



(AMARAVATI, AMRITAPURI, BANGALORE, COIMBATORE, CHENNAI)

B.Tech in Artificial intelligence and Data Science

CURRICULUM and SYLLABUS 2023

GENERAL INFORMATION

ABBREVIATIONS USED IN THE CURRICULUM

Cat	-	Category
L	-	Lecture
T	-	Tutorial
P	-	Practical
Cr	-	Credits
ENGG	-	Engineering Sciences (including General, Core and Electives)
HUM	-	Humanities (including Languages and others)
SCI	-	Basic Sciences (including Mathematics)
PRJ	-	Project Work (including Seminars)
AES	-	Aerospace Engineering
AIE	-	Computer Science and Engineering - Artificial Intelligence
BIO	-	Biology
CCE	-	Computer and Communication Engineering
CHE	-	Chemical Engineering
CHY	-	Chemistry
CSE	-	Computer Science and Engineering
CVL	-	Civil Engineering
CUL	-	Cultural Education
EAC	-	Electronics and Computer Engineering
ECE	-	Electronics and Communication Engineering
EEE	-	Electrical and Electronics Engineering
ELC	-	Electrical and Computer Engineering
HUM	-	Humanities
MAT	-	Mathematics
MEE	-	Mechanical Engineering
PHY	-	Physics

Course Outcome (CO) – Statements that describe what students are expected to know, and are able to do at the end of each course. These relate to the skills, knowledge and behaviour that students acquire in their progress through the course.

Program Outcomes (POs) – Program Outcomes are statements that describe what students are expected to know and be able to do upon graduating from the Program. These relate to the skills, knowledge, attitude and behaviour that students acquire through the program. NBA has defined the Program Outcomes for each discipline.

PROGRAM OUTCOMES FOR ENGINEERING

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **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.
4. **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.

5. **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.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.
11. **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.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SEMESTER I

Cat.	Course Code	Title	L T P	Credit
SCI	23MAT106	Mathematics for Intelligent Systems 1	3 0 2	4
SCI	23PHY104	Computational Mechanics 1	2 0 2	3
ENGG	23AID101	Computational Thinking	2 0 2	3
ENGG	23AID102	Elements of Computing - 1	2 0 2	3
ENGG	23EEE103	Introduction to Electrical Engineering	2 0 2	3
SCI	23BIO112	Introduction to Biological Data	2 0 2	3
ENGG	22ADM101	Foundations of Indian Heritage	2 0 1	2
ENGG	22AVP103	Mastery Over Mind	1 0 2	2
HUM	19ENG111	Technical Communication	2 0 3	3
TOTAL				26

SEMESTER II

Cat.	Course Code	Title	L T P	Credit
SCI	23MAT112	Mathematics for Intelligent Systems 2	2 0 2	3
SCI	23PHY114	Computational Mechanics 2	2 0 2	3
ENGG	23AID111	Object Oriented Programming	2 0 2	3
ENGG	23AID112	Data Structures & Algorithms	2 0 2	3
ENGG	23AID113	Elements of Computing 2	2 0 2	3
ENGG	23ECE113	Introduction to Electronics	2 0 2	3
SCI	23CHY115	Introduction to Materials Informatics	2 0 2	3
HUM	22ADM111	Glimpses of glorious India	2 0 1	2
TOTAL				23

SEMESTER III

Cat	Course Code	Title	L T P	Cr
SCI	23MAT204	Mathematics for Intelligent Systems 3	2 0 2	3
ENGG	23AID201	Modelling, Simulation & Analysis	2 0 2	3
ENGG	23AID202	Introduction to Robotics	2 0 2	3
ENGG	23AID203	Software-Defined Communication Systems	2 0 2	3
ENGG	23AID204	Advanced Data Structures & Algorithm Analysis	2 0 2	3
ENGG	23AID205	Introduction to AI and Machine Learning	2 0 2	3
ENGG	23AID206	Introduction to Computer Networks	2 0 2	3
HUM		Amrita Value Programme I	1 0 0	1
HUM	23LSE201	Life Skills for Engineers I	1 0 2	P/F
Total				22

– These 3 slots are equivalent to 2 regular slots.

SEMESTER IV

Cat	Course Code	Title	L T P	Cr
SCI	23MAT214	Mathematics for Intelligent Systems 4	2 0 2	3
ENGG	23AID211	Deep Learning	2 0 2	3
ENGG		Elective - 1	2 0 2	3
ENGG	23AID212	Introduction to IoT	2 0 2	3
ENGG	23AID213	Operating Systems	3 0 2	4
ENGG	23AID214	Database Management Systems	2 0 2	3
HUM	23AID215	User Interface Design	1 0 2	2
HUM		Amrita Value Programme II	1 0 0	1
HUM	23LSE211	Life Skills for Engineers II	1 0 2	2
Total				24

– These 3 slots are equivalent to 2 regular slots.

SEMESTER V

Cat	Course Code	Title	L T P	Cr
SCI	23MAT303	Mathematics for Intelligent Systems 5	2 0 2	3
ENGG	23AID301	Computer Vision	2 0 2	3
ENGG	23AID302	Big Data Analytics	2 0 2	3
ENGG	23AID303	Quantum Computing & Algorithms	2 0 2	3
ENGG	23AID304	High Performance and Cloud Computing	2 0 2	3
ENGG	23AID305	Control System	2 0 2	3
ENGG		Elective - 2	2 0 2	3
HUM	23LSE301	Life Skills for Engineers III	1 0 2	2
		Total		23

– These 3 slots are equivalent to 2 regular slots.

SEMESTER VI

Cat	Course Code	Title	L T P	Cr
SCI	23MAT313	Mathematics for Intelligent Systems 6	2 0 2	3
ENGG		Elective - 3	2 0 2	3
ENGG		Elective - 4	2 0 2	3
ENGG		Elective - 5	2 0 2	3
ENGG		Elective - 6	2 0 2	3
ENGG	23AID311	Analog Computing	2 0 2	3
ENGG	23AID312	Reinforcement Learning	2 0 2	3
HUM	23LSE311	Life Skills for Engineers IV	1 0 2	2
		Total		23

– These 3 slots are equivalent to 2 regular slots.

SEMESTER VII

Cat	Course Code	Title	L T P	Cr
ENGG		Free Elective - 1	2 0 2	3
ENGG		Free Elective - 2	2 0 2	3
ENGG	23AID498	Project Phase - 1		7
ENGG	19ENV300	Environmental Science		P/F
ENGG	19LAW300	Indian Constitution		P/F
		Total		13

– These 3 slots are equivalent to 2 regular slots.

SEMESTER VIII

Cat	Course Code	Title	L T P	Cr
PRJ	23AID499	Project & Internship	10	
		Total		10

		Total Credits		164
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@'Hands-on' Project-based Lab.

***Professional Elective** - Electives categorized under Engineering, Science, Mathematics, Live-in-Labs, and NPTEL Courses. Student can opt for such electives across departments/campuses. Students with CGPA of 7.0 and above can opt for a maximum of 2 NPTEL courses with the credits not exceeding 8.

**** Free Electives** - This will include courses offered by Faculty of Humanities and Social Sciences/Faculty Arts, Commerce and Media / Faculty of Management/Amrita Darshanam -(International Centre for Spiritual Studies).

***** Live-in-Labs** - Students undertaking and registering for a Live-in-Labs project, can be exempted from registering for an Elective course in the higher semester.

Amrita Value Programmes I & II for UG programmes

Course Code	Title	L-T-P	Credits
22ADM201	Strategic Lessons from Mahabharatha	1-0-0	1
22ADM211	Leadership from Ramayana	1-0-0	1
22AVP210	Kerala Mural Art and Painting	1-0-0	1
22AVP218	Yoga Therapy and Lessons	1-0-0	1
22AVP212	Introduction to Traditional Indian Systems of Medicine	1-0-0	1
22AVP201	Amma's Life and Message to the modern world	1-0-0	1
22AVP204	Lessons from the Upanishads	1-0-0	1
22AVP205	Message of the Bhagavad Gita	1-0-0	1
22AVP206	Life and Message of Swami Vivekananda	1-0-0	1
22AVP207	Life and Teachings of Spiritual Masters of India	1-0-0	1
22AVP208	Insights into Indian Arts and Literature	1-0-0	1
22AVP213	Traditional Fine Arts of India	1-0-0	1
22AVP214	Principles of Worship in India	1-0-0	1
22AVP215	Temple Mural Arts in Kerala	1-0-0	1
22AVP218	Insights into Indian Classical Music	1-0-0	1
22AVP219	Insights into Traditional Indian Painting	1-0-0	1
22AVP220	Insights into Indian Classical Dance	1-0-0	1
22AVP221	Indian Martial Arts and Self Defense	1-0-0	1
22AVP209	Yoga and Meditation	1-0-0	1

PROFESSIONAL ELECTIVES

Robotics		Credits	Smart Grids		Credits
23AID431	Robotics - Kinematics, Dynamics and Control	3	23AID461	Fundamentals and Analysis of Power Systems	3
23AID432	Introduction to ROS2	3	23AID462	Sustainable Energy Technologies	3
23AID433	NLP for Robotics	3	23AID463	Power System Stability	3
23AID434	Robotics Vision	3	23AID464	Micro Grids	3
23AID435	Mobile Robotics	3	23AID465	Intelligent Energy Management Systems	3
23AID436	Artificial Intelligence for Robotics	3	23AID466	Power Quality Management	3
	Computational Healthcare	Credits		NLP	Credits
23AID441	Introduction to Biomedical Informatics	3	23AID471	Speech Processing	3
23AID442	CRISPR/Cas9 Technology	3	23AID472	Text Analytics	3
23AID443	Introduction to Molecular Modelling	3	23AID473	Information Retrieval	3
23AID444	Transcriptomic, Proteomics and Metabolomics	3	23AID474	Introduction to Chat Bots	3
23AID445	Introduction to High Performance Computing	3	23AID475	Machine Translation and Sequence-to- Sequence Models	3
23AID446	Genomics Data Science	3	23AID476	Speech Recognition and Understanding	3
23AID447	AI in system biology	3	23AID477	Social Media Text Analysis	3
23AID448	AI in Drug Design	3			

	Intelligent Security Systems	Credits			
23AID451	Applied Cryptography	3			
23AID452	Network & Wireless Security	3			
23AID453	Intrusion Detection & Prevention Systems	3			
23AID454	Software Vulnerability Analysis	3			
23AID455	Cybercrime Investigations & Digital Forensics	3			
23AID456	Distributed Systems Security	3			

PROFESSIONAL ELECTIVES UNDER SCIENCE STREAM

CHEMISTRY				
Cat.	Course Code	Title	L T P	Credit
SCI	23CHY240	Computational Chemistry and Molecular Modelling	3 0 0	3
SCI	23CHY241	Electrochemical Energy Systems and Processes	3 0 0	3
SCI	23CHY242	Fuels and Combustion	3 0 0	3
SCI	23CHY243	Green Chemistry and Technology	3 0 0	3
SCI	23CHY244	Instrumental Methods of Analysis	3 0 0	3
SCI	23CHY245	Batteries and Fuel Cells	3 0 0	3
SCI	23CHY246	Corrosion Science	3 0 0	3
PHYSICS				
SCI	23PHY240	Advanced Classical Dynamics	3 0 0	3
SCI	23PHY241	Electrical Engineering Materials	3 0 0	3
SCI	23PHY242	Physics of Lasers and Applications	3 0 0	3
SCI	23PHY243	Concepts of Nanophysics and Nanotechnology	3 0 0	3
SCI	23PHY244	Physics of Semiconductor Devices	3 0 0	3
SCI	23PHY245	Astrophysics	3 0 0	3
Mathematics				
SCI	23MAT240	Statistical Inference	3 0 0	3
SCI	23MAT241	Introduction to Game Theory	3 0 0	3
SCI	23MAT242	Numerical Methods and Optimization	3 0 0	3

