 Hrs

Textbooks:

1. Downey Allen , 2002, ”Think Python- How to think like a Computer Scientist”, O'Reilly Media Inc.
2. Dusty Phillips, 2015, "Python 3 - Object Oriented Programming", 2nd Edition, Packet Publishing Ltd.

Reference Materials:

1. Ashok Namdev Kamthane, Amit Ashok Kamthane, 2018, “Programming and Problem Solving with Python” , Mc-Graw Hill Education.
2. T Jeyapoovan, 2015, “Fundamentals of computing and programming in C”, Vikas Publishing.

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U18AIC1006	INTRODUCTION TO INDIC CULTURE AND TECHNOLOGIES	L	T	P	J	C
		2	0	0	0	1

Course Objectives:

- To develop a broad understanding of Indian society and intercultural literacy through cultural immersion.
- To deepen knowledge on Indian development, environmental, and cultural issues through coursework, local engagement, and independent projects.

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Understand the various dimensions of Indian Culture and Philosophy
CO 2:	Develop appreciation for the contribution of Indians to various science and technologies

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							M	M	M			
CO2							M	M	M			

Course Assessment methods:

a) Direct

1. Continuous Assessment Test
2. Quiz

b) Indirect

1. Course-end survey

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Topics covered:

Foundations of Indic Knowledge	**3 Hours**
Branches of Indian Knowledge - Six Foundational Philosophies of Indian Sciences - Indian Big History: Cosmology - Evolutionary Life Sciences	
Indic Perspective on Health and Well-being	**3 Hours**
Body-Mind-Cognition according to Indian health systems - Technologies used by ancient Indians for well-being of people	
Indic Ecology and Sustainability	**3 Hours**
Purpose of life and sustainable development - Traditional Indian tools and practices for sustainability: agriculture, energy, waste management, construction	
Indic Values and Modern Technology	**3 Hours**
Value frameworks from the Indian tradition - evaluating modern technology through Indic frameworks - Digital dharma: ethics and responsibility in technology age	
Ancient Indian Technologies	**3 Hours**
Technologies used in Ancient India: Computation, Astronomy, Architecture	

Theory: 15 Hrs	**Tutorial: 0**	**Total Hours: 15 Hrs**

Textbooks:

1. Excel Health Journals, First edition, 2016, Certification of yoga professionals official guidebook, Excel books Pvt Ltd.
2. Vasant Lad, UK ed. edition, 2002, Textbook of Ayurveda: Volume 1 - Fundamental Principles of Ayurveda, Ayurvedic Press.

Reference Books:

1. Neeltje Huppes, 2017, Indian Psychology - an experiential approach, Indian Psychology Institute, Puducherry, India.
2. S Balachandar rao, 1999, Indian Astronomy: An Introduction, Universities Press.
3. Swami Harshananda, The Six Systems of Hindu Philosophy, (http://rkmathbangalore.org/Books/TheSixSystemsofHinduPhilosophy.pdf)

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U18ENI1202	FUNDAMENTALS OF COMMUNICATION	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

- To understand and evaluate key theoretical approaches used in the interdisciplinary field of communication
- To communicate effectively orally and in writing
- To understand and apply knowledge of human communication and language processes as they occur across various contexts, e.g., interpersonal, intrapersonal, small group, organizational, media, gender, family, intercultural communication, technologically mediated communication, etc. from multiple perspectives.
- To understand the research methods associated with the study of human communication, and apply at least one of those approaches to the analysis and evaluation of human communication.

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Demonstrate their ability to write effectively with the optimum use of formats and writing strategies of appropriate grammar and vocabulary.
CO 2:	Develop active listening strategies to enhance language skills.
CO 3:	Speak fluently with effective delivery strategies.

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									**S**	**S**		**S**
CO2									**S**	**S**		**S**
CO 3									**S**	**S**		**S**

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Course Assessment methods:

Direct

1. Continuous Assessment of Skills
2. Assignment
3. Written Test
4. End Semester Examination

Topics covered:

UNIT 1	**12 Hours**

Glimpses of Essential English for Engineers (General Overview) - Word Classification - Articles - Word Formation (Prefixes & Suffixes) – Different grammatical forms of the same word – Phrasal Verbs – Nominal Compounds

Listening: Listening to Weather Forecast - Listening for Specific Information, Numbers, Time, Duration

Speaking: Self-Introduction with goal setting and SWOT

UNIT 2	**12 Hours**

Sentences and its kinds (Framing Questions) - Cause and Effect Expressions - Purpose and Function Expressions - Subject Verb Agreement - Writing Instructions - Mother Tongue Influence in relation to Pronunciation and Redundancy

Listening: Listening to Social & Cultural Contexts - Listening to Facts & Opinions

Speaking: Proverbs with prompts and cues

UNIT 3	**12 Hours**

Skimming & Scanning - Reading Passages, Newspaper articles, blogs - Reading Comprehension - Cloze test, Note-making - Summary Writing - Formal Letter writing (Enquiry, Complaint & Clarification, Invitation, Acceptance, Rejecting)

Listening: Listening to Scientific Inventions

Speaking: Pair Activity (Negotiation / Pitching opinion)

UNIT 4	**12 Hours**

Tenses – Voice - Reading Advertisement & Graphical representation - Creating Advertisements - Email Etiquettes, Structure, Writing and Responding to Emails

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Listening: Listening to News Story

Speaking: Formal Presentation

UNIT 5	**12 Hours**

Discourse Markers - Preparing Checklist and Itinerary - Paragraph Writing (Descriptive, Compare & Contrast, Narrative) - Blog Writing - Proof Reading (Spelling, punctuation, grammar)

Listening: Listening to Documentary

Speaking: Integrated Speaking (Listening, Video & Reading)

Theory: 30 Hrs	**Practical: 30 Hrs**	**Total Hours: 60 Hrs**

Text Books:

1. Basic Communication Skills for Technology, by Andrea J Rutherfoord, Pearson Publishers.
2. English Language Skills by Aruna Koneru, Tata Mc Graw Hills Publications.

Reference Materials:

1. Word Power Made Easy, by Norman Lewis, Simon and Schuster.
2. Effective Technical Communication, by Ashraf Rizvi, Tata Mc Graw Hills Publications.
3. English Grammar in Use, by Murphy, Raymond Ernst Klett Sprachen,
4. Oxford Guide to Effective Writing & Speaking by John Seely, Oxford University Press
5. British Council LearnEnglish Teens Website https://learnenglishteens.britishcouncil.org/

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Semester II

U18PHT2203	ADVANCED PHYSICS	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To impart knowledge on the concepts of Faraday‘s law, induced emf and Maxwell‘s equations
- To discuss and explain the key concepts and principles of quantum physics
- To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Impart knowledge on the concepts of electrodynamics for various conditions and its applications
CO 2:	Understand the behaviour of magnetostatics conditions, materials and its applications
CO 3:	Study the importance of various operators and its application in quantum computing
CO 4:	Infer the nuclear reactions and its impact in energy models for data processing
CO 5:	Explore the types of high energy particles and its characteristic effects
CO 6:	Understand the various materials aspects for identify modelling using various tools

Pre-requisite courses: U18PHI1202

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M									M
CO2	S	M	M									M
CO3	S	M		M								M

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CO4	S									M		M
CO5	S	M								M		M
CO6	S	M	M		M							M

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory components)

b) Indirect

1. Course-end survey

Topics covered:

ELECTRODYNAMICS	**9 Hours**

Poisson's and Laplace's Equations – Electric Polarization – Nature of Dielectric Materials- Maxwell's displacement current – Maxwell's equations – vector and scalar potentials – Gauge invariant – wave equation and plane wave solutions

MAGNETODYNAMICS	**9 Hours**

Energy Density in Magnetic Fields – Types of Magnetic Materials - Magnetization and Permeability – Magnetic boundary conditions. Hysteresis – Soft and Hard Magnetic Materials – Ferrites-Storage of Magnetic Data, Floppy, tapes and Magnetic Disc Drives