FREE ELECTIVES

FREE ELECTIVES OFFERED UNDER MANAGEMENT STREAM				
Cat.	Course Code	Title	L T P	Credit
HUM	23MNG331	Financial Management	3 0 0	3
HUM	23MNG332	Supply Chain Management	3 0 0	3
HUM	23MNG333	Marketing Management	3 0 0	3
HUM	23MNG334	Project Management	3 0 0	3
HUM	23MNG335	Enterprise Management	3 0 0	3
HUM	23MNG336	Operations Research	3 0 0	3
HUM	23MEE321	Industrial Engineering	3 0 0	3
HUM	23MEE322	Managerial Statistics	3 0 0	3
HUM	23MEE323	Total Quality Management	3 0 0	3
HUM	23MEE324	Lean Manufacturing	3 0 0	3
HUM	23CSE321	Software Project Management	3 0 0	3
HUM	23CSE322	Financial Engineering	3 0 0	3
HUM	23CSE323	Engineering Economic Analysis	3 0 0	3
HUM	23CSE324	Information Systems	3 0 0	3

FREE ELECTIVES OFFERED UNDER HUMANITIES / SOCIAL SCIENCE STREAMS				
Cat.	Course Code	Title	L T P	Credit
HUM	23CUL230	Achieving Excellence in Life - An Indian Perspective	2 0 0	2
HUM	23CUL231	Excellence in Daily Life	2 0 0	2
HUM	23CUL232	Exploring Science and Technology in Ancient India	2 0 0	2
HUM	23CUL233	Yoga Psychology	2 0 0	2
HUM	23ENG230	Business Communication	1 0 3	2
HUM	23ENG231	Indian Thought through English	2 0 0	2
HUM	23ENG232	Insights into Life through English Literature	2 0 0	2
HUM	23ENG233	Technical Communication	2 0 0	2
HUM	23ENG234	Indian Short Stories in English	2 0 0	2
HUM	23FRE230	Proficiency in French Language (Lower)	2 0 0	2
HUM	23FRE231	Proficiency in French Language (Higher)	2 0 0	2
HUM	23GER230	German for Beginners I	2 0 0	2
HUM	23GER231	German for Beginners II	2 0 0	2
HUM	23GER232	Proficiency in German Language (Lower)	2 0 0	2
HUM	23GER233	Proficiency in German Language (Higher)	2 0 0	2
HUM	23HIN230	Hindi I	2 0 0	2
HUM	23HIN231	Hindi II	2 0 0	2
HUM	23HUM230	Emotional Intelligence	2 0 0	2
HUM	23HUM231	Glimpses into the Indian Mind - the Growth of Modern India	2 0 0	2
HUM	23HUM232	Glimpses of Eternal India	2 0 0	2
HUM	23HUM233	Glimpses of Indian Economy and Polity	2 0 0	2
HUM	23HUM234	Health and Lifestyle	2 0 0	2
HUM	23HUM235	Indian Classics for the Twenty-first Century	2 0 0	2
HUM	23HUM236	Introduction to India Studies	2 0 0	2
HUM	23HUM237	Introduction to Sanskrit Language and Literature	2 0 0	2
HUM	23HUM238	National Service Scheme	2 0 0	2
HUM	23HUM239	Psychology for Effective Living	2 0 0	2
HUM	23HUM240	Psychology for Engineers	2 0 0	2
HUM	23HUM241	Science and Society - An Indian Perspective	2 0 0	2
HUM	23HUM242	The Message of Bhagwat Gita	2 0 0	2

HUM	23HUM243	The Message of the Upanishads	2 0 0	2
HUM	23HUM244	Understanding Science of Food and Nutrition	2 0 0	2
HUM	23HUM245	Service Learning	2 0 0	2
HUM	23JAP230	Proficiency in Japanese Language (Lower)	2 0 0	2
HUM	23JAP231	Proficiency in Japanese Language (Higher)	2 0 0	2
HUM	23KAN230	Kannada I	2 0 0	2
HUM	23KAN231	Kannada II	2 0 0	2
HUM	23MAL230	Malayalam I	2 0 0	2
HUM	23MAL231	Malayalam II	2 0 0	2
HUM	23SAN230	Sanskrit I	2 0 0	2
HUM	23SAN231	Sanskrit II	2 0 0	2
HUM	23SWK230	Corporate Social Responsibility	2 0 0	2
HUM	23SWK231	Workplace Mental Health	2 0 0	2
HUM	23TAM230	Tamil I	2 0 0	2
HUM	23TAM231	TAMIL II	2 0 0	2

PROGRAMME SPECIFIC OUTCOMES

- PSO1** Develop AI systems using a variety of algorithms and techniques, such as machine learning, natural language processing, computer vision, and robotics, to solve real-world problems and demonstrate proficiency in coding and implementing AI algorithms.
- PSO2** Analyze the performance of AI models and systems using appropriate evaluation metrics and techniques, and apply optimization methods to improve the efficiency and effectiveness of AI algorithms, while considering factors such as accuracy, speed, scalability, and resource utilization.
- PSO3** Develop ethical and responsible AI solutions by considering the ethical implications of AI technologies, including issues related to bias, fairness, transparency, privacy, and security, and propose strategies to mitigate potential ethical concerns in the development and deployment of AI systems.

SEMESTER 1

23MAT106

Mathematics for Intelligent Systems 1

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

Course Objectives

- To introduce students to the fundamental concepts and techniques of linear algebra, ordinary differential equations, probability theory, complex numbers, and quantum computing that are necessary for further study in science and related fields.
- To enable students to apply the concepts they learn in practical situations by using analytical and numerical methods to model real-world problems.
- To expose students to the wide range of applications of linear algebra, ordinary differential equations, probability theory, complex numbers, and quantum computing within the scientific field and to inspire them to pursue further study or research in these areas.
- To introduce students to the fundamental concepts of quantum computing
- To develop students' ability to communicate mathematical concepts and solutions clearly and effectively.

Course Outcomes

After completing this course, students will be able to

CO1	Apply the fundamental concepts of linear algebra and calculus to solve canonical problems analytically and computationally
CO2	Model and simulate simple physical systems using ordinary differential equations
CO3	Apply the concept of probability and random variables to solve elementary problems
CO4	Explain the basic concepts of quantum computing and differentiate it from conventional computing

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	3	2	3	-	-	-	3	2	3	3	3	3	3
CO2	3	3	3	2	3	2		-	3	2	3	3	3	3	3
CO3	3	3	3	2	3	-	2	-	3	2	3	3	3	2	-
CO4	3	-	-	-	-	-	-	-	3	2	3	3	2	-	-

Syllabus

Unit 1

Basics of Linear Algebra - Linear Dependence and independence of vectors - Gaussian Elimination - Rank of set of vectors forming a matrix - Vector space and Basis set for a Vector space – Dot product and Orthogonality -CR decomposition - Rotation matrices - Eigenvalues and Eigenvectors and its interpretation-Introduction to SVD-Computational experiments using Matlab/Excel/Simulink.

Unit 2

Ordinary Linear differential equations, formulation - concept of slope, velocity and acceleration - analytical and numerical solutions- Impulse Response computations- converting higher order into first order equations - examples of ODE modelling in falling objects, satellite and planetary motion, Electrical and mechanical systems– Introduction to solving simple differential equations with Simulink- Introduction to one variable optimization - Taylor series- Computational experiments using Matlab /Excel/Simulink.

Unit 3

Introduction to random variables (continuous and discrete), mean, standard deviation, variance, sum of independent random variable, convolution, sum of convolution integral, probability distributions

Amrita Vishwa Vidyapeetham.

B.Tech-AIE

B.Tech Curriculum June 2021

Unit 4

Introduction to quantum computing, Quantum Computing Roadmap, Quantum Mission in India, A Brief Introduction to Applications of Quantum computers, Quantum Computing Basics, Bracket Notation, Inner product, outer product, concept of state.

Text Books / References

Gilbert Strang, Introduction to Linear Algebra, Fifth Edition, Wellesley-Cambridge Press, 2016.
Gilbert Strang, Linear Algebra and Learning from Data, Wellesley, Cambridge press, 2019.
William Flannery, Mathematical Modelling and Computational Calculus, Vol-1, Berkeley Science Books, 2013.
Stephen Boyd and Lieven Vandenberghe, Introduction to Applied Linear Algebra – Vectors, Matrices, and Least Squares, 2018.
Bernhardt, Chris. Quantum computing for everyone. Mit Press, 2019. (From pages 1 to 36).

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 3)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23PHY104	Computational Mechanics 1	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- This course aims to introduce students to the fundamental concepts of computational mechanics, with a focus on developing computational models for mechanical systems using numerical methods.
- This course aims to provide students with a thorough understanding of kinematics, statics, and kinetics and their application to mechanical systems.
- This course aims to equip students with the skills and knowledge necessary to analyze the behavior of mechanical systems using computational mechanics tools and techniques.

Course Outcomes

After completing this course, students will be able to

CO1	Apply numerical methods to develop computational models for mechanical systems and analyze their behavior
CO2	Derive constitutive relations for mechanical systems in motion or at rest, including particles and rigid bodies, and use these equations to solve real world problems.
CO3	Evaluate the results of computational simulations and use this information to make informed decisions about mechanical systems design and optimization
CO4	Use software tools for computational mechanics, including code for solving equations of motion and simulating mechanical systems

CO-PO Mapping

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

Unit 1 Kinematics and Statics

Position, velocity, and acceleration of particles, Newton's laws of motion, Work and energy, Rigid body kinematics, Translations and Rotations, Alternate representations of Rigid body Rotation - Rotation matrices, Euler angles, Axis-angle representations, Quaternions. Introduction to statics and equilibrium, Free body diagrams, Equilibrium of particles and rigid bodies, Computational aspects of solving kinematics and statics problems of real world systems.

Unit 2 Introduction to Kinetics

Cross product of two vectors, Inertial and Non-Inertial frame of reference, Linear momentum, Center of mass, Coriolis, Inertial and Centripetal forces, Acceleration in polar coordinates, Angular velocity, Angular momentum and Torque on particles, Computational aspects of solving kinetics problems of particles.

Unit 3 Kinetics of Rigid Bodies

Two particle system angular momentum, Inertia matrix, Moment and product of inertia, Principal axes theorem, Principal axes as eigenvector of Inertia matrix, Parallel axes theorem, Computational aspects of solving kinetics problems of particles, Introduction to Euler-Lagrange and Newton-Euler equations for solving rigid body dynamics. Euler-Lagrange equation derivation using one dimensional point mass example, Application of Euler-Lagrange equation for solving dynamics of simple mechanical systems.

Text Books / References

"Introduction to Computational Mechanics" by B. S. Choo and S. H. Han - 2005, 1st edition

"Engineering Mechanics: Dynamics" by J.L. Meriam and L.G. Kraige - 2016, 8th edition

"Engineering Mechanics: Statics" by J.L. Meriam and L.G. Kraige - 2016, 8th edition

"Vector Mechanics for Engineers: Statics and Dynamics" by Ferdinand P. Beer and E. Russell Johnston Jr. - 2015, 11th edition

"Mechanics of Materials" by James M. Gere and Barry J. Goodno - 2018, 9th edition

"Introduction to Classical Mechanics: With Problems and Solutions" by David Morin - 2008, 1st edition

Engineering Mechanics: Statics and Dynamics" by Irving H. Shames –2002, 4th edition.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

Course Objectives

- Provide an insight on the importance of computational thinking
- Help to develop skills to solve problems using spreadsheet and matlab
- Provide logical thinking capabilities to solve problems

Course Outcomes

After completing this course, students will be able to

CO1	Develop critical thinking
CO2	Apply logical thinking to solve problems
CO3	Develop skills to use spreadsheet for problem solving
CO4	Develop skills to use matlab for problem solving

CO-PO Mapping

PO/P SO	PO 1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO 9	PO 10	PO1 1	PO1 2	PSO 1	PSO2	PSO3
CO															
CO1	2	3	-	2	2	-	-	-	-	-	-	-	1	2	1
CO2	2	3	-	2	2	-	-	-	-	-	-	-	1	2	1
CO3	2	3	-	2	2	-	-	-	-	-	-	-	1	2	1
CO4	2	3	-	2	2	-	-	-	-	-	-	-	1	2	1

Syllabus**Unit 1**

Computational Thinking, critical thinking, data representation, abstraction, decomposition- breaking problems into parts, basic data types, pseudocode, algorithms-methods to solve the problems, brute-force or exhaustive search problems, divide and conquer problems

Unit 2

Computational Thinking using spreadsheets, basic operations, cell references – relative and absolute, lookup operations, implement fractals – newton, Sierpinski triangle, L-system fractals, solve calculus based problems using spreadsheet, using spreadsheet for solving probability related problems

Unit 3

Computational thinking using matlab, basic operations, plotting of vectors, array and matrix operations, implement fractals – newton, Sierpinski triangle, L-system fractals, solve calculus based problems using matlab, using matlab for solving probability related problems

Text Books / References

Ferragina P, Luccio F. Computational Thinking: First Algorithms, Then Code. Springer; 2018

Beecher K. Computational Thinking: A beginner's guide to Problem-solving and Programming. BCS Learning & Development Limited; 2017.

Irfan Turk, Matlab programming, 2018

Noreen Brown, Beginning Excel 2019, 2019 .

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID102	Elements of Computing - 1	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- The course will introduce the principles of number system conversions, Boolean logic, logic gates, and Boolean algebra.
- The course will aid the students in the design and analysis of combinational and sequential logic circuits.
- The course will also equip students to build a general-purpose computing system using elementary NAND gates through a simulation software

Course Outcomes

After completing this course, students will be able to

CO1	Demonstrate proficiency in performing number system conversion, manipulating Boolean Algebra expressions and realization of basic gates .
CO2	Implement different combinational logic circuits.
CO3	Implement different sequential logic circuits
CO4	Build a general-purpose computer using elementary NAND gates through a simulation software

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	2	3	-	-	-	3	2	3	3	1	1	1
CO2	3	3	3	3	3	2	1	1	3	2	3	3	2	2	2
CO3	3	2	3	3	3	2	1	1	3	2	3	3	2	2	2
CO4	3	2	3	2	3	-	-	-	3	2	3	3	2	2	2

Syllabus

Unit 1

Number System, Conversions, Signed and Unsigned Binary Number Representation, Boolean algebra and Karnaugh Maps, Logic gates, Realization of basic gates using universal gates, Boolean function synthesis, Introduction to Hardware simulator platform Nand2teris, Hardware description language, Implementation of basic gates and its multi-bit and multiway versions in Nand2teris software suite.

Unit 2

Combinational Logic, Half Adder, Full Adder, Multiplexer and demultiplexer, Multi-bit and Multiway versions, Realization of Boolean functions using combinational logic, Arithmetic logic unit (ALU)- specification, design, Sequential logic, Flip Flops, Registers, RAM, ROM.

Unit 3

Von-Neumann architecture, Program Counter, Central Processing unit, Data Memory, Hack machine language specifications/ instructions for CPU design, Hack CPU Design, CPU Control logic, building a Hack Computer.

Text Books / References

- Noam Nisan and Shimon Schocken, "Elements of Computing Systems", MIT Press, 2012.
M. Morris Mano, "Digital Design", 5th Edition, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2014.
John. M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
Anil K. Maini, "Digital Electronics", Wiley, 2014.
Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.
Donald D.Givone, "Digital Principles and Design", TMH, 2003.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

Approved by the Department of IT

BTC-AIE

B.Tech Curriculum June 2021

Course Objectives

- To develop the understanding of both AC and DC circuits.
- To acquire the knowledge of circuit analysis techniques for solving both AC and DC circuits
- To learn state space modelling and solution of DC circuits.
- To establish connections between the concepts of electrical engineering, mathematics, and computational solution methods.

Course Outcomes

After completing this course, students will be able to

CO1	Apply and analyse circuit laws and the analysis techniques for solving electric circuits
CO2	Comprehend the transient behaviour of DC circuits and generate solutions computationally
CO3	Use the concepts of Thevenin and Norton equivalent networks to simplify complex circuits
CO4	Computationally solve the state space model of electric circuits

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2	PSO 1	PSO2	PSO 3
CO															
CO1	3	3	2	2	3	1	-	-	3	2	3	3	2	1	1
CO2	3	3	3	3	3	2	-	-	3	2	3	3	2	3	2
CO3	3	2	3	3	3	2	2	-	3	2	3	3	2	2	3
CO4	3	3	3	2	3	2	2	-	3	2	3	3	3	3	2

Syllabus**Unit 1 DC Circuit**

EMF, Charge, Voltage, Current - Linear circuit elements – Energy and power - Ohms law – Kirchhoff's voltage and current law – Series parallel combination of R, L, C components – Voltage divider and current divider rules – Super position theorem – Nodal and Mesh Analysis – Step response of RL and RC Circuits (Transient behaviour) – Equivalent network: Thevenin and Norton.

Unit 2 AC Circuit

Impedance - Instantaneous, Average, Active, Reactive and Apparent Power – Power Factor – Phasors

Unit 3 Introduction to Control Systems

State Space Representation: State, State variable, and State Model – Canonical state space model for Series RLC Circuit – Solution using eigen values and eigen vectors.

Text Books / References

"Basic Electrical Engineering" by D. P. Kothari and J. Nagrath (4th edition), McGraw Hill, 2019.

"Electric Circuits" by James W. Nilsson and Susan Riedel (11th edition), Pearson, 2018.

"Modern Control Engineering" by Ogata (5th edition), Pearson, 2009.

"Linear Control Systems with MATLAB Applications," by B.S. Manke, Khanna, 12th edition, 2016

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23BIO112	Introduction to Biological Data	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- The course is aimed at educating students on fundamentals concept of biomolecules (sequence, structure, conformational state and functions) and the central dogma of biology.
- To teach them how to read /write molecular structure and sequence from specific file using scripting language (like awk, LINUX command vim) and introduced with LINUX system.
- It will explore different biological databases (Uniprot, RSCB, GeneBank, PDBbind etc) and teach how to extract data from those databases.
- Ontology: Storing data in a structured manner through ontologies
- Teach fundamental concept to process the bio-signal and biomedical images.
- The fundamental concept of regression and classification will be introduced using example of biological data set.
- Introduced students with the biological visualization software (PyMol, VMD, ChemDraw, Arena3D etc.) and different webserver.

Course Outcomes

After completing this course, students will be able to

CO1	Develop ability to process (read, write, and analyse) biological data.
CO2	Analysis of different biological data
CO3	Design AI and ML research problem to address biological research problem
CO4	Develop knowledge to use different visualization tools and write script to handle software by command line

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	2	3	1	3	-	-	2	3	3	-	-	-
CO2	3	3	3	3	3	1	-	-	3	2	3	3	2	-	-
CO3	3	3	3	3	3	-	-	-	3	2	3	3	3	3	3
CO4	3	3	3	3	3	1	-	-	3	2	3	3	-	-	-

Syllabus

Unit 1

Introduction to nucleic acid and protein sequence, structure, and function – introduction of drug molecules - Scripting language / Linux command to handle big biological data files (sequence and structure) – programming using python and R – Linux commands.

Unit 2 Amrita Vishwa Vidyapeetham.

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Explore different biological databases (RCSB, GenBank, DrugBank etc.) – introduction to protein family and onotology - protein functional database (Pfam, GO etc.) - extract data from database using scripting languages (awk, bash)

Unit 3

Biomolecular sequence descriptors – presents biomolecular structure using graph – quantify dynamics natures of biomolecules - scoring matrices to describe evolution relationship – fundamental of biomedical image analysis using python and MATLAB (CT scan, mammography, MRI etc.) – biomedical signal (ECG, EEG etc.) visualization and annotation using MATLAB -Virtualization software (PyMol, VMD etc) – TCL and Python programming to write code for PyMol and VMD.

Unit 4

Application of AI and machine learning to predict biological activity of biomolecules (regression) – AI-based biomolecular structure prediction models – Binary and multi classification problems related to biological data..

Text Books / References

“Introduction to Protein Structure” by Carl Ivar Branden, John Tooze

Ramachandran, G.N., and Sasisekharan, V. Advances in Protein Chemistry, Vol. 23, Academic Press, P. 283 (1968).

Schulz and Schirmer, Principles of Protein Structure, Springer-Verlag (1979).

Wolfram Saenger. Principles of Nucleic Acid Structure (19840).

UNIX: Concepts and Applications Sumitabha Das

“Bioinformatics: Sequence and Genome Analysis” by David mount

“Bioinformatics algorithm, An active learning Approach”, Phillip Compeau and Pavel Pevzner, Vol.1. and Vol.2, 2015.

"Bio-Inspired Computation and Applications in Image Processing" by João Paulo Papa and Xin-She Yang Professor

ECG Signal Processing, Classification and Interpretation: A Comprehensive Framework of Computational Intelligence" by Witold Pedrycz and Adam Gacek.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	25
Quizzes (minimum 2)	Internal	20
Viva	Internal	10
Mid-Term Examination	Internal	15
Term Project/ End Semester Examination	External	30

22ADM101	Foundations of Indian Heritage	L-T-P-C: 2- 0- 1- 2
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Course Objectives

- The course is designed as an introductory guide to the variegated dimensions of Indian cultural and intellectual heritage, to enable students to obtain a synoptic view of the grandiose achievements of India in diverse fields.
- It will equip students with concrete knowledge of their country and the mind of its people and instil in them some of the great values of Indian culture.

Course Outcomes

After completing this course, students will be able to

CO1	Be introduced to the cultural ethos of Amrita Vishwa Vidyapeetham, and Amma's life and vision of holistic education	2021
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CO2	Understand the foundational concepts of Indian civilization like puruṣārtha-s, law of karma and varṇāśrama
CO3	Gain a positive appreciation of Indian culture, traditions, customs and practices
CO4	Imbibe spirit of living in harmony with nature, and principles and practices of Yoga
CO5	Get guidelines for healthy and happy living from the great spiritual masters

CO-PO Mapping

PO/P SO	PO 1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO 9	PO 10	PO1 1	PO1 2	PSO 1	PSO2	PSO3
CO															
CO1	-	-	-	-	-	3	2	3	-	-	-	2	-	-	-
CO2	-	-	-	-	-	3	1	3	-	-	-	2	-	-	-
CO3	-	-	-	-	-	3	1	3	-	-	-	2	-	-	-
CO4	-	-	-	-	-	3	3	3	-	-	-	2	-	-	-
CO5	-	-	-	-	-	3	1	3	-	-	-	2	-	-	-

Syllabus

Unit 1

Introduction to Indian culture; Understanding the cultural ethos of Amrita Vishwa Vidyapeetham; Amma's life and vision of holistic education.

Unit 2

Goals of Life – Purusharthas; Introduction to Varnasrama Dharma; Law of Karma; Practices for Happiness.

Unit 3

Symbols of Indian Culture; Festivals of India; Living in Harmony with Nature; Relevance of Epics in Modern Era; Lessons from Ramayana; Life and Work of Great Seers of India.

Text Books / References

Cultural Education Resource Material Semester-1

The Eternal Truth (A compilation of Amma's teachings on Indian Culture)

Eternal Values for a Changing Society. Swami Ranganathananda. BharatiyaVidyaBhavan.

Awaken Children (Dialogues with Mata Amritanandamayi) Volumes 1 to 9

My India, India Eternal. Swami Vivekananda. Ramakrishna Mission

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Periodical 1 (P1)	Internal	15
Periodical 2 (P2)	Internal	15
*Continuous Assessment (CA)	Internal	20
End Semester	External	50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Outcomes

After completing this course, students will be able to

CO1	To be able to describe what meditation is and to understand its health benefits
CO2	To understand the causes of stress and how meditation improves well-being.
CO3	To understand the science of meditation.
CO4	To learn and practice MA OM meditation in daily life.
CO5	To understand the application of meditation to improve communication and relationships.
CO6	To be able to understand the power of meditation in compassion-driven action.

Syllabus

Unit 1: Describe Meditation and Understand its Benefits

A:Importance of meditation. How does meditation help to overcome obstacles in life (Pre-recorded video with Swami Shubhamritananda Puri)

Reading 1: Why Meditate? (Swami Shubamritananda ji)

MAOM Mastery Over Mind, School of Spiritual and Cultural Studies| Amritapuri Campus Course Outline, September 2022

Reading 2: ‘Stillness of the Mind’ Chapter 17 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Additional Reading: Abhyasa Yoga: The Yoga of Practice. (Br. Achyutamrita Chaitanya)

B:Understand how meditation works. Understand how meditation helps in improving physical and mental health. Understand how meditation helps in the development of personality (Pre-recorded video with Dr. Ram Manohar).