QUANTUM PHYSICS	**9 Hours**

Introduction to Quantum States - Observables and Operators- Herminian operators-Hamiltonian operators Angular momentum-Spin-orbit coupling- Simon's Algorithm - Grover Search Algorithm

NUCLEAR AND PARTICLE PHYSICS	**9 Hours**

Nuclear Mass and Binding energy- Stability of the nucleus- Mass defect and packing factor-Introduction to Particle physics- particle accelerators and detectors-Antiparticles properties- Symmetry Functions-Quark model-

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MATERIALS MODELLING	9 Hours

Crystal systems-Symmetry in crystals-Plane and Space groups- Types and effects of defects and imperfections-Bonding and Chemical interactions-Reciprocal lattice-Brillioun zone

Theory: 45 Hrs	Tutorial: 0 Hrs	Total Hours: 45 Hrs

Textbooks:

1. D.J. Griffiths, 2016, Introduction to Electromagnetic Theory, Prentice Hall, USA.
2. N. Zettili, 2009, Quantum Mechanics Concepts and Applications, Wiley, USA.
3. P M Mathews and K Venkatesan, A Textbook of Quantum Mechanics (2016), Tata McGraw-Hill, India

Reference Books:

1. B. B. Cohen, 2014, “Concepts of Nuclear Physics”, TMGH , India
2. C. Kittel, 7th Edn, 1995, Introduction to Solid state Physics. John Wiley & Sons
3. D. Griffiths, 2nd Ed., 2008, “Introduction to Elementary Particles”, Wiley-Vch
4. Neil W. Ashcroft, N.David Mermin, 1st Ed., 2003, Solid State Physics, Cengage Learning.

Crafted By : Dr Arul H, M.Sc., PhD., Department of Physics, KCT

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U18MAT2001	DISCRETE MATHEMATICS	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To introduce concepts of mathematical logic for analyzing propositions and proving theorems.
- To use sets for solving applied problems, and use the properties of set operations algebraically.
- To work with relations and investigate their properties.
- To investigate functions as relations and their properties.
- To introduce basic concepts of graphs, digraphs and trees

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Understand the concepts of set theory and apply them to situations involving inclusion and exclusion.
CO 2:	Acquire the knowledge of relations, and analyse equivalence relations and their properties.
CO 3:	Understand and analyse the properties of different kinds of functions and solve recurrence relations.
CO 4:	Evaluate the validity of logical arguments and construct simple mathematical proofs.
CO 5:	Determine whether given graphs are isomorphic and apply Dijkstra's algorithm to find the shortest path.

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M										
CO2	M											
CO3	M	M										
CO4	S	S										S
CO5	S	S										S

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Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory components)

b) Indirect

1. Course-end survey

Topics covered:

SET THEORY	**5 Hours**
Algebra of sets – The power set – Ordered pairs and Cartesian product – principle of inclusion and exclusion.	
RELATIONS	**6 Hours**
Relations on sets –Types of relations and their properties - Equivalence relations –Relational matrix and the graph of relation – Operations on relations.	
FUNCTIONS AND RECURRENCE RELATIONS	**11 Hours**
Functions –Type of functions – Injective, surjective and bijective functions –Composition of functions – Inverse functions –Permutation functions - Recurrence relations-Solving linear recurrence relations.	
LOGIC	**12 Hours**
Propositions- Logical operators- Normal forms –Rules of inference-Consistency and inconsistency-Propositional logic- Proofs-Predicates- Quantifiers- Universe of discourse – Logical equivalences and implications for quantified statements-Rules of specification and generalization – Validity of arguments.	
GRAPH THEORY	**11 Hours**
Graphs- Types of graphs- Matrix representation of graphs- Graph isomorphism- Walk – Path - Cycles- Eulerian graphs -Hamiltonian graphs- Planar graphs- Euler formula- Shortest path algorithm: Dijkstra's algorithm	

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

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Textbooks:

1. Kenneth H. Rosen, “Discrete Mathematics and its applications: With Combinatorics and Graph Theory (7th Edition)”, Tata McGraw-Hill, 2015.
2. Tremblay J.P., Manohar R., “Discrete Mathematical Structures with applications to Computer Science”, Tata McGraw-Hill, International Edition, 2017

Reference Books:

1. Liu C.L, “Elements of Discrete Mathematics”, 4th Edition, McGraw Hill, 2017.
2. Grimaldi, R.P. “Discrete and Combinatorial Mathematics: An Applied Introduction”, 5 th Edition, Pearson Education Asia, Delhi, 2016.
3. Mott J.L, Kandel A. and Baker T.P., “Discrete Mathematics for Computer Scientists and Mathematicians”, 2nd Edition, Prentice Hall India, 2015.
4. Narsingh Deo, “Graph Theory with Applications to Engineering and Computer Science”, Courier Dover Publications, 2017.

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U18MAI2203	PROBABILITY AND STATISTICS	L	T	P	J	C
		3	0	2	0	4

Course Objective:

- To introduce the basic concepts of probability and random variables
- To introduce the basic concepts of two dimensional random variables
- To acquire the knowledge of testing hypotheses for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of engineering and statistical quality control.

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Understand and apply the concept of probability and random variables and predict probabilities of events in models following normal distribution.
CO 2:	Apply the concepts of two dimensional random variables, central limit theorem and estimation, which lay the foundation for Machine Learning and Data Science.
CO 3:	Perform hypothesis testing and interpret the results which will form the basis for Data Analysis
CO 4:	Understand the principles of design of experiments and perform analysis of variance which will help in Data Analysis.
CO 5:	Learn and apply multivariate analysis necessary for Principal Component Analysis.
CO 6:	Use R software to solve problems in the above topics

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Pre-requisite courses: Nil

CO/PO Mapping (S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcomes (POs)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S										
CO2	S	S										
CO3	S	M										W
CO4	S	S										M
CO5	M	S										M
CO6					S							S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

PROBABILITY AND RANDOM VARIABLES	**13 Hours**

Axioms of probability - Conditional probability – Total probability – Bayes' theorem Random variable – Distribution function – properties – Probability mass function – Probability density function – moments - Standard Distributions - Binomial, Poisson and Normal distributions

TWO DIMENSIONAL RANDOM VARIABLES AND ESTIMATION	**9 Hours**

Joint distributions – Marginal and conditional distributions – Expected values of functions of two variables– Correlation and regression (for discrete data only) - Central limit theorem – Statement

TESTING OF HYPOTHESIS	**10 Hours**

Large sample tests for single mean and difference of means-Small samples tests based on t and F distributions (single mean, difference of means, paired t- test and variance ratio test) – Chisquare test for independence of attributes and goodness of fit.

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DESIGN OF EXPERIMENTS	5 Hours

Analysis of Variance (ANOVA) – Completely Randomized Design (CRD) – Randomized Block Design (RBD)

MULTIVARIATE ANALYSIS	8 Hours

Random vectors and matrices – Mean vectors and covariance matrices –Principal components – Population principal components – Principal components from standardized variables.

Theory: 45 Hrs	Tutorial: 0	Total : 45 Hrs

Lab component Contents:

List of R Programmes:

1. Introduction to R programming
2. Application of descriptive statistics – Mean, Median, Mode and standard deviation, Skewness and Kurtosis
3. Applications of Correlation and Regression
4. Application of Normal distribution
5. Application of Student – t test
6. Application of F test
7. Application of Chi-square test
8. ANOVA – one way classification
9. ANOVA - two way classification
10. Box Plots

Practical: 30 Hrs	Tutorial: 0	Total Hours : 30 Hrs

Text Books:

1. Johnson R. A., Miller & Freund's, Sixth Edition, 2000, "Probability and Statistics for Engineers", Pearson Education, Delhi.
2. Gupta.S.C and Kapoor.V.K, 11th extensively revised edition, 2007 Fundamentals of Mathematical Statistics,, Sultan Chand & Sons.