Unit 2: Causes of Stress and How Meditation Improves Well-being

A:Learn how to prepare for meditation. Understand the aids that can help in effectively practicing meditation. Understand the role of sleep, physical activity, and a balanced diet in supporting meditation. (Pre-recorded video with Dr. Ram Manohar)

Causes of Stress. The problem of not being relaxed. Effects of stress on health. How meditation helps to relieve stress. Basics of stress management at home and the workplace. (Pre-recorded video with Prof Udhaykumar)

Reading 1: Mayo Clinic Staff (2022, April 29). Meditation: A Simple, Fast Way to Reduce Stress. Mayo Clinic. <https://www.mayoclinic.org/tests-procedures/meditation/in-depth/meditation/art-20045858> (PDF provided)

Reading 2: ‘Efficient Action.’ Chapter 28 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Unit 3: The Science of Meditation

A:Learn how to prepare for meditation. Understand the aids that can help in effectively practicing meditation. Understand the role of sleep, physical activity, and a balanced diet in supporting meditation. (Pre-recorded video with Dr. Ram Manohar)

B:Causes of Stress. The problem of not being relaxed. Effects of stress on health. How meditation helps to relieve stress. Basics of stress management at home and the workplace. (Pre-recorded video with Prof Udhaykumar)

Reading 1: Mayo Clinic Staff (2022, April 29). Meditation: A Simple, Fast Way to Reduce Stress. Mayo Clinic. <https://www.mayoclinic.org/tests-procedures/meditation/in-depth/meditation/art-20045858> (PDF provided)

Reading 2: ‘Efficient Action.’ Chapter 28 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Unit 4: Practicing MA OM Meditation in Daily Life

Amrita Vishwa Vidyapeetham
Guided Meditation Sessions following scripts provided (Level One to Level Five)

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Reading 1: MA OM and White Flower Meditation: A Brief Note (Swami Atmananda Puri)

Reading 2: 'Live in the Present Moment.' Chapter 71 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Unit 5: Improving Communication and Relationships

How meditation and mindfulness influence interpersonal communication. The role of meditation in improving relationship quality in the family, at the university and in the workplace. (Pre-recorded video with Dr Shobhana Madhavan)

Reading 1: Seppala E (2022, June 30th) 5 Unexpected Ways Meditation Improves

Relationships a Lot. Psychology Today.

<https://www.psychologytoday.com/intl/blog/feeling-it/202206/5-unexpected-ways-meditation-improves-relationships-lot>

Reading 2: 'Attitude.' Chapter 53 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Unit 6 Meditation and Compassion-driven Action

Understand how meditation can help to motivate compassion-driven action. (Pre-recorded video with Dr Shobhana Madhavan)

Reading 1: Schindler, S., & Friese, M. (2022). The relation of mindfulness and prosocial

behavior: What do we (not) know?. Current Opinion in Psychology, 44, 151-156.

Reading 2: 'Sympathy and Compassion.' Chapter 100 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Reflection	Internal	20
Group Activities	Internal	20
Class Participation	Internal	40
Written Examination	Internal	20

19ENG111

Technical Communication

L-T-P-C: 2- 0- 3- 3

Course Objectives

- To introduce the students to the fundamentals of mechanics of writing
- To facilitate them with the style of documentation and specific formal written communication
- To initiate in them the art of critical thinking and analysis
- To help them develop techniques of scanning for specific information, comprehension and organization of ideas
- To enhance their technical presentation skills.

Course Outcomes

After completing this course, students will be able to

CO1	To gain knowledge about the mechanics of writing and the elements of formal correspondence
CO2	To understand and summarise technical documents
CO3	To apply the basic elements of language in formal correspondence
CO4	To interpret and analyze information and to organize ideas in a logical and coherent manner
CO5	To compose project reports/ documents, revise them for language accuracy and make technical presentations

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO4	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-

Syllabus

Unit 1

Mechanics of Writing: Grammar rules -articles, tenses, auxiliary verbs (primary & modal) prepositions, subject- verb agreement, pronoun-antecedent agreement, discourse markers and sentence linkers

General Reading and Listening comprehension - rearrangement & organization of sentences

Unit 2

Different kinds of written documents: Definitions- descriptions- instructions-recommendations- user manuals - reports – proposals.

Formal Correspondence: Writing formal Letters Mechanics of Writing: impersonal passive & punctuation Scientific Reading & Listening Comprehension

Unit 3

Technical paper writing: documentation style - document editing – proof reading - Organising and formatting Mechanics of Writing: Modifiers, phrasal verbs, tone and style, graphical representation

Reading and listening comprehension of technical documents Mini Technical project (10 -12 pages)

Technical presentations

Text Books / References

Hirsh, Herbert. L “Essential Communication Strategies for Scientists, Engineers and Technology Professionals”. II Edition. New York: IEEE press, 2002

Anderson, Paul. V. “Technical Communication: A Reader-Centred Approach”. V Edition. Harcourt Brace College Publication, 2003

Strunk, William Jr. and White. EB. “The Elements of Style” New York. Alliyen & Bacon, 1999.

Riordan, G. Daniel and Pauley E. Steven. “Technical Report Writing Today” VIII Edition (Indian Adaptation). New Delhi: Biztantra, 2004.

Michael Swan. “ Practical English Usage”, Oxford University Press, 2000

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Periodical 1	Internal	10
Periodical 2	Internal	10
*Continuous Assessment (Theory) (CAT)	Internal	10
*Continuous Assessment (Lab) (CAL)	Internal	40
End Semester	External	30

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Objectives

- To introduce students to the fundamental concepts of linear algebra, differential equations, optimization, and probabilistic modelling
- To enable students to apply the concepts they learn in practical situations by using analytical and numerical methods to model real-world problems.
- To expose students to the wide range of applications of linear algebra, ordinary differential equations, probability theory, and quantum computing within the scientific field and to inspire them to pursue further study or research in these areas.
- To equip students with advanced mathematical knowledge and problem-solving skills highly valued in various industries and research fields.

Course Outcomes

After completing this course, students will be able to

CO1	Implement matrix decomposition techniques to solve linear systems of equations.
CO2	Formulate optimization problems and solve them using gradient based and Newton's methods
CO3	Analyse data using fundamental techniques of probability.
CO4	Explain quantum entanglement, qubits and state vectors

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	3	2	3	-	-	-	3	2	3	3	3	3	3
CO2	3	3	3	2	3	2		-	3	2	3	3	3	3	3
CO3	3	3	3	2	3	-	2	-	3	2	3	3	3	2	-
CO4	3	-	-	-	-	-	-	-	3	2	3	3	2	-	-

Syllabus

Unit 1

Gaussian elimination – LU decomposition – Vector spaces associated with Matrices- Special orthogonal matrices - Fourier Series and Fourier Transform and its properties – Convolution - Projection matrix and Regression - Convolution sum - Convolution Integral - Eigenvalues and Eigenvectors of Symmetric matrices - Eigenvalues and Eigen vectors of ATA, AAT - Relationship between vector spaces associated with A, ATA, AAT- Singular Value Decomposition – Concept of Pseudoinverse- Computational experiments using MATLAB/Excel/Simulink

Unit 2

Taylor series expansion of multivariate functions-conditions for maxima, minima and saddle points-Concept of gradient and Hessian matrices- Impulse Response computations- converting higher order into first order equations – concept of eAT- Multivariate regression and regularized regression -Theory of convex and non-convex optimization-Newton method for unconstrained optimization- Signal processing with regularized regression- Computational experiments using MATLAB/Excel/Simulink

Unit 3

Random variables and distributions - Expectation, Variance, Moments, Cumulants- Moment generating functions - Sampling from univariate distribution- various methods - Bayes theorem, Concept of Jacobian, and its use in finding pdf of functions of Random variables (RVs), Box-muller formula for sampling normal distribution - Concept of correlation and Covariance of two linearly related RVs. Amrita Vishwa Vidyapeetham.

Unit 4

Introduction to quantum computing–Introduction to spin – state vectors – Qubits – Entanglement. Measurement in Quantum Mechanics.

Textbooks / References

Gilbert Strang, Linear Algebra and Learning from Data, Wellesley, Cambridge press, 2019.

William Flannery, Mathematical Modelling and Computational Calculus, Vol-1, Berkeley Science Books, 2013.

Stephen Boyd and Lieven Vandenberghe, Introduction to Applied Linear Algebra – Vectors, Matrices, and Least Squares, 2018.

Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, (2005) John Wiley and Sons Inc

Bernhardt, Chris. Quantum computing for everyone. Mit Press, 2019. (From pages 37 to 70).

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23PHY114	Computational Mechanics 2	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- This course introduces students to the concepts and techniques of computational applied Mechanics, providing them with a solid foundation in analyzing and solving mechanical engineering problems using computational methods.
- This course equips students with the necessary skills to apply the Finite Element Method (FEM) and Computational Fluid Mechanics (CFD) for the analysis of common robotic applications.
- This course familiarizes students with the basic robotic control and its implementation for simple robotic systems.

Course Outcomes

After completing this course, students will be able to

CO1	Apply the Finite Element Method (FEM) to solve linear and nonlinear equations, demonstrating proficiency in utilizing FEM for computational analysis of mechanical engineering problems.
CO2	Analyze stress and strain analysis results, utilizing computational techniques to evaluate the structural behavior of beams and frames.
CO3	Perform computational fluid dynamics (CFD) simulations to analyze fluid flow over simple 3-dimensional objects. Implement reactive control systems for simple robotic systems.
CO4	Implement reactive control systems for simple robotic systems.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
Amrita Vishwa Vidyapeetham, Bangalore															

CO															
CO1	3	3	3	2	3	-	-	-	3	3	-	2	-	-	-
CO2	3	3	3	3	3	-	-	-	3	3	-	2	1	-	-
CO3	3	3	3	2	3	-	-	-	3	3	1	2	2	1	-
CO4	3	3	3	2	3	-	-	-	3	3	-	2	2	2	1

Syllabus

Unit 1 Solid Mechanics

Stress and strain analysis, Stiffness matrices and element equations, Introduction to Finite Element Method (FEM), Discretization techniques: Meshing and Grid Generation, Solving linear and nonlinear equations using FEM, Finite element analysis software overview and usage, Modeling and analysis of beams and frames.

Unit 2 Fluid Mechanics

Introduction to fluids, Conservation of mass, Conservation of momentum, Navier-Stokes equations, Introduction to Computational fluid dynamics (CFD) simulations, Flow in channels & Flow over simple 3-dimensional objects simulations.

Unit 3 Introduction to Robotics Control

Chronology of Robotic control systems, Control objectives for robotic control, Model free or Reactive control – Proportional, Proportional Derivative, Proportional Integral, Proportional Integral Derivative controls. Computational aspects of reactive control for simple robotic systems.

Text Books / References

“A First Course in the Finite Element Method” by Daryl L. Logan – 2016, CL Engineering; 6th edition.

“MATLAB Guide to Finite Elements: An Interactive Approach” by Peter I. Kattan - 2007, Springer; 2nd edition.

“Fluid Mechanics” by Frank M. White & Henry Xue – 2022, McGraw Hill.

“Computational Fluid Dynamics: A Practical Approach” by Jiyuan Tu, Guan-Heng Yeoh & Chaoqun Liu – 2018, Butterworth-Heinemann; 3rd edition.

Robot Modeling and Control by Mark W. Spong, Seth Hutchinson, and M. Vidyasagar -2005, 1st edition.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

- To introduce Objective Oriented Programming concepts.
- To equip the students to solve engineering problems by applying Object Oriented Concepts.
- To introduce development of GUI based applications.

Course Outcomes

After completing this course, students will be able to

CO1	Represent the problems using objects and classes.
CO2	Implement object-oriented concepts using the Java language
CO3	Apply object-oriented concepts to design and visualize programs using UML.
CO4	Implement applications using object-oriented features.

CO-PO Mapping

PO/P SO	PO 1	PO2	PO3	PO4	PO5	PO 6	PO7	PO 8	PO 9	PO 10	PO1 1	PO1 2	PSO 1	PSO2	PSO3
CO															
CO1	3	3	2	2	3	-	-	-	2	2	-	3	1	2	1
CO2	3	3	3	3	3	-	-	-	2	2	-	3	1	2	1
CO3	3	2	3	3	3	-	-	-	2	2	-	3	1	2	1
CO4	3	2	3	3	3	-	-	-	2	2	-	3	1	2	1

Syllabus

Unit 1

Introduction to Java Language and Runtime Environment, JVM, Bytecode, Basic program syntax, Datatypes, Variables, Operators, Control statements, Loops, Arrays, Functions.

Unit 2

Object-oriented concepts- Abstraction, Encapsulation, Inheritance and Polymorphism. Class and objects, Constructor functions, Class members and methods, Class Instance variables, Garbage collector, Method overloading.

Basics of Inheritance, Types of Inheritance, Super keyword, Final keyword, overriding of methods, Applying and implementing interfaces, Packages-create, access and importing packages. Introduction to UML diagrams.

Unit 3

Introduction to exception handling, Hierarchy of exception, Usage of try, catch, throw, throws and finally. Built-in and user defined exceptions, Threads, Creating Threads, Thread lifecycle, Concept of multithreading.

Unit 4

Applets-Applet class, Delegation event model-events, event sources, event listeners, event classes, mouse and keyboard events, JLabel, JText, JButton, JList, JCombo box.

Text Books / References

Herbert Schildt, Java: A Beginner's Guide, Tata McGraw-Hill Education, Ninth Edition

Herbert Schildt, Java The Complete Reference, Tata McGraw-Hill Education, Ninth Edition.

Sierra, Kathy, and Bert Bates. Head first java. " O'Reilly Media, Inc.", 2003

John R. Hubbard, Schaum's Outline of Programming with Java, McGraw-Hill Education, 2004

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30

Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID112	Data Structures & Algorithms	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- This course aims at introducing the concept of data structure.
- It will also expose the students to the basic and higher order data structures.
- Further the students will be motivated to apply the concept of data structures to various engineering problems.

Course Outcomes

After completing this course, students will be able to

CO1	Choose an appropriate data structure as applied to a specified problem
CO2	Use various techniques for representation of the data in the real world
CO3	Develop applications using data structures.
CO4	Test the logical ability for solving problems

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	2	3	-	-	-	3	2	3	3	2	1	-
CO2	3	3	3	3	3	-	-	-	3	2	3	3	3	2	-
CO3	3	2	3	3	3	-	-	-	3	2	3	3	2	2	-
CO4	3	3	3	2	3	-	-	-	3	2	3	3	2	3	2

Syllabus

Unit 1

Data Structure – primitive and non-primitive, Array data structure, properties and functions, single and multi-dimensional arrays, simple problems, Basics of Algorithm Analysis, big-Oh notation, notion of time and space complexity, dynamic arrays

Unit 2

Linked List - singly linked list, doubly linked list, circular linked list- properties and functions, implementations, Sorting algorithms – selection, bubble, insertion, quick sort, merge sort, comparison of sorting algorithms, implementation using arrays.

Unit 3

Stack data structure, properties and functions, recursion, expression evaluation, Queue data structure - circular queue, double ended queue, properties, and functions

Unit 4

Binary Tree– arrays and linked list representation, tree traversals-preorder, postorder, inorder, level order. Graphs- directed and undirected graphs, adjacency list and matrices, Incidence matrices, path, graph traversals – breadth-first and depth-first, Shortest path- Dijkstra's algorithm, Bellman-Ford algorithm, Floyd-Warshall algorithm -

Text Books / References

Alfred V Aho, John E Hopcroft, Jeffrey D Ullman. *Data Structures & Algorithms*, Pearson Publishers, 2002.

'Maria Rukadikar S. *Data Structures & Algorithms*, SPD Publishers, 2011.

Michael T. Goodrich & Roberto Tamassia, *Data Structures and Algorithms in Java*, Wiley India Edition, Third Edition

Narasimha Karumanchi, *Data Structures and Algorithms Made Easy in Java*, CarrerMonk, 2011

Y. Langsam, M. Augenstein and A. Tannenbaum, *Data Structures using C and C++*, Pearson Education, 2002.

Lipschutz Seymour, *Data Structures with C (Schaum's Outline Series)*, McGraw Hill Education India, 2004

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID113	Elements of Computing -2	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- This course aims to provide an integrative, project-oriented approach to build software layers of a general-purpose computer system.
- The course will take the students through a series of software-layer construction tasks.
- This course will demonstrate how theoretical and applied techniques taught in other computer science courses are used in practice.

Course Outcomes

After completing this course, students will be able to

CO1	Develop and execute programs in low-level languages such as Hack machine language and assembly language
CO2	Create virtual machine specification or VM code for high-level and assembly languages
CO3	Develop programs in object-based language 'Jack'
CO4	Execute experiments related to basic concepts and functions of operating systems/compilers

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	2	3	-	-	-	3	2	3	3	1	1	1
CO2	3	3	2	2	3	-	-	-	3	2	3	3	2	2	1
CO3	3	2	3	2	3	-	-	-	3	2	3	3	2	2	2
CO4	3	2	2	2	3	-	-	-	3	2	3	3	2	2	2

Syllabus

Unit 1

Amrita Vishwa Vidyapeetham.

BTC-AIE

B.Tech Curriculum June 2021

Basic Computer architecture, Basic Elements of Machine Language, Hack Machine language, different sets of instructions, Hack programming, Assembly language vs Machine language, Assembler- assembly process, Hack assembly language, assembly language to binary conversions.

Unit 2

Virtual Machine I: Stack Arithmetic Background, VM Specification Part-1, Implementation and Perspective, Virtual Machine II: Program Control Background, VM Specification Part-2, Implementation, Perspective, High- Level Language: Background, The Jack Language Specification, Writing Jack Applications.

Unit 3

Compiler I - Syntax Analysis: Background, Specification, Implementation, Perspective. Compiler II – Code Generation: Background, Specification, Implementation, Perspective. Operating System: Background, the Jack OS Specification, Implementation, Perspective.

Text Books / References

Nisan, Noam, and Shimon Schocken. The elements of computing systems: building a modern computer from first principles. MIT press, 2005

M. Morris Mano Computer System Architecture, Prentice Hall, Third Edition.

Hennessy, John L., and David A. Patterson. Computer architecture: a quantitative approach. Elsevier, 5th Edition, 2011.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23ECE113	Introduction to Electronics	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- The course will lay down the basic concepts and techniques of electronics needed for advanced topics in AI.
- It will explore the concepts through computational/hardware experiments alongside introducing the concepts/theory behind it.
- It will help the students to perceive the engineering problems using the fundamental concepts in electronics.

Course Outcomes

After completing this course, students will be able to

CO1	Explain the basic concepts of analogy and digital electronics
CO2	Design and implement various electronic circuits using diodes and transistors and demonstrate an understanding of their applications in electronic devices and systems.
CO3	Design and implement operational amplifier circuits for a range of applications and demonstrate an understanding of their operation and behaviour in electronic systems
CO4	Model and analyse engineering problems and demonstrate the ability to propose and implement electronic solutions to these problems.

CO-PO Mapping

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PO16	PO17	PO18	PO19	PO20	PO21	PO22	PO23	PO24	PO25	PO26	PO27	PO28	PO29	PO30	PO31	PO32	PO33	PO34	PO35	PO36	PO37	PO38	PO39	PO40	PO41	PO42	PO43	PO44	PO45	PO46	PO47	PO48	PO49	PO50	PO51	PO52	PO53	PO54	PO55	PO56	PO57	PO58	PO59	PO60	PO61	PO62	PO63	PO64	PO65	PO66	PO67	PO68	PO69	PO70	PO71	PO72	PO73	PO74	PO75	PO76	PO77	PO78	PO79	PO80	PO81	PO82	PO83	PO84	PO85	PO86	PO87	PO88	PO89	PO90	PO91	PO92	PO93	PO94	PO95	PO96	PO97	PO98	PO99	PO100	PO101	PO102	PO103	PO104	PO105	PO106	PO107	PO108	PO109	PO110	PO111	PO112	PO113	PO114	PO115	PO116	PO117	PO118	PO119	PO120	PO121	PO122	PO123	PO124	PO125	PO126	PO127	PO128	PO129	PO130	PO131	PO132	PO133	PO134	PO135	PO136	PO137	PO138	PO139	PO140	PO141	PO142	PO143	PO144	PO145	PO146	PO147	PO148	PO149	PO150	PO151	PO152	PO153	PO154	PO155	PO156	PO157	PO158	PO159	PO160	PO161	PO162	PO163	PO164	PO165	PO166	PO167	PO168	PO169	PO170	PO171	PO172	PO173	PO174	PO175	PO176	PO177	PO178	PO179	PO180	PO181	PO182	PO183	PO184	PO185	PO186	PO187	PO188	PO189	PO190	PO191	PO192	PO193	PO194	PO195	PO196	PO197	PO198	PO199	PO200	PO201	PO202	PO203	PO204	PO205	PO206	PO207	PO208	PO209	PO210	PO211	PO212	PO213	PO214	PO215	PO216	PO217	PO218	PO219	PO220	PO221	PO222	PO223	PO224	PO225	PO226	PO227	PO228	PO229	PO230	PO231	PO232	PO233	PO234	PO235	PO236	PO237	PO238	PO239	PO240	PO241	PO242	PO243	PO244	PO245	PO246	PO247	PO248	PO249	PO250	PO251	PO252	PO253	PO254	PO255	PO256	PO257	PO258	PO259	PO260	PO261	PO262	PO263	PO264	PO265	PO266	PO267	PO268	PO269	PO270	PO271	PO272	PO273	PO274	PO275	PO276	PO277	PO278	PO279	PO280	PO281	PO282	PO283	PO284	PO285	PO286	PO287	PO288	PO289	PO290	PO291	PO292	PO293	PO294	PO295	PO296	PO297	PO298	PO299	PO300	PO301	PO302	PO303	PO304	PO305	PO306	PO307	PO308	PO309	PO310	PO311	PO312	PO313	PO314	PO315	PO316	PO317	PO318	PO319	PO320	PO321	PO322	PO323	PO324	PO325	PO326	PO327	PO328	PO329	PO330	PO331	PO332	PO333	PO334	PO335	PO336	PO337	PO338	PO339	PO340	PO341	PO342	PO343	PO344	PO345	PO346	PO347	PO348	PO349	PO350	PO351	PO352	PO353	PO354	PO355	PO356	PO357	PO358	PO359	PO360	PO361	PO362	PO363	PO364	PO365	PO366	PO367	PO368	PO369	PO370	PO371	PO372	PO373	PO374	PO375	PO376	PO377	PO378	PO379	PO380	PO381	PO382	PO383	PO384	PO385	PO386	PO387	PO388	PO389	PO390	PO391	PO392	PO393	PO394	PO395	PO396	PO397	PO398	PO399	PO400	PO401	PO402	PO403	PO404	PO405	PO406	PO407	PO408	PO409	PO410	PO411	PO412	PO413	PO414	PO415	PO416	PO417	PO418	PO419	PO420	PO421	PO422	PO423	PO424	PO425	PO426	PO427	PO428	PO429	PO430	PO431	PO432	PO433	PO434	PO435	PO436	PO437	PO438	PO439	PO440	PO441	PO442	PO443	PO444	PO445	PO446	PO447	PO448	PO449	PO450	PO451	PO452	PO453	PO454	PO455	PO456	PO457	PO458	PO459	PO460	PO461	PO462	PO463	PO464	PO465	PO466	PO467	PO468	PO469	PO470	PO471	PO472	PO473	PO474	PO475	PO476	PO477	PO478	PO479	PO480	PO481	PO482	PO483	PO484	PO485	PO486	PO487	PO488	PO489	PO490	PO491	PO492	PO493	PO494	PO495	PO496	PO497	PO498	PO499	PO500	PO501	PO502	PO503	PO504	PO505	PO506	PO507	PO508	PO509	PO510	PO511	PO512	PO513	PO514	PO515	PO516	PO517	PO518	PO519	PO520	PO521	PO522	PO523	PO524	PO525	PO526	PO527	PO528	PO529	PO530	PO531	PO532	PO533	PO534	PO535	PO536	PO537	PO538	PO539	PO540	PO541	PO542	PO543	PO544	PO545	PO546	PO547	PO548	PO549	PO550	PO551	PO552	PO553	PO554	PO555	PO556	PO557	PO558	PO559	PO560	PO561	PO562	PO563	PO564	PO565	PO566	PO567	PO568	PO569	PO570	PO571	PO572	PO573	PO574	PO575	PO576	PO577	PO578	PO579	PO580	PO581	PO582	PO583	PO584	PO585	PO586	PO587	PO588	PO589	PO590	PO591	PO592	PO593	PO594	PO595	PO596	PO597	PO598	PO599	PO600	PO601	PO602	PO603	PO604	PO605	PO606	PO607	PO608	PO609	PO610	PO611	PO612	PO613	PO614	PO615	PO616	PO617	PO618	PO619	PO620	PO621	PO622	PO623	PO624	PO625	PO626	PO627	PO628	PO629	PO630	PO631	PO632	PO633	PO634	PO635	PO636	PO637	PO638	PO639	PO640	PO641	PO642	PO643	PO644	PO645	PO646	PO647	PO648	PO649	PO650	PO651	PO652	PO653	PO654	PO655	PO656	PO657	PO658	PO659	PO660	PO661	PO662	PO663	PO664	PO665	PO666	PO667	PO668	PO669	PO670	PO671	PO672	PO673	PO674	PO675	PO676	PO677	PO678	PO679	PO680	PO681	PO682	PO683	PO684	PO685	PO686	PO687	PO688	PO689	PO690	PO691	PO692	PO693	PO694	PO695	PO696	PO697	PO698	PO699	PO700	PO701	PO702	PO703	PO704	PO705	PO706	PO707	PO708	PO709	PO710	PO711	PO712	PO713	PO714	PO715	PO716	PO717	PO718	PO719	PO720	PO721	PO722	PO723	PO724	PO725	PO726	PO727	PO728	PO729	PO730	PO731	PO732	PO733	PO734	PO735	PO736	PO737	PO738	PO739	PO740	PO741	PO742	PO743	PO744	PO745	PO746	PO747	PO748	PO749	PO750	PO751	PO752	PO753	PO754	PO755	PO756	PO757	PO758	PO759	PO760	PO761	PO762	PO763	PO764	PO765	PO766	PO767	PO768	PO769	PO770	PO771	PO772	PO773	PO774	PO775	PO776	PO777	PO778	PO779	PO780	PO781	PO782	PO783	PO784	PO785	PO786	PO787	PO788	PO789	PO790	PO791	PO792	PO793	PO794	PO795	PO796	PO797	PO798	PO799	PO800	PO801	PO802	PO803	PO804	PO805	PO806	PO807	PO808	PO809	PO810	PO811	PO812	PO813	PO814	PO815	PO816	PO817	PO818	PO819	PO820	PO821	PO822	PO823	PO824	PO825	PO826	PO827	PO828	PO829	PO830	PO831	PO832	PO833	PO834	PO835	PO836	PO837	PO838	PO839	PO840	PO841	PO842	PO843	PO844	PO845	PO846	PO847	PO848	PO849	PO850	PO851	PO852	PO853	PO854	PO855	PO856	PO857	PO858	PO859	PO860	PO861	PO862	PO863	PO864	PO865	PO866	PO867	PO868	PO869	PO870	PO871	PO872	PO873	PO874	PO875	PO876	PO877	PO878	PO879	PO880	PO881	PO882	PO883	PO884	PO885	PO886	PO887	PO888	PO889	PO890	PO891	PO892	PO893	PO894	PO895	PO896	PO897	PO898	PO899	PO900	PO901	PO902	PO903	PO904	PO905	PO906	PO907	PO908	PO909	PO910	PO911	PO912	PO913	PO914	PO915	PO916	PO917	PO918	PO919	PO920	PO921	PO922	PO923	PO924	PO925	PO926	PO927	PO928	PO929	PO930	PO931	PO932	PO933	PO934	PO935	PO936	PO937	PO938	PO939	PO940	PO941	PO942	PO943	PO944	PO945	PO946	PO947	PO948	PO949	PO950	PO951	PO952	PO953	PO954	PO955	PO956	PO957	PO958	PO959	PO960	PO961	PO962	PO963	PO964	PO965	PO966	PO967	PO968	PO969	PO970	PO971	PO972	PO973	PO974	PO975	PO976	PO977	PO978	PO979	PO980	PO981	PO982	PO983	PO984	PO985	PO986	PO987	PO988	PO989	PO990	PO991	PO992	PO993	PO994	PO995	PO996	PO997	PO998	PO999	PO1000
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PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO															
CO1	3	3	2	2	3	-	-	-	3	2	3	3	1	1	1
CO2	3	3	3	3	3	-	-	-	3	2	3	3	2	2	2
CO3	3	3	3	3	3	-	-	-	3	2	3	3	2	2	2
CO4	3	2	3	3	3	-	-	-	3	2	3	3	3	3	3