Reference Books:

1. Walpole R. E., Myers S.L. & Keying Ye, 9th edition, 2012, "Probability and Statistics for Engineers and Scientists", Pearson Education Inc.
2. Gupta S.C, and KapurV.K, 4th Edition, 2014, "Fundamentals of Applied Statistics", Sultan Chand, New Delhi.

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3. Charles Henry Brase and Corrinne Pellillo Brase , 9th edition, 2007, “Understandable Statistics”, D.C. Heath and Company, Toronto.
4. Gareth M. James, Daniela Witten, Trevor Hastie, Robert Tibshirani, 7th edition, “An Introduction to Statistical Learning: With Applications in R”.
5. Richard A. Johnson and Dean W. Wichern, 5th Edition, 2012, Applied Multivariate Statistical Analysis, Pearson Education, Asia.
6. Anderson, T. W , 2003, An Introduction to Multivariate Statistical Analysis, John Wiley and Sons

Crafted By : Dr. Vijeta Iyer, M.Sc., PhD., Department of Mathematics, KCT & Gokul Kumar M.Sc (BITS Pilani), MBA, Co-Founder & CTO, Vusar - AR 3D Design Visualization

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U18AII2204	OBJECT-ORIENTED PROGRAMMING AND DATA STRUCTURES	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

- To understand the importance of Classes & objects along with constructors
- To discuss the principles of inheritance and Class and interface and demonstrate though problem analysis
- assignments how they relate to the design of methods, abstract classes and interfaces and packages
- To introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms
- Understand and remember algorithms and its analysis procedure.
- To introduce the concept of data structures through ADT including List, Stack, Queues

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Understand the object oriented programming concepts and GUI
CO 2:	Apply Overloading and concept of handling exceptions
CO 3:	Demonstrate the concepts of data structures using python
CO 4:	Develop the graph, sorting and search techniques of data structures

Pre-requisite courses: Introduction to Python

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	M	S						S	S
CO2	S	S	S	S	S						S	S
CO3	S	S	S	M	S						S	S
CO4	S	S	S	S	S						S	S

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Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

OBJECT ORIENTED CONCEPTS IN PYTHON	**8 Hours**

Introduction - Classes and Objects - Creating Python Classes - Classes and Functions - Pure Functions- Classes and Methods - Inheritance: Basic Inheritance, Multiple Inheritance - Polymorphism - Class Diagrams - Data Encapsulation - GUI - Event-driven programming paradigm; tkinter module, creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames.

EXCEPTIONS	**7 Hours**

Operator Overloading - The Basics- Indexing and Slicing- Index Iteration-Iterable Objects- Membership- Attribute AccessObject Destruction- Exceptions - Exception Basics-Catching Exceptions- Raising Exceptions- UserDefined ExceptionsThe try/except/else Statement- The try/finally Statement- Unified try/except/finally- The Raise Statement- Exception Objects- Nesting Exception.

DATA STRUCTURES	**7 Hours**

Abstract Data Types (ADT) - Linked List Implementation - Doubly-Linked Lists - Circularly Linked Lists - Applications of Lists - Stack ADT - Implementation of Stack and its Applications - Queue ADT - Implementation of Queue and its Applications - Tree ADT - Tree Traversals - Binary Tree ADT - Expression Trees - Applications of Trees - Binary Search tree ADT .

GRAPHS, SORTING AND SEARCHING TECHNIQUES	**8 Hours**

Graph and its Representations - Graph Traversals - Heap - Binary Heap - Applications of Priority Queues, Preliminaries - Insertion Sort - Shell sort - Heap sort - Merge sort - Quick sort - Linear Search - Binary Search

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Theory: 30 Hrs	Tutorial: 0	Total: 30 Hrs

Lab Component:

List of Experiments:

1. Class & Object
2. Inheritance
3. Access Specifier and Abstract Class
4. Exception
5. Constructor Overloading, Operator Overloading
6. Implementation of Stack and Queue
7. Implementation Linked list, Circular Linked List, Double Linked
8. Implementation of Binary Search Tree
9. Implementation of Sorting Algorithms

Practical: 30 Hrs	Tutorial: 0	Total Hours : 30 Hrs

Textbooks:

1. Allen Downey , 2002, ”Think Python- How to think like a Computer Scientist”, O'Reilly Media, Inc.
2. Dusty Phillips, 2nd Edition, 2015, "Python 3 - Object Oriented Programming", Packet Publishing Ltd.

Reference Books:

1. Kenneth Lambert, 2nd Edition, 2018, “Fundamentals of Python: Data Structures” .
2. Thomas H. Cormen, Charles E. Leiserson, 3rd Edition, 2009, “ Introduction to Algorithms”.
3. Eric Matthes, 2nd Edition, 2019, “Python Crash Course: A Hands-On, Project-Based Introduction to Programming”.

Crafted By: Dorai Thodla, B.E (CEG, Guindy), Founder & CTO, iMORPH, California and
Gokul Kumar, M.Sc (BITS Pilani), MBA, Co-Founder & CTO, Vusar - AR 3D Design Visualization, California

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U18AII2205	INTRODUCTION TO AI & ML	L	T	P	J	C
		2	0	2	0	3

Course Objective:

- To introduce the basic concepts, theories and state-of-the-art techniques of artificial intelligence.
- To introduce basic concepts and applications of machine learning.
- To learn the application of machine learning /A.I algorithms in the different fields of engineering, science, medicine, finance etc.

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Understand the basic concepts of machine learning and some typical applications
CO 2:	Understanding how to build and validate models and improve them iteratively
CO 3:	Understand the core concepts of artificial intelligence and applications
CO 4:	Apply knowledge representation with artificial intelligence using FOL and Predicate logic

Pre-requisite courses: Introduction to Python

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	M	S						S	S
CO2	S	S	S	S	S						S	S
CO3	S	S									M	S
CO4	S	S	S	M							S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)

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6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

INTRODUCTION TO MACHINE LEARNING	**8 Hours**

Introduction - Machine Learning Process - Supervised Learning - Regression - Linear Regression - Predicting - Polynomial Regression - Classification - Feature Engineering - Logistic Regression - kNN classification - SVM - Naive bayes - Decision tree and Random Forest classifier - Unsupervised Learning - Clustering techniques.

ANALYSIS OF MODELS	**8 Hours**

Model representation, decision boundary, cost function, gradient descent, regularization, evaluating a hypothesis (Model selection), training/validation/testing procedures, bias/variance, learning curves, Accuracy and Error measures, evaluating the accuracy of a classifier or predictor, Confusion metric, precision, recall, ROC curve and AUC score, Parameter Tuning.

ARTIFICIAL INTELLIGENCE: PROBLEM SOLVING	**6 Hours**

Introduction to AI, Control strategies, Search strategies, Production system characteristics - Specialized production system- Problem solving methods - Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing- Depth first and Breadth first, Constraint's satisfaction Problem.

KNOWLEDGE REPRESENTATION AND REASONING	**8 Hours**

Game playing - Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge. - First order logic – Syntax and Semantics – Knowledge Engineering in First Order Logic – Inference in First Order Logic.