Syllabus

Unit 1 Semiconductor Physics

Conduction in semiconductors, Doping, PN Junction, Semiconductor diodes: PN diodes, Zener diode, Rectifiers and filters, Clipping and clamping circuits, Voltage regulators.

Unit 2 Transistors

Bipolar Junction Transistor (BJT), Field Effect Transistors (FET), MOSFET, BJT amplifiers and oscillators, Transistor as a switch - Amplifiers: common amplifier configurations, voltage gain and current gain, input and output impedance, small signal analysis, frequency response, power amplifiers.

Unit 3 Operational Amplifiers (Op-Amps)

Ideal characteristics, inverting and non-inverting amplifiers, summing and difference amplifiers, integrators and differentiators, comparators, oscillators, Schmitt trigger, Multivibrators - Feedback Amplifiers - Oscillators - DAC and ADC

Text Books / References

“Microelectronics” by Jacob Millman and A. Grabel, Tata McGraw-Hill Publishers, Second Edition, New Delhi, 1999.

“Op-amps and Linear Integrated circuits” by Ramakant Gayakwad, , Prentice Hall, New Delhi, 1988.

‘Operational Amplifiers and Linear Integrated Circuits’ by Robert F. Coughlin and Frederick F. Driscoll, Pearson, 6th edition, 2000.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23CHY115	Introduction to Material Informatics	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- Provide a fundamental understanding of the field of material science and informatics, material properties.
- Explore the cutting-edge of modern material informatics tools, including machine learning, data analysis and visualization, and molecular/multiscale modelling.
- Learn how to work with small, sparse, and low-quality dataset.
- Analysis material failure and sustainability
- Develop AI-based computational model to design new materials with specific properties.

After completing this course, students will be able to

CO1	Apply modern material informatics tools including machine learning, simulations. Modelling, visualizations to solve a specific challenge most significantly.
CO2	Analysis material failure and sustainability
CO3	Design new materials and solve inverse design problem using AI.
CO4	Developed efficient predictive model using small, spares and low-quality dataset.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	3	3	2	-	-	2	2	1	2	-	3	3
CO2	3	3	1	3	3	2	2	1	2	3	2	2	-	3	-
CO3	3	3	3	3	3	2	2	1	3	3	2	2	3	3	3
CO4	3	3	3	3	3	2	2	1	3	3	2	2	3	2	3

Syllabus

Unit 1

Introduction to material science – structure, properties, and process spaces - process-structure-property linkages – foundation of material informatics – introduction to molecular mechanism and force field – quantification of dynamics properties of polymers (monte carlo simulation, molecular dynamics simulation, normal mode analysis) – electronics structure of atoms (Gaussian, Gauss view, density functional theory)

Unit 2

Quantification and screening of materials properties - property prediction and optimization using AI - materials design and discovery using AI – how to handle small, spared, and low-quality dataset using AI.

Unit 3

Materials failure and sustainability analysis – new material and inverse materials design concept – solve inverse design using AI – enhance speed, efficacy and cost-effectiveness of material using AI - basic concept of quantum computing in material informatics.

Unit 4

Case studies of materials informatics (use of AI) in different fields (e.g. energy, aerospace, biomedical, etc.) - ethical considerations and limitations of materials informatics - future directions and challenges in materials informatics.

Text Books / References

“Material Informatics: Methods, Tools and Applications” by Olexandr Isayev, Alexander Tropsha and Stefano.

“Informatics for Materials Science and Engineering” by Krishna Rajan

“Machine Learning in Materials Informatics: Methods and Applications by Yuling An

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20

Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

22ADM111	Glimpses of Glorious India	L-T-P-C: 2- 0- 1- 2
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Course Objectives

- To deepen students' understanding and further their knowledge about the different aspects of Indian culture and heritage.
- To in still into students a dynamic awareness and understanding of their country's achievements and civilizing influences in various fields and at various epochs.

Course Outcomes

After completing this course, students will be able to

CO1	Get an overview of Indian contribution to the world in the field of science and literature.
CO2	Understand the foundational concepts of ancient Indian education system.
CO3	Learn the important concepts of Vedas and Yogasutra-s and their relevance to daily life.
CO4	Familiarize themselves with the inspirational characters and anecdotes from the Mahābhārata and Bhagavad Gita and Indian history.
CO5	Gain an understanding of Amma's role in the empowerment of women

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	-	-	-	-	-	3	3	-	-	-	-	2	-	-	-
CO2	-	-	-	-	-	1	-	3	-	-	-	2	-	-	-
CO3	-	-	-	-	-	3	3	3	-	-	-	2	-	-	-
CO4	-	-	-	-	-	3	3	3	-	-	-	2	-	-	-
CO5	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-

Syllabus

Unit 1

To the World from India; Education System in India; Insights from Mahabharata; Human Personality. India's Scientific System for Personality Refinement.

Unit 2

The Vedas: An Overview; One God, Many Forms; Bhagavad Gita – The Handbook for Human Life; Examples of Karma Yoga in Modern India.

Unit 3

Chanakya's Guidelines for Successful Life; Role of Women; Conservations with Amma.

Textbooks / References

Amrita Vishwa Vidyapeetham.

BTC-AIE

B.Tech Curriculum June 2021

Cultural Education Resource Material Semester-2

Cultural Heritage of India. R.C.Majumdar. Ramakrishna Mission Institute of Culture.

The Vedas. Swami ChandrashekharaBharati. BharatiyaVidyaBhavan.

Indian Culture and India's Future. Michel Danino. DK Publications.

The Beautiful Tree. Dharmapal. DK Publications.

India's Rebirth. Sri Aurobindo. Auroville Publications

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Periodical 1	Internal	15
Periodical 2	Internal	15
*Continuous Assessment (CA)	Internal	20
End Semester	External	50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

SEMESTER 3

23MAT204	Mathematics for Intelligent Systems 3	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- To provide students with advanced knowledge and skills in optimization, PDEs, probability and statistics, and quantum computing.
- To develop students proficiency in solving real-world problems in various domains, including physics, engineering, and computer science using the concepts of optimization, PDEs, and probability.
- To apply the concepts and techniques learned in the course to solve complex problems and communicate their solutions effectively to both technical and non-technical audiences.
- To equip students with advanced mathematical knowledge and problem-solving skills highly valued in various industries and research fields.

Course Outcomes

After completing this course, students will be able to

CO1	Apply the fundamental techniques of optimization theory to solve data science problems.
CO2	Analyse and solve computationally, physical systems using the formalism of partial differential equations.
CO3	Apply Markovian concepts in stochastic sequential systems.
CO4	Explain Bells Inequality and Quantum gates.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	3	2	3	-	-	-	3	2	-	3	3	-	3
CO2	3	3	3	2	3	-	-	-	3	2	-	3	3	-	3
CO3	3	3	3	2	3	-	-	-	3	2	-	3	3	-	-
CO4	3	-	-	-	-	-	-	-	3	2	-	3	2	-	3

Syllabus

Unit 1

Direct methods for convex functions - sparsity inducing penalty functions- Constrained Convex Optimization problems - Krylov subspace -Conjugate gradient method - formulating problems as LP and QP - Lagrangian multiplier method-KKT conditions - support vector machines- solving by packages (CVXOPT) - Introduction to RKS - Introduction to DMD-Tensor and HoSVD- Linear algebra for AI.

Unit 2

Introduction to PDEs - Formulation and numerical solution methods (Finite difference and Fourier) for PDEs in Physics and Engineering- Computational experiments using Matlab/Excel/Simulink.

Unit 3

Multivariate Gaussian and weighted least squares - Markov chains - Markov decision Process

Unit 4

Introduction to quantum computing-Bells inequality-Quantum gates

Text Books / References

Gilbert Strang, *Linear Algebra and Learning from Data*, Wellesley, Cambridge press, 2019.