Theory: 30 Hrs	**Tutorial: 0 Hrs**	**Total Hours: 30 Hrs**

Lab Component:

List of Experiments:

1. Implement python program to perform operations like mean, median, mode, standard deviation, percentile and various data distributions
2. Try to open a csv file and sort the content with respect to one column using python
3. Implement a python program to perform linear regressions for a dataset that prevails in csv format
4. Implement a python program to perform logistic regression

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5. Write a program to implement k-Nearest Neighbour algorithm to classify any dataset. Print both correct and wrong predictions. Python ML library classes can be used for this problem.
6. Assume that K=3
7. Write a program to construct a Support Vector Machine considering medical data. Use this model to demonstrate the diagnosis of heart patients using the standard Heart Disease Data Set. You can use Python ML library classes/API.
8. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
9. Assuming a set of data that need to be classified, use a decision tree model to perform this task. Preferably use any dataset like medical, titanic dataset or others to evaluate the accuracy
10. Implement a python program to perform Hill climbing algorithm

Practical: 30 Hrs	Tutorial: 0	Total: 30 Hrs

Textbooks:

1. Alexey Grigorev, 2020, "Machine Learning Bookcamp", MEAP.
2. Shai Shalev-Shwartz, Shai Ben-David, 2014, "Understanding Machine Learning From Theory to Algorithms", Cambridge University Press

Reference Book:

1. Kevin Night and Elaine Rich, Nair B., 2008, "Artificial Intelligence (SIE)", McGraw Hill.

Crafted By : Dorai Thodla, B.E (CEG, Guindy), Founder & CTO, iMORPH, California and
Gokul Kumar, M.Sc (BITS Pilani), MBA, Co-Founder & CTO, Vusar - AR 3D Design Visualization, California

Reviewed By : Derrick Jose, B.E (BITS Pilani), CEO & Founder, Flutura, Texas

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U18AII2206	INTRODUCTION TO DATA SCIENCE	L	T	P	J	C
		2	0	2	0	3

Course Objective:

- To introduce the basic concepts of data science
- To enable students to handle various dataset
- To train the applications of data science and perform data transformations

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Understand the various aspects of data science and the skill sets necessary for a data scientist
CO 2:	Explain the concepts of data storage and Big Data
CO 3:	Illustrate the different types of process and tools used in data science
CO 4:	Apply the principles of Data Science for analysis using Google Sheets and Excel

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2	S	S		M							S	S
CO3	S	S	S	M	S						S	S
CO4	S	S	S		S						S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)

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6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

BASICS OF DATA SCIENCE	**10 Hours**

Data Science: Steps in doing Data Science - Data Science relation to other fields- Data Science and Information Science- Computational Thinking - Skills and tools needed to do Data Science - Storing data - Combining bytes into larger structures - Creating data sets - Identifying data problem - Understanding data sources - Exploring data models- Introduction to Big Data

DATA HANDLING	**10 Hours**

Structured and unstructured data - Challenges with unstructured data - Data collection: Open data - multimodal data - Data Preprocessing: Data Cleaning - Data Integration, Data Transformation - Data Reduction - Data Discretization

EXCEL FOR DATA SCIENCE	**10 Hours**

Elementary data handling: Types - Data Transformation - Filtering -Pivot tables - Graphical Methods - Descriptive statistics - Random sampling - Probability distributions using functions- Binomial - poisson - Normal - Geometric - Negative binomial - exponential - gamma - beta- lognormal - pmf and cmd- Hypothesis testing using Data Analysis Pack - Z test and t-test.

Theory: 30 Hrs	**Tutorial: 0 Hrs**	**Total Hours: 30 Hrs**

Lab Component:

List of Experiments:

1. Basic Statistics and Visualization
2. Data distribution
3. Reading and Writing different types of dataset
4. Correlation and Covariance
5. Regression Model
6. Implementation of Pivot table
7. Implementation of Probability Distribution using Function
8. Implementation of Hypothesis

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Practical: 30 Hrs	Tutorial: 0	Total Hours: 30 Hrs

Textbooks:

1. Jeffrey S. Saltz, Jeffrey M. Stanton, 2018, An Introduction to Data Science, SAGE Publications
2. Chirag Shah, 2020, A Hands-On Introduction to Data Science, Cambridge University Press

Reference Books:

1. Ash Narayan Sah, 2009, Data Analysis Using Microsoft Excel, Excel books
2. Joel Grus, 2015, "Data Science from Scratch".

Crafted By : Gokul Kumar, M.Sc (BITS Pilani), MBA, Co-Founder & CTO, Vusar - AR 3D Design Visualization, California

Reviewed By : Adarsh Natarajan, MBA (IIM B), CEO & Founder, AIndra Systems

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Syllabi - 2nd Year
Semester III

U18MAI3201	MULTIVARIATE CALCULUS AND FORECASTING	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To enable learning of Multivariate calculus as it's one of the most important data science skills and multivariate calculus is used everywhere in Machine Learning Projects.
- To demonstrate an understanding of Calculus beyond the manipulation of symbols,
- To enable classification or regression when operations are related with multiple variables
- To understand the theory and methods of Calculus to solve a variety of problems in terms of multivariate dataset

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Evaluate the total derivative of a function, expand the given function as a series and locate the maximum and minimum for multivariate functions which is an important part of data science.
CO 2:	Solve higher order partial differential equations arising in real world situations.
CO 3:	Evaluate double and triple integrals in Cartesian coordinates and apply them to calculate area and volume.
CO 4:	Evaluate gradient, divergence and curl which form the basis of gradient descent and apply them to real life problems.
CO 5:	Analyze and apply the knowledge of time series and interpolation to predict the future values.
CO 6:	Determine multiple integrals, vector differentials, vector integrals using MATLAB.

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Pre-requisite courses: NIL

CO/PO Mapping (S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcomes (POs)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S										M
CO2	W											
CO3	W	W										W
CO4	M	M										
CO5	M											M
CO6					S							S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

FUNCTIONS OF SEVERAL VARIABLES	**9 Hours**

Partial derivatives – Homogeneous functions and Euler's theorem –Total derivative – Taylor's series expansion – Maxima and minima of functions of two variables – Constrained maxima and minima: Lagrange's multiplier method with single constraints – Jacobians.

PARTIAL DIFFERENTIAL EQUATIONS	**5 Hours**

Linear Homogeneous partial differential equations of second and higher order with constant coefficients

MULTIPLE INTEGRALS	**9 Hours**

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Double integration – Cartesian coordinates – Change of order of integration – Triple integration in Cartesian coordinates – Applications: Area as double integral and Volume as triple integral.

VECTOR CALCULUS	**10 Hours**

Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (Only statements excluding proofs)

TIME SERIES AND INTERPOLATION	**12 Hours**

Time series - components - Trend-Determination of trend by moving averages – Least square method-Seasonal Variations-Ratio to moving average method.

Interpolation – Newton's forward and backward interpolation – Newton's divided difference interpolation – Lagrange's interpolation.

Theory : 45 Hrs	**Tutorial : 0**	**Total Hours: 45 Hrs**

Lab component Contents:

List of MATLAB Programmes:

1. Determining Maxima and Minima of a function of two variables.
2. Evaluating double integral with constant and variable limits.
3. Area as double integral
4. Evaluating triple integral with constant and variable limits
5. Volume as triple integral
6. Evaluating gradient, divergence and curl
7. Evaluating line integrals and work done
8. Verifying Green's theorem in the plane

Practical : 30 Hrs	**Tutorial : 0**	**Total Hours: 30 Hrs**

Textbooks:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2014.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
3. Grewal B.S. and Grewal J.S., "Numerical methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.
4. Montgomery D.C., Johnson. L.A., Gardiner J.S., "Forecasting and Time series Analysis", McGraw Hill, 1990.

Reference Books:

1. Kreyzig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley and sons, 2011.
2. Venkataraman M.K., "Engineering Mathematics", The National Publishing Co., Chennai,2003
3. Weir, MD, Hass J, Giordano FR: Thomas' "Calculus", Pearson education 12th Edition, 2015.

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4. Thomas G.B. and Finney R.L., “Calculus and Analytic Geometry”, 11th Edition, Pearson Education, 2006.
5. Gerald, C. F. and Wheatley, P. O.,“Applied Numerical Analysis”, 7th Edition, Pearson Education Asia, New Delhi, 20073.
6. Grewal B.S. and Grewal J.S., “Numerical methods in Engineering and Science”, 9th Edition, Khanna Publishers, New Delhi, 2007.
7. Montgomery D.C., Johnson. L.A., Gardiner J.S., “Forecasting and Time series Analysis”, McGraw Hill, 1990..

Crafted By : Dr. K. Maheswari, M.Sc., PhD., Department of Mathematics, KCT

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U18AII3202	ALGORITHMS AND OPTIMIZATION OF PROGRAMS	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

- To teach paradigms and approaches used to analyze and design algorithms and to appreciate the impact of algorithm design in practice.
- To make students understand how the worst-case time complexity of an algorithm is defined, how asymptotic notation is used to provide a rough classification of algorithms.
- To explain different computational models (e.g., divide-and-conquer), order notation and various complexity measures (e.g., running time, disk space) to analyze the complexity/performance of different algorithms.
- To teach various advanced design and analysis techniques such as greedy algorithms, dynamic programming & know the concepts of tractable and intractable problems and the classes P, NP and NP-complete problem

Course Outcomes:

After successful completion of this course, the students should able to

CO 1:	Understand techniques for effective problem solving in computing
CO 2:	Design different paradigms of problem solving to illustrate clever and efficient ways to solve a given problem.
CO 3:	Identify and apply for rigorously proving correctness of the algorithm for a variety of problems.
CO 4:	Implement to show the efficiency of the algorithm over the naive techniques

Pre-requisite courses: U18AII2204

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2	S	S		M							S	S

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CO3	S	S	S	M	S						S	S
CO4	S	S	S		S						S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

ANALYSIS OF ALGORITHMS	**7 Hours**

Introduction Role of Algorithms in computing, Analyzing algorithms and Designing algorithms, Algorithm Design techniques: Divide and Conquer – Merge Sort and Quicksort. **Time complexity:** Growth of Function: Asymptotic notation, Standard notations and common functions Complexity analysis-Time and space tradeoffs in algorithms, Using recurrence relations to analyze recursive algorithms, Master Theorem(Without Proof).

ADVANCED DESIGN AND OPTIMIZATION	**8 Hours**

Algorithm design techniques - Brute-force – Sequential search, Dynamic Programming – Rod cutting problem, Greedy algorithms – Activity Selection Problem; Divide-and-conquer – Strassen's Matrix Multiplication; Backtracking – 8 queens problem; Branch and- bound – Traveling Salesman Problem, 0/1 Knapsack Problem- String Matching Algorithms - Geometric algorithms - Approximation algorithms.

TREES, GRAPHS AND HASHING	**8 Hours**

Non-Linear Data Structures: General Tree; Binary trees, Binary Search Tree: Traversals Graphs: Introduction, Representations of graphs (adjacency list, adjacency matrix)
Hashing: Hash tables, including collision-avoidance strategies, MD5 Hashing, Hashing in SSH. DFS and BFS, Shortest-path algorithms (Single source shortest path. Dijkstra's and Floyd's algorithms); Minimum spanning tree (Prim's and Kruskal's algorithms)

COMPLEXITY CLASS	**7 Hours**

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COMPLEXITY CLASS: P, NP and NP -Completeness Problems (without proofs). **Case Study**: Implement a program that resolves any real time problem and optimize the same script in which its time and space complexity is reduced linearly or exponentially.

Theory : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Lab component Contents:

List of Experiments:

1. Implementation of Sorting algorithms
2. Implementation of Warshall's algorithm
3. Designing Knapsack problem
4. Shortest paths Algorithm
5. Minimum cost spanning tree
6. Implementation of travelling salesman problem
7. Implement N Queens problem using Backtracking

Practical : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Textbooks:

1. Design and Analysis of Algorithms by Sartaj Sahni and Ellis Horwitz, Galgotia Publications 2015.
2. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Pearson Education , 2012
3. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, Prentice Hall of India,New Delhi, 2010

Reference Books:

1. J. Klienberg and E. Tardos, Algorithm Design, Pearson Education Limited , 2014
2. Algorithms, by Dasgupta, Papadimitrou and Vazirani, McGraw-Hill Education, 2006.
3. Computer Algorithms, by Horowitz, Sahni, and Rajasekaran, Silicon Press, 2007.

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U18AII3203	OPERATING SYSTEM	L	T	P	J	C
		2	0	2	0	3

Course Objective

- To learn the mechanisms of OS to handle processes and threads and their Communication
- To learn the mechanisms involved in memory management in contemporary OS
- To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
- To know concept and working principle of open-source OS

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Apply the concepts of CPU scheduling and Process synchronization
CO 2:	Experiment creation of different virtual machines in a hypervisor
CO 3:	Simulate the principles of memory management
CO 4:	Examine the features of various open source operating systems

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2	S	S			M			S			S	S
CO3	S	S		S	M	S					S	S
CO4	S	S		S		S					S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)

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2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

INTRODUCTION AND PROCESS CONCEPT	**7 Hours**

Operating System Structure - Operating System Operations - Process Management - Memory Management - Storage Management - Protection and Security - System Structures: Operating System Services - User and Operating System Interface - System Calls - Types of System Calls - Process Scheduling - Operations on Processes - Inter-process Communication.

MULTITHREADED PROGRAMMING AND PROCESS SCHEDULING	**8 Hours**

Overview of threads - Multicore programming - Multithreading Models - Threading Issues - Basic Concepts of process scheduling - Scheduling Criteria - Scheduling Algorithms - Multiple Processor Scheduling - Synchronization - The Critical-Section Problem - Peterson's Solution Synchronization Hardware - Semaphores - Classic problems of Synchronization - Monitors

DEADLOCK AND MEMORY MANAGEMENT STRATEGIES	**7 Hours**

System Model - Deadlock Characterization - Methods for Handling Deadlock - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock. Swapping - Contiguous Memory Allocation - Paging - Structure of the Page Table- Segmentation.

OPEN SOURCE SOFTWARE SYSTEMS	**8 Hours**

Basic UNIX Commands - File Filters: File Related Commands - Piping -Joining - awk and backup Commands - Processes in Linux: User Process and Terminal Handling. Users and Account Management: Configuration - Creating - Testing - Removing - Allocating - System Logging: Logging – Accounting. Compiling and Debugging: Compiling C and C++ Programs under Linux - GNU Debugger: Debugger using GDB - Make: Syntax of makefiles - Automake and Autoconf.

Theory : 30 Hrs	**Tutorial : 0**	**Total Hours: 30 Hrs**

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Lab component Contents:

List of Experiments:

1. Develop programs for process creation and communication. To
2. Creation of process and child process
3. Demonstration of inter-process communication Creation of Zombie and Orphan process Creation of threads
4. Demonstration of shared memory concept
5. Simulation of the CPU scheduling algorithms
6. Demonstration of Semaphores
7. Implementation of Producer-Consumer problem
8. Simulation of Bankers algorithm for deadlock avoidance
9. Creation of virtual machine in a hypervisor

Practical : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Textbooks:

1. William Stallings, “Operating Systems – Internals and Design Principles”, 7th Edition, Prentice Hall, 2011.
2. Andrew S. Tanenbaum, “Modern Operating Systems”, Second Edition, Addison Wesley, 2001.

Reference Books:

1. Charles Crowley, “Operating Systems: A Design-Oriented Approach”, Tata Mc Graw Hill Education”, 1996.
2. D M Dhamdhere, “Operating Systems: A Concept-Based Approach”, Second Edition, Tata Mc Graw-Hill Education, 2007.