Gilbert Strang, *"Differential Equations and Linear Algebra Wellesley"*, Cambridge press, 2018.

Stephen Boyd and Lieven Vandenberghe, *Introduction to Applied Linear Algebra – Vectors, Matrices, and Least Squares*, 2018.

Bernhardt, Chris. *Quantum computing for everyone*. Mit Press, 2019. (From pages 71 to 140).

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID201	Modelling, Simulation & Analysis	L-T-P-C: 2- 0- 2-3
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Course Objectives

- This course intends to provide students with the ability to create and analyze mathematical models of physical systems using various techniques such as bond graph modeling and system transfer functions.
- This course aims to equip students with the skills to use simulation tools such as MATLAB to simulate and analyze the behavior of dynamic systems and validate and verify simulation models.
- The course aims to develop student's abilities to apply system analysis and optimization techniques such as block diagram algebra, signal flow graphs, state variable formulation, frequency response, and Bode plot, to engineering problems.

Course Outcomes

After completing this course, students will be able to

CO1	Apply various modeling techniques including physical, mathematical, and computer-based modeling for engineering applications.
CO2	Analyze different system models, including basic ones such as mechanical, electrical, hydraulic, pneumatic, and thermal systems, and advanced ones such as electro-mechanical, hydro-mechanical, and robotic systems.
CO3	Apply various methods for modeling and simulating the behavior dynamic systems, including bond graph modeling, simulation using MATLAB, and parameter estimation methods.
CO4	Design simulations and analysis for engineering problems using optimization, block diagram algebra, signal flow graphs, state variable formulation, frequency response, and Bode plot.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	1	1	1	-	-	1	2	2	-	1	-	-	-
CO2	3	3	1	1	1	-	1	1	2	2	1	1	-	1	1
CO3	3	3	3	3	3	1	1	1	2	2	2	1	2	2	1
CO4	3	3	2	2	2	1	1	1	2	1	2	1	2	2	1

Unit 1

Introduction to modelling - Examples of models, Modelling of dynamic systems, Introduction to simulation - Matlab as a simulation tool, Bond graph modelling - Bond graph model and causality, Generation of system equation, Methods of drawing bond graph models - Mechanical systems, Electrical systems. Basic system models – Mechanical systems, Electrical systems, Hydraulic systems, Pneumatic systems, and Thermal systems

Unit 2

System models – Linearity and nonlinearity in systems, Combined rotary and translator systems, Electro-Mechanical systems, Hydro-mechanical systems, Robotic systems, Dynamic response of 1st and 2nd order systems, Performance measures for 2nd order system, System transfer functions – 1st and 2nd order systems

Unit 3

Block diagram algebra, Signal flow graphs, State variable formulation, Frequency response, Bode plot, Simulation using Matlab, Simulation of - simple and compound pendulums, planar mechanisms, and wheeled mobile robots, Validation and verification of simulation models, Parameter estimation methods, Parameter estimation examples, System identification, Introduction to optimization, Optimization with modeling engineering problems.

Text Books / References

Borutzky, Wolfgang, "Bond Graph Modelling of Engineering Systems", Springer, 2011.

Esfandiari, Ramin S. and Bei Lu, "Modeling and Analysis of Dynamic Systems", CRC Press, 2010.

Gardner, John F., Bohdan T. Kulakowski, and J. Lowen Shearer. "Dynamic Modeling and Control of Engineering Systems." Publisher: Cambridge University Press; 3rd edition (2008).

Karnopp, Dean C., Donald L. Margolis, and Ronald C. Rosenberg. "System Dynamics: Modeling, Simulation, and Control of Mechatronic Systems." Publisher: Wiley; 5th edition (2012).

Lennart, L. and Torkel, G., "Modeling of Dynamic Systems", Prentice Hall, 1994.

Woods, Robert L. and Kent L. Lawrence. "Modeling and Simulation of Dynamic Systems." Publisher: Prentice Hall; 1st edition (1997).

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID202	Introduction to Robotics	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- This course aims to provide students with an overview of concepts to applications of robotics.
- This course intends to equip students with the ability to design and analyze simple and elementary robotic systems (Upto 4 DOF systems like SCARA) using mathematical and computational tools.
- This course aims to give students elementary hands-on experience in programming robotic systems using Robotic Toolbox in python/Matlab.

Course Outcomes

After completing this course, students will be able to

CO1	Explain facts pertaining to robotics including history, sub-fields, and applications.
CO2	Explain the elementary concepts required for modelling robotic systems.
CO3	Develop mathematical and mechanistic models for simple robotic systems.
CO4	Use tools such as Robotics toolbox to program and visualize simple robotic systems

CO-PO Mapping

PO	P O 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PS O3
CO															
CO1	1	1	1	1	1	1	1	-	3	3	-	2	-	-	-
CO2	2	2	1	1	2	-	-	-	2	2	-	2	1	-	-
CO3	2	2	2	1	2	-	-	-	2	2	-	2	2	1	-
CO4	2	2	1	1	3	-	-	-	2	2	-	2	1	1	-

Syllabus

Unit 1 Overview of Robotics

Definition and History of Robots, Applications of robots, Current trend in robotics, Basic mathematics for robotics – Vectors, Matrices and Linear Algebra concepts, Rigid body transformations – Translation and Rotation, Homogeneous Transformation matrix.

Unit 2 Kinematics of Simple Robotic Systems

Forward Kinematics of simple industrial robotic systems, Inverse kinematics of simple industrial robotic systems, Differential Kinematics of simple industrial robotic systems, Kinematics of simple wheeled mobile robots.

Unit 3 Dynamics and Control of Simple Robotic Systems

Introduction to rigid body kinetics, Euler-Lagrange equation of simple robotic systems, Forward and Inverse dynamics of simple robotic systems, Velocity based control of simple robotic systems, Torque based control of robotic systems.

Textbooks

Corke P. Robotics, Vision and Control. Springer; 2017.

Craig J J. Introduction to Robotics: Mechanics and Control. Pearson Publishing, 2017.

Spong M.W., Hutchinson S. and Vidyasagar M, Robot Modeling and Control, Wiley, 2006

Saha S K, Introduction to Robotics, McGraw Hill publishing, 2014

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID203	Software-Defined Communication Systems	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- Understand the basic principles of communication systems, including signal analysis, system characteristics, and different types of modulation/demodulation techniques.
- Develop practical skills in using SDR platforms and tools such as MATLAB Simulink, GNU Radio Companion, RTL-SDR, and Adalm Pluto to implement analog and digital modulation/demodulation techniques and analyse signals/spectra.

Course Outcomes

After completing this course, students will be able to

CO1	Analyse different signal attributes related to communication system
CO2	Design and implement basic analog communication techniques using software defined radio platforms
CO3	Design and implement basic digital communication techniques using software defined radio platforms
CO4	Develop an appreciation of the role of AI in communication systems

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	2	3	3	-	-	3	3	2	2	2	1	1
CO2	3	3	3	2	3	3	-	-	3	3	3	2	2	2	1
CO3	3	3	3	2	3	3	-	-	3	3	3	2	2	2	1
CO4	3	3	3	3	3	3	-	2	3	3	3	3	1	2	3

Syllabus

Unit 1

Introduction to communication systems, introduction to signals, different types of signals and their characteristics, concept of system, linear time-invariant (LTI) system, sinusoids- concept of frequency, in-phase and quadrature component, bandwidth, pass band and stop band, Introduction to SDR platforms and devices- MATLAB Simulink and GNU radio Companion (GRC), RTL-SDR and Adalm Pluto. Signal analysis/ spectrum analysis and visualization using SDR tools.

Unit 2

Need for modulation, analog modulation schemes, amplitude modulation (AM) and its types - AM-DSB-SC, AM-DSB-TC, SSB. AM Demodulation schemes, angle modulation- frequency modulation (FM) -Narrowband and wideband, phase modulation, FM demodulation, implementation of analog modulation/demodulation schemes using SDR tools.

Unit 3

Quadrature amplitude modulation and demodulation, pulse analog modulation schemes, digital carrier modulation/demodulation Schemes- amplitude shift keying (ASK), frequency shift keying (FSK), phase shift keying (PSK), M-ary signalling, BPSK, QPSK, implementation of digital modulation/demodulation schemes using SDR tools. Multicarrier modulation- OFDM, MIMO, Prospects of AI in communication system- radio signal or modulation classification.

Text Books / References

Wyglinski, Alexander M., Robin Getz, Travis Collins, and Di Pu. *Software-defined radio for engineers*. Artech House, 2018.

QasimChaudhari, *Wireless Communications from the Ground Up: An SDR Perspective*, 2018

Andrew Barron, *Software Defined Radio: for Amateur Radio Operators and Shortwave Listeners*, 2019

C.R. Johnson and W.A. Sethares, *Software Receiver Design: Build Your Own Digital Communication System in Five Easy Steps*, Cambridge University Press, 2011

Proakis, John G., Masoud Salehi, and Gerhard Bauch. *Contemporary communication systems using MATLAB*. Cengage Learning, 2012.

Wyglinski, Alexander M., and Di Pu. *Digital communication systems engineering with software-defined radio*. Artech House, 2013.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (Minimum 3)	Internal	30
Quizzes (Minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	20

23AID204	Advanced Data Structures & Algorithm Analysis	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- To impart various design techniques for formulation of algorithm.
- To understand basic categories of algorithms.
- To comprehend basic complexity classes.
- To acquaint with will know tractable and intractable problems and map solutions to it.

Course Outcomes

After completing this course student will be able to,

CO1	Develop skills for analyzing algorithmic strategies
CO2	Analyse and apply appropriate algorithmic technique for a given problem
CO3	Implementing standard algorithms on arrays, strings, trees and graphs
CO4	Visualize multidimensional geometry of data structure and concurrency.

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	3	3	3	3	1	-	3	3	2	3	3	1	1
CO2	3	3	3	2	3	2	-	-	3	3	2	3	3	2	2
CO3	3	3	3	3	2	1	-	-	3	3	3	3	3	3	3
CO4	3	3	3	3	2	1	-	-	3	3	3	3	2	3	3

Syllabus

Unit 1

Full binary tree, complete binary tree, perfect binary tree, balanced binary tree, binary search tree, properties and functions

Unit 2

Binary Heap Data Structure-Heap property, properties and functions, Heapsort, AVL Tree – balance factor, rotating the subtrees in an AVL tree –right rotation, left rotations, left-right and right-left rotate, operations on AVL trees- insertion and deletion

Unit 3

Trie data structure- basic operations, simple problems, Hashing and Hash Tables – hash functions, collision, collision avoidance methods, Merkel trees

Unit 4

Fundamentals of the Analysis of Algorithmic Efficiency –Asymptotic Notations and growth rate- Empirical Analysis - Divide and Conquer Methodology - Dynamic programming - Knapsack Problem and Memory functions. Greedy Technique - Iterative methods – Backtracking - Branch and Bound

Text Books / References

Mehlhorn, Kurt, Peter Sanders, and Peter Sanders. *Algorithms and data structures: The basic toolbox*. Vol. 55. Berlin: Springer, 2008.

Bhim P Upadhyaya, *Data Structures and Algorithms with Scala*. Springer International Publishing, 2019.

Aho, Alfred V. "Data Structures and Algorithms, Addison-Wesley." Reading, Mass. (1983).

Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. 2009. *Introduction to Algorithms, Third Edition (3rd ed.)*. The MIT Press

Jeffrey McConnell, *Analysis of algorithms*. Jones & Bartlett Publishers, 2nd Revised edition, 2007

Anany Levitin, *Introduction to the Design and Analysis of Algorithms, Third Edition*, Pearson Education, 2012

Harsh Bhasin, *Algorithms Design and Analysis*, Oxford university press, 2016

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

Course Objectives

- To introduce fundamentals of AI.
- To introduce fundamentals of Data Science.
- To introduce different tools and techniques used in AI and Data Science.

Course Outcomes

After completing this course, students will be able to

CO1	Analyse different elements of an AI system.
CO2	Analyse different types of data representation.
CO3	Apply concepts of AI and Data Science to solve canonical problems.
CO4	Implement basic computational tools pertinent to AI and Data Science to solve canonical problems.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	2	2	2	3	2	2	2	2	2	-	2	3	2	3
CO2	2	2	2	2	3	-	-	-	2	2	-	2	3	2	3
CO3	2	2	2	2	3	-	-	-	2	2	-	2	3	2	3
CO4	3	2	2	2	3	-	-	-	2	2	2	2	3	2	3

Syllabus

Unit 1

History and Foundations of AI and Data Science, Applications of AI and Data Science, Career paths pertinent to AI and Data Science

Unit 2

Rational Intelligent Agents, Agents and Environments, Nature of Environments, Structure of Agents. Introduction - Overview of Data Science – Introduction to Statistics: Sampling, Sample Means and Sample Sizes - Descriptive statistics: Central tendency, dispersion, variance, covariance, kurtosis, five-point summary

Unit 3

Basic tools for AI and Data Science, Introduction to Data Science process pipeline, Different representations of Data, Importance of pre-processing the data, Elementary Applications of AI and Data Science

Text Books / References

Russell, Stuart Jonathan, Norvig, Peter, Davis, Ernest. Artificial Intelligence: A Modern Approach. United Kingdom: Pearson, 2010.

Deepak Khemani. A First Course in Artificial Intelligence. McGraw Hill Education (India), 2013.

Denis Rothman. Artificial Intelligence by Example, Packt, 2018.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID206	Introduction to Computer Networks	L-T-P-C: 2- 0- 2- 3
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Course Objective

- This course helps students to understand the fundamental networking concepts and standards.
- This course helps students to understand the function of TCP/IP layers and the protocols involved.
- This course helps students to understand the configuration of different networks and routing using simulator/emulator.
- This course helps students to understand the importance and application of artificial intelligence in computer networks
- This course gives an introduction to the concepts of software defined networks and its applications.

Course Outcomes

After completing this course, students will be able to

CO1	Analyze the requirements for a given organizational structure to select the most appropriate networking architecture and technologies.
CO2	Analyze the working of protocols in the internet protocol stack for network applications.
CO3	Configure a router using simulator/emulator.
CO4	Analyze the network data to detect potential security threats in a network

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	-	-	-	1	2	1	-	1	-	-	-	1	-	2	-
CO2	2	2	2	2	2	-	-	1	-	-	-	2	3	2	1
CO3	2	2	2	2	2	-	-	1	-	-	-	2	3	2	1
CO4	1	1	1	2	2	1	-	1	-	-	-	2	1	-	1

Syllabus

Unit 1

Basic concepts of computer networks, Internet- network edge, network core, delay, loss, and throughput in packet switched networks, network topology, types of networks, Internet standards and organization. OSI layer stack, protocols in the context of the Internet protocol stack. Introduction to AI powered networks that monitor the connected devices and their bandwidth requirements

Unit 2

Application Layer – Protocols in Web and Email applications, Peer-to-Peer Applications. Transport Layer – connection-oriented and connectionless service, protocols, and socket programming. Network Layer – Internet Protocol, Host Addressing for subnets, Routing and Forwarding principles. Data link and Physical layer concepts for wired and wireless network

Unit 3

Network security- analyze the network traffic. Introduction to Software Define Networks

Text Books / References

Kurose, James F. *Computer networking: A top-down approach featuring the internet*, 3/E. Pearson Education India, 2005.

Andrew, S. *"Tanenbaum-Computer Networks –Prentice Hall."* New Jersey (2003).

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

22ADM211

Leadership from Ramayana

L-T-P-C: 1 0 0 1

Syllabus

Chapter 1 - Introduction to the Great Itihasa

Chapter 2 - Bala-Kāṇḍa: (Preparing for the renowned mission.)

And Ayodhya-Kāṇḍa: (Harbinger of an Entire Tradition of Nobleness.)

Chapter 3 - Araṇya-Kāṇḍa: (Tale of the forest life)

And Kishkindha-Kāṇḍa: (The Empire of Holy Monkeys.)

Chapter 4 - Sundara-Kāṇḍa: (Heart of the Ramayana)

And Yuddha-Kāṇḍa: (The most popular part of the Ramayana)

Chapter 5 - Ramayana and Modern-day learning

Chapter 6 - Ecological Awareness in the Ramayana

Chapter 7 - Different Ramayana: (Epic that connects the world)

Chapter 8 - Uttara-Kāṇḍa: (An attempt to explain the untold stories)

Text Books / References

1. *Valmiki Ramayana* (English translation published by Gita Press)

2. *Skanda Purana*

3. *Ramayana - C Rajagopalachari* .

Pre-requisite(s): An open mind and the urge for self-development, basic English language skills, knowledge of high school level mathematics.

Course Objectives

- Assist students in inculcating Soft Skills and developing a strong personality
- Help them improve their presentation skills
- Support them in developing their problem solving and reasoning skills
- Facilitate the enhancement of their communication skills

Course Outcomes

CO1: Soft Skills: To develop greater morale and positive attitude to face, analyse, and manage emotions in real life situations, like placement process.

CO2: Soft Skills: To empower students to create a better impact on a target audience through content creation, effective delivery, appropriate body language and overcoming nervousness, in situations like presentations, Group Discussions and interviews.

CO3: Aptitude: To analyse, understand and employ the most suitable methods to solve questions on arithmetic and algebra.

CO4: Aptitude: To investigate and apply suitable techniques to solve questions on logical reasoning and data analysis.

CO5: Verbal: To infer the meaning of words and use them in the right context. To have a better understanding of the basics of English grammar and apply them effectively.

CO6: Verbal: To identify the relationship between words using reasoning skills. To develop the capacity to communicate ideas effectively.

CO-PO Mapping

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

Syllabus

Soft Skills

Soft Skills and its importance: Pleasure and pains of transition from an academic environment to work-environment. New-age challenges and distractions. Learning to benefit from constructive criticisms and feedback, Need for change in mind set and up-skilling to keep oneself competent in the professional world.

Managing Self: Knowing oneself, Self-perception, Importance of positive attitude, Building and displaying confidence, Avoiding being overconfident, Managing emotions, stress, fear. Developing Resilience and handling failures. Self-motivation, Self-learning, and continuous knowledge up-gradation / Life-long learning. Personal productivity – Goal setting and its importance in career planning, Self-discipline, Importance of values, ethics and integrity, Universal Human Values.

Aptitude

Problem Solving I

Numbers: Types, Power Cycles, Divisibility, Prime, Factors & Multiples, HCF & LCM, Surds, Indices, Square roots, Cube Roots and Simplification.

Percentage: Basics, Profit, Loss & Discount, and Simple & Compound Interest. Ratio, Proportion & Variation: Basics, Allegations, Mixtures, and Partnership. Averages: Basics, and Weighted Average.

Data Interpretation: Tables, Bar Diagrams, Venn Diagrams, Line Graphs, Pie Charts, Caselets, Mixed Varieties, Network Diagrams and other forms of data representation.

Verbal

Vocabulary: Familiarize students with the etymology of words, help them realize the relevance of word analysis and enable them to answer synonym and antonym questions. Create an awareness about the frequently misused words, commonly confused words and wrong form of words in English.

Grammar (Basic): Help students learn the usage of structural words and facilitate students to identify errors and correct them.

Reasoning: Stress the importance of understanding the relationship between words through analogy questions.

Speaking Skills: Make students conscious of the relevance of effective communication in today's world through various individual speaking activities.

Reference(s):

1. Students' Career Planning Guide, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
2. Soft Skill Handbook, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
3. Adair. J., (1986), "Effective Team Building: How to make * winning team", London, U.K
4. Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
9. Cracking the New GRE 2012
10. Kaplan's – GRE Comprehensive Programme
11. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
12. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
13. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.
14. How to Prepare for Data Interpretation for the CAT, Arun Sharma.

Evaluation Pattern: 50:50

Assessment	Internal	External
Continuous Assessment (CA) – Soft Skills	30	–
Continuous Assessment (CA) – Aptitude	10	25
Continuous Assessment (CA) – Verbal	10	25
Total	50	50
Pass / Fail		

*CA – Can be presentations, speaking activities and tests.

SEMESTER 4

23MAT214	Mathematics for Intelligent Systems 4	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- To provide students with advanced knowledge and skills in optimization, statistical estimation theory, and quantum computing.
- To understand and analyze special matrices used in various areas of signal processing and data analysis.
- To learn optimization techniques for convex and non-convex problems, and their application to machine learning problems.
- To introduce statistical estimation theory and hypothesis testing, and their relevance to data analysis.
- To provide an overview of quantum computing and its potential applications in various field

Course Outcomes

After completing this course, students will be able to

CO1	Apply proximal algorithms, augmented Lagrangian, and ADMM to solve convex and non-convex optimization problems.														
CO2	Develop optimization algorithms used in neural networks.														
CO3	Apply statistical estimation theory and hypothesis testing to data analysis applications.														
CO4	Apply quantum computing concepts to solve problems in various fields including cryptography and optimization.														

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	3	2	3	-	-	-	3	2	2	3	3	-	3
CO2	3	3	3	2	3	-	-	-	3	2	2	3	3	-	3
CO3	3	3	3	2	3	-	-	-	3	2	2	3	3	-	3
CO4	3	3	3	1	3	-	-	2	3	2	2	3	2	-	3

Syllabus

Unit 1 Amrita Vishwa Vidyapeetham.

BTC-AIE

B.Tech Curriculum June 2021

Special Matrices: Fourier Transform, discrete and Continuous, Shift matrices and Circulant matrices, The Kronecker product, Toeplitz matrices and shift invariant filters, Hankel matrices, DMD and need of Hankelization - Importance of Hankelization – DMD and its variants - Linear algebra for AI

Unit 2

Matrix splitting and Proximal algorithms - Augmented Lagrangian- Introduction to ADMM, ADMM for LP and QP - Optimization methods for Neural Networks: Gradient Descent, Stochastic gradient descent- loss functions and learning functions

Unit 3

Basics of statistical estimation theory and testing of hypothesis.

Unit 4

Introduction to quantum computing- Bells's circuit, Superdense coding, Quantum teleportation. Programming using Qiskit, Matlab.

Text Books / References

Gilbert Strang, Linear Algebra and Learning from Data, Wellesley, Cambridge press, 2019.

Gilbert Strang, "Differential Equations and Linear Algebra Wellesley", Cambridge press, 2018.

Stephen Boyd and, Lieven Vandenberghe, "Introduction to Applied Linear Algebra – Vectors, Matrices, and Least Squares", Cambridge University Press, 2018

Bernhardt, Chris. Quantum computing for everyone. Mit Press, 2019. (From pages 71 to 140).

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID211	Deep Learning	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- This course provides the basic concepts of deep learning and implementation using Matlab/Python.
- This course provides the application of deep learning algorithms in signal and image data analysis.
- This course covers the concept of deep learning algorithms such as transfer learning and attention models for signal and image analysis.

Course Outcomes

After completing this course, students will be able to

CO1	Apply the fundamentals of deep learning.
CO2	Apply deep learning algorithms using Matlab/Python.
CO3	Apply deep learning models for signal analysis
CO4	Implement deep learning models for image analysis.

CO-PO Mapping

PO/ PSQ	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
Amrita Vishwa Vidyapeetham.															

CO																
CO1	3	2	2	-	3	2	-	-	3	3	-	3	2	3	2	
CO2	3	2	2	2	3	3	-	-	3	3	2	3	3	3	2	
CO3	3	2	2	2	3	3	-	-	3	3	2	3	3	3	2	
CO4	3	3	2	2	3	3	-	-	3	3	2	3	3	3	3	

Syllabus

Unit 1

Introduction to neural networks – Gradient Descent Algorithm - Deep Neural Networks (DNN) –Convolutional Neural Network (CNN) – Recurrent Neural Network (RNN): Long-Short- Term-Memory (LSTM).

Unit 2

Pre-processing: Noise Removal using deep learning algorithms - Feature Extraction - Signal Analysis: Time Series Analysis, CNNs, Auto encoders.

Unit 3

Image Analysis: Transfer Learning, Attention models- Ensemble Methods for Signal and Image Analysis.

Textbooks & References:

Bishop C.M, "Pattern Recognition and Machine Learning", Springer, 1st Edition, 2006.

Goodfellow I, Bengio Y, Courville A, & Bengio Y, "Deep learning", Cambridge: MIT Press, 1st Edition, 