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U18AII3204	APPLIED MACHINE LEARNING	L	T	P	J	C	
		3	0	2	0	4	

Course Objectives:

· To train in terms of Machine Learning Problems and its forms

· To make students understand statistical analysis for classification

· To explain different fuzzy inference systems

· To teach various advanced techniques in business intelligent systems

Course Outcomes:

After successful completion of this course, the students should able to

CO 1:	Understand different methodologies to create application using statistical models
CO 2:	Design the test procedures to assess the efficacy of the developed model.
CO 3:	Identify and apply appropriate machine learning models for analyzing the data for a variety of problem
CO 4:	Implement different algorithms for business intelligence

Pre-requisite courses: U18AII2205

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S				M		M					M
CO2	S	S		M				S			S	S
CO3	S	S	S	M	S			S		M	S	S
CO4	S	S	S		S						S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)

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2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

INTRODUCTION	**8 Hours**
Real-world use cases of Machine Learning. Introduction to SciKit-Learn. Machine learning LifeCycle a implement a multi-variable regression problem with the scikit-learn library	
LINEAR REGRESSION AND LOGISTIC REGRESSION	**18 Hours**
Understanding cost function and gradient descent. Overfitting and Underfitting K-Nearest Neighbou Classification and Regression Linear Regression: Least Squares, Ridge, Lasso and Polynominal Regression Logistic Regression: SVM and Hyperparameter tuning and Implementing SVM using scikit-learn	
MODEL EVALUATION	**7 Hours**
How and why should we evaluate models? Model Evaluation and Selection methods, Precision-Recall and RO Curves Confusion Matrices, Regression Evaluation, Optimizing Classifiers for Different Evaluation Metrics	
NAIVE BAYES, DECISION TREES AND RANDOM FOREST	**12 Hours**
Naive Bayes Classifiers, Decision Tree, Training and Visualizing a Decision Tree, Entropy and The CA Training Algorithm, Random Forests, Implement Random forest with a real-world use case and understand basics of random forest, Boosting - AdaBoost and Gradient Boosting, Capstone Project	

Theory: 45 Hrs	**Tutorial : 0**	**Total Hours: 45 Hrs**

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Lab component Contents:

List of Experiments:

1. Implementing multi variable regression problem
2. Evaluating cost function and gradient descent
3. Implementing K NN
4. Implementing SVM
5. Evaluating Precision, Recall
6. Implementing Decision Tree
7. Implementing Random forest
8. Implementing Adaboost
9. Implementing Gradient boosting

Practical : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Textbooks:

1. 1.Aurélien Géron "Hands-On Machine Learning with Scikit-Learn and TensorFlow" Publisher(s): O'Reilly Media, Inc 2017.

Reference Books:

1. M.Gopal, “Applied Machine Learning”, McGraw Hill Education (15 May 2018).
2. David Forsyth “Applied Machine Learning” Springer; 1st edition (12 July 2019).
3. Mohd. Shafi Pathan, Nilanjan Dey, Parikshit N. Mahalle, Sanjeev Wagh, "Applied Machine Learning for Smart Data Analysis", CRC Press, 2019.

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U18AII3205	DATA COLLECTION AND DATA MANAGEMENT	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

- To learn and practice data modelling using the entity relationship and developing database designs.
- To understand the concept of non structured data handling in data science
- To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce
- To enable students to have skills that will help them to solve complex real-world problems in for decision support

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Explain basic database concepts, applications, data models, schemas and instances
CO 2:	Understand the concept of handling unstructured data
CO 3:	Explain the various data collection methodologies such as map ,filter and List comprehension
CO 4:	Apply mapreduce in real world applications

Pre-requisite courses:

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2	S	S			M			S			S	S
CO3	S	S		S	M	S						
CO4	S	S		S		S			M			S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)

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2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

INTRODUCTION TO DATABASE AND RELATIONAL DATABASE	**9 Hours**

Introduction - Purpose of database systems - Views of data - Database Development Life cycle - Architecture of DBMS - Key Principles of RDBMS- Database Design and Relational Database- ETL Concepts - ER Model - Constraints - ER-Diagrams - Design Issues - Weak Entity Sets - UML - Converting ER Model to Relational Database Design - Normalization - NF - 2NF - 3NF - multivalued dependency and 4 NF

UNSTRUCTURED DATA HANDLING	**7 Hours**

Introduction to unstructured data - XML and JSON - NoSQL databases - MongoDB - Web crawling and web APIs - Regular expressions- Information retrieval - Scoring - weighting - vector space

DATA COLLECTION AND PROCESSING	**7 Hours**

Map - Filter - List manipulations - List Comprehensions - Nested Data and Nested Iterations- Structuring Nested Data - Shallow Copies - Deep Copies - Extracting from Nested Data - Example of Nested Iteration

INTRODUCTION TO MAPREDUCE	**7 Hours**

Cloud computing and data centers - Hadoop API - Mapreduce programming model- Algorithms Using MapReduce - Extensions to MapReduce - The Communication Cost Model - Complexity Theory for MapReduce

Theory: 30 Hrs	**Tutorial : 0**	**Total Hours: 30 Hrs**

Lab component Contents:

List of Experiments:

1. Processing CSV Data using python(Kaggle data)
2. Processing JSON Data using python
3. Processing XLS Data using python
4. Implementation of MongoClient using python
5. Implementation of Map & Filter
6. Implementation of List Comprehension
7. File Management tasks in Hadoop

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8. Analyse time-temperature statistics and generate report with max/min temperature in Hadoop

Practical : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Textbooks:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts , McGraw -Hill, 2015
2. C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.

Reference Books:

1. Atul Kahate, "Introduction to Database Management Systems", Pearson Education, New Delhi, 2006.
2. Alexis Leon and Mathews Leon, "Database Management Systems", Vikas Publishing House Private Limited, New Delhi,
3. Raghu Ramakrishnan, "Database Management Systems", Fourth Edition, Tata McGraw Hill, 2010.
4. G.K.Gupta,"Database Management Systems", Tata McGraw Hill, 2011.
5. Rob Cornell, "Database Systems Design and Implementation", Cengage Learning, 2011.

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U18AIC3006	TOOLS AND TECHNOLOGIES FOR WELLNESS	L	T	P	J	C
		1	0	0	0	1

Course Objectives:

- To understand the concept of ayurveda
- To explain how Asana, Pranayama, Ayurvedic knowledge and Mindfulness for well-being is useful in day to day life

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Understand the various tools like Asana, Pranayama, Ayurvedic knowledge and Mindfulness for well-being
CO 2:	Develop a practical understanding of the various tools

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							M	M	M			
CO2							M	M	M			

Course Assessment methods:

a) Direct

1. Continuous Assessment Test
2. Quiz

b) Indirect

1. Course-end survey

Topics covered:

FOUNDATIONS OF WELLNESS	3 Hours

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What is wellness- Looking at wellness from various viewpoints of Body - Emotions and Cognition and across cultures Introduction to tools: Yogic practices - Mindfulness and other contemplative practices

PHYSICAL DIMENSION	**3 Hours**

Understanding the various aspects of the physical body - problems and issues and tools for physical well-being

EMOTIONAL DIMENSION	**3 Hours**

Understanding emotions - stress - mental health - Tools for emotional well-being

ENERGY AND COGNITIVE DIMENSION	**3 Hours**

Understanding Cognitive executive functions, cognitive biases and challenges and tools for enhanced cognitive capabilities

TRANSCENDENTAL DIMENSION	**3 Hours**

Understanding the science of happiness and transcending the limitations of the physical, emotional and cognitive dimensions.

Theory: 15 Hrs	**Tutorial: 0**	**Total Hours: 15 Hrs**

Text Books:

1. Certification of yoga professionals official guidebook- First edition, Excel books Pvt Ltd., 2016
2. Harvard Medical School Guide to Yoga, Marlynn Wei, James E. Groves

Crafted By: Smrithi Rekha Adinarayanan, MS (State University of New York), co-founder of Anaadi Foundation, Palani

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U18AIT3008	PRINCIPLES OF ECONOMICS	L	T	P	J	C
		2	0	0	0	2

Course Objectives:

- To familiarize the students with the basic concept of microeconomics
- To make student understand the demand and supply analysis in business applications
- To familiarise students with the production and cost structure under different stages of production
- To understand the pricing and output decisions under various market structure
- To help students understand and apply the various decision tools to understand the market structure

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Understand the conceptual foundations and analytical methods used in micro economics
CO 2:	Explain the basics of consumer behavior, behavior of firms and market equilibrium
CO 3:	Understand the market structures of perfect competition, oligopoly and monopolies

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							M	M	M			
CO2							M	M	M			
CO3							M	M	M			

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)

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4. End Semester Examination (Theory)

b) Indirect

1. Course-end survey

Topics covered:

INTRODUCTION OF ECONOMICS	**4 hours**
Scope - Relationship with other Disciplines	
MICROECONOMICS	**7 hours**
Firms and Managerial Objectives - Demand - Law of Demand - Determinants of demand - Elasticity of demand - Law of diminishing marginal utility - Exceptions of Demand - Demand forecasting techniques (only theory) - Supply - Law of Supply - Elasticity of Supply	
PRODUCTION FUNCTIONS	**6 hours**
Short and long run laws of production - law of returns 6 to scale - Cost - types of cost - Short and long run cost output relationship - Economies and diseconomies of Scale	
MARKET STRUCTURE	**6 hours**
Perfect Competition- monopoly- duopoly - oligopoly - 6 Monopolistic market structures - characteristics & Price - Output determination- Pricing Methods	
MACROECONOMICS	**7 hours**
Nature & importance. National Income - concepts - GNP - GDP - NNP - Business cycle - Phases of Business Cycle - Controlling Trade Cycle - Inflation - Indian Financial System - Fiscal Policy - Monetary Policy	

Theory: 30 Hrs	**Tutorial: 0**	**Total Hours: 30 Hrs**

Textbooks:

1. Piyali Ghosh Geetika, Purba Roy Chowdhury (2017),Managerial Economics, 3 e, McGraw- Hill Education
D N Diwedi (2009). Managerial Economics. Seventh Edition, Vikas Publication

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Reference Books:

1. D. N. Gujarati and D.C. Porter, Essentials of Econometrics, McGraw Hill, 4th edition, International Edition, 2009.
2. Christopher Dougherty, Introduction to Econometrics, Oxford University Press, 3rd edition, Indian edition, 2007.
3. Jan Kmenta, Elements of Econometrics, Indian Reprint, Khosla Publishing House,2nd edition, 2008.

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Semester 4

U18MAT4105	RANDOM PROCESS AND OPTIMIZATION	L	T	P	J	C
		3	1	0	0	4

Course Objectives:

- To make students understand Discrete and Continuous Random
- variables, Random Processes and their applications in data science
- To Understand about the correlation Functions
- To understand the functional relationship between random inputs and outputs with the use of Random Process Techniques

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Analyze various random processes with practical applications
CO 2:	Analyze correlation related to various random processes and establish the properties of spectral densities
CO 3:	Analyze and apply appropriate queuing models in domain specific situations
CO 4:	Apply linear programming models to domain specific situations.
CO 5:	Determine the extreme values of functions without constraint and with equality constraints

Pre-requisite courses:Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M										
CO2	S	S										S
CO3	M	M										M
CO4	S	M										
CO5	M	M										

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Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory)

b) Indirect

1. Course-end survey

Topics covered:

RANDOM PROCESSES	**9+3 Hours**

Random Process – Stationary Process – Wide sense stationary and Ergodic processes– Gaussian Random Process – Markov process–Markov chain–Poisson process

CORRELATION AND SPECTRAL DENSITIES	**9+3 Hours**

Auto correlation - Cross correlation - Properties – Power spectral density – Cross spectral density - Properties – Wiener-Khinchine relation – Relationship between cross power spectrum and cross correlation function

QUEUEING MODELS	**9+3 Hours**

Markovian Queues – Single and Multi-server Models – Little's formula – Machine Interference Model – Self Service Queue.

LINEAR PROGRAMMING	**9+3 Hours**

The phases of OR study – formation of an L.P model – graphical solution – simplex algorithm – artificial variables technique -Big M method

CLASSICAL OPTIMIZATION THEORY	**9+3 Hours**

Unconstrained extremal problems – Equality constraints – Lagrange's method – Inequality constraints - Kuhn - Tucker conditions – Quadratic programming – Simple problems.

Theory: 45 Hrs	**Tutorials: 15 Hrs**	**Total Hours: 60 Hrs**

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Text Book:

1. Taha H.A., “Operations Research: An Introduction”, 10th Edition, Pearson Education, 2017.
2. Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata McGraw Hill, 4th Edition, New Delhi, 2002.

Reference Books:

1. Cooper. G.R., Mc Gillem. C.D., "Probabilistic Methods of Signal and System Analysis", 3 rd Indian Edition, Oxford University Press, New Delhi, 2012.
2. Miller S.L. and Childers D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", 2nd Edition, Academic Press, 2012.
3. Stark H, and Woods J.W., "Probability and Random Processes with Applications to Signal Processing", 3rd Edition, Pearson Education, Asia, 2002.
4. Wagner H.M., “Operations Research”, Prentice Hall of India, 2011.
5. Bhaskar S., “Operations Research”, Anuradha Agencies, 2 nd Edition, 2014.

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U18AII4201	COMPUTER NETWORKS	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

- To study the basic taxonomy and terminology of the computer networking and enumerate the layers of OSI model and TCP/IP model.
- To acquire knowledge of Application layer and Presentation layer paradigms and protocols
- To study Session layer design issues, Transport layer services, and protocols
- To gain core knowledge of Network layer routing protocols and IP addressing.
- To study data link layer concepts, design issues, and protocols
- To study the fundamentals and basics of Physical layer, and will apply them in real time applications.

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Understand the functionality and protocols operating in each layer of OSI reference model
CO 2:	Design error control, flow control and routing protocols
CO 3:	Construct network traffic characteristics and congestion control mechanism
CO 4:	Apply terror control, flow control and routing protocols

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2	S	S			M			S		S		S
CO3	S	S		S	M	S				S		
CO4	S			S		S						S

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Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

DATA COMMUNICATIONS AND DATA LINK LAYER	**8 Hours**

Data Communication – The OSI Model – TCP/IP Protocol Suite – Addressing – Transmission Media – Networking devices – Network Topologies. Encoding - Error Detection – Reliable Transmission – MAC protocols – CSMA/CD – CSMA/CA

NETWORK LAYER	**8 Hours**

Circuit Switching – Packet Switching – Bridges and LAN Switches: Spanning Tree algorithm – Internetworking – IPv4 - Subnetting – IPv6 – Routing Techniques: Distance vector (RIP) – Link state (OSPF) — Interdomain Routing (BGP).

TRANSPORT LAYER	**8 Hours**

UDP – TCP – Congestion Control and Resource Allocation: TCP Congestion Control – Congestion Avoidance Mechanisms – Quality of Service: Integrated Services – Differentiated Services – Network Traffic Analysis Bidirectional Protocols: Piggybacking - User Datagram Protocol - Transmission Control Protocol - Congestion Control

APPLICATION LAYER	**6 Hours**

Domain Name System – Electronic Mail (SMTP, MIME, IMAP) – File Transfer (FTP) – WWW (HTTP) -TLS/SSL -IP Security

Theory: 30 Hrs	**Tutorial : 0**	**Total Hours: 30 Hrs**

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Lab component Contents:

List of Experiments:

1. Develop client server based TCP applications using UNIX socket programming functions.
2. Develop client server based UDP applications using UNIX socket programming functions.
3. Simulation of data link and network layer protocols.
4. Performance analysis of TCP and UDP protocol using simulation tool.
5. Performance analysis of routing protocols using simulation tool.
6. Demonstrate the working of network tools such as Ping, TCPDump, Traceroute, Netstat, IPconfig.
7. Analyze the network traffic using Wireshark tool/Packet tracer tool.

Practical : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Textbooks:

1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth edition, Morgan Kaufmann Publishers Inc., 2011.
2. William Stallings, “Data and Computer Communications”, Tenth edition, Pearson Education, 2013.

Reference Books:

1. Behrouz A Forouzan, “Data Communications and Networking”, Fifth edition, Tata McGraw–Hill, New Delhi, 2013.
2. James F. Kurose, Keith W. Ross, “Computer Networking, A Top–Down Approach Featuring the Internet”, Sixth edition, Pearson Education, 2012.

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U18AII4202	Neural Networks and Deep Learning	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

· To teach paradigms and approaches representations and classifications

· To make students understand architectural designs and propagation algorithms

· To explain different belief networks and convolution neural networks

· To teach various advanced techniques in Recurrent Neural Networks, BPTT, Natural language Processing, Regression and deep networks

Course Outcomes:

After successful completion of this course, the students should able to

CO 1:	Understand different methodologies to create application using deep nets
CO 2:	Design the test procedures to assess the efficacy of the developed model.
CO 3:	Identify and apply appropriate deep learning models for analyzing the data for a variety of problems.
CO 4:	Implement different deep learning algorithms

Pre-requisite courses: U18AII2205

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S								M			M
CO2	S	S		M							S	S
CO3	S	S	S	M	S		M		M		S	S
CO4	S	S	S		S						S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)

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2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

CONVOLUTIONAL NEURAL NETWORKS	**10 Hours**
Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Popular CNN Architectures: ResNet, AlexNet – Applications	
RECURRENT AND RECURSIVE NETS	**12 Hours**
Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short-Term Memory Networks, Computer Vision - Speech Recognition - Natural language Processing, Case studies in classification, Regression and deep networks.	
DEEP LEARNING ARCHITECTURES	**12 Hours**
Machine Learning and Deep Learning, Representation Learning, Width and Depth of Neural Networks, Learning Algorithms: Capacity - Overfitting - Underfitting - Bayesian Classification - Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted and Deep Boltzmann Machines , Auto Encoders	
ADVANCED NEURAL NETWORKS	**11 Hours**
Deep Feedforward Networks : Gradient based learning - Hidden Units - Architectural design – Back Propagation algorithms - Regularization for deep learning: Dataset Augmentation - Noise Robustes –Semi supervised learning - Multitask learning - Deep Belief networks -Generative Adversial Networks by Keras MXnet	

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Lab component Contents:

List of Experiments:

1. Develop programs for data representation.
2. Estimating depth and width of Neural Networks
3. Training of Unsupervised Neural Networks
4. Implementing Gradient based learning
5. Implementing Backpropagation algorithms
6. Implementing Deep Belief networks
7. Visualize data by Computer Vision

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8. Implementing RNN

Practical : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Text Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “Deep Learning”, First Edition, MIT Press, 2016.
2. Nikhil Buduma and Nicholas Lacascio, “Fundamentals of Deep Learning”, First Edition, O.Reilly, 2017

Reference Books:

1. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
2. Laura Graesser, Wah Loon Keng "Foundations of Deep Reinforcement Learning: Theory and Practice in Python" Addison-Wesley Professional -2020
3. Jon Krohn, Grant Beyleveld, Aglaé Bassens "Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence", 1st edition Addison-Wesley Professional 2019

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U18AII4203	DATA MINING AND MODELING	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

· To train the basic concepts and techniques of Data Mining.

· To introduce mathematical statistics foundations of the Data Mining Algorithms.

· To include a wide range of clustering, estimation, prediction, and classification algorithms.

· To experiment basic principles, concepts and applications of cluster analysis

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Understand about data mining basics,issues and the working principle of classification technique.
CO 2:	Explain the basic concepts of Association Rule Mining and evaluate the working of various Association Rule Mining algorithms
CO 3:	Implement classification and prediction techniques
CO 4:	Analyze the working of different clustering algorithms

Pre-requisite courses: U18MAI2203

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2	S	S			M			S			S	S
CO3	S	S		S	M	S					S	S
CO4	S	S		S		S					S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product

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3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

INTRODUCTION TO DATA MINING	**10 Hours**

Data Mining Goals Stages of the Data Mining Process - Data Mining Techniques - Knowledge Representation Methods Applications Data preprocessing: Data cleaning - Data transformation - Data reduction - Discretization and generating concept hierarchies - Real time data processing in Kaggle - OLAP - OLTP.

MINING FREQUENT PATTERNS, ASSOCIATION AND CORRELATIONS	**10 Hours**

Mining Frequent Patterns - Associations and Correlations - Mining Methods - Mining various Kinds of Association Rules - Correlation Analysis - Constraint Based Association Mining

CLASSIFICATION	**13 Hours**

Classification and Prediction - Basic Concepts - Decision Tree Induction - Bayesian Classification - Rule Based Classification - Classification by Backpropagation - Associative Classification - Lazy Learners - Other Classification Methods - Prediction CaseStudies: Implementation in Rapidminer, Weka

CLUSTER ANALYSIS	**12 Hours**

Cluster Analysis - Types of Data - Categorization of Major Clustering Methods - K-means - Partitioning Metho Hierarchical Methods - Density-Based Methods - Grid Based Methods - Model-Based Clustering Methods - Cluste High Dimensional Data - Constraint - Based Cluster Analysis - Outlier Analysis and Data Mining Applications.

Theory : 45 Hrs	**Tutorial : 0**	**Total Hours: 45 Hrs**

Lab component Contents:

List of Experiments:

1. Demonstration of preprocessing on different dataset
2. Demonstration of preprocessing on different dataset
3. Demonstration of Association rule process using apriori algorithm
4. Demonstration of classification rule process using decision tree algorithm
5. Demonstration of classification rule process using naïve bayes algorithm

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6. Demonstrate performing Regression on data sets
7. Demonstration of clustering rule process using simple k-means

Practical : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Text Books:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson, I impression,2014
2. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining -Concepts and Techniques, 3rd Edition, Mor Kaufmann Publisher, 2012

Reference Books:

1. Sam Anahory, Dennis Murray: Data Warehousing in the Real World, Pearson, Tenth Impression, 2012.
2. Michael.J.Berry, Gordon.S.Linoff: Mastering Data Mining, Wiley Edition, second edtion, 2012.
3. Hand, Mannila, and Smyth,Principles of Data Mining, MIT Press, 2001.
4. Hastie,Tibshirani, and Friedman, Springer,The Elements of Statistical Learning- Data Mining, Inference, Prediction, 2001.
5. Chakrabarti, Morgan Kaufmann, Mining the Web - Discovering Knowledge from Hypertext Data, 2003
6. I. H. Witten and E. Frank, Data Mining: Practical Machine Learning Tools and Techniques with J Implementations,2005.

S. Murali.

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Course Objectives:

- To acquire knowledge of economics to facilitate the process of economic decision making
- To acquire knowledge on basic financial management aspects
- To develop the skills to analyze financial statements

Course Outcomes:

After successful completion of this course, the students should be able to

CO 1:	Understand key accounting concepts, terms, and principles.
CO 2:	Learn complex accounting transactions and how they relate to accounting principles.

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							M	M	M			
CO2							M	M	M			
CO3							M	M	M			

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory)

b) Indirect

1. Course-end survey

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Topics covered:

BASICS OF ACCOUNTING	**8 hours**

Introduction to basic accounting concepts. Accounting terminologies, Accounting fundamentals, debits & credits Accounts payable & Receivables, Accounting cycle,Inventory accounting & Cost accounting

FINANCIAL REPORTS	**7 hours**

Overview of financial reporting. Types of financial reports. The balance sheet equation - Assets, Liabilities, and Stockholders' Equity. Bookkeeping and managing transactions into book entry.

CLASSIFICATION	**7 hours**

Classification of cash flows into operating, investing, and financing activities. Preparing and analyzing the Statement of Cash Flows. Earnings, Cash from Operations, EBITDA,and Free Cash Flow.

ACCOUNTING VERTICALS	**8 hours**

Links between accounting, measurement, and financial statements.Key business ratios that can be calculated using your Income Statement and Balance Sheet. Interpret two key financial statements (Income Statement and Balance Sheet) that drive business decisions.

Case Study: Case study of a start-up company - recording the first transactions of a new business and preparing the first set of financial statements.

Theory : 30 Hrs	**Tutorial : 0**	**Total Hours: 30 Hrs**

Textbooks:

1. “An Easy Introduction to Financial Accounting: A Self-study Guide” by V.G. Narayanan

Reference Books:

1. Christopher Dougherty, Introduction to Econometrics, Oxford University Press, 3rd edition, Indian edition, 2007.
2. Jan Kmenta, Elements of Econometrics, Indian Reprint, Khosla Publishing House,2nd edition, 2008.

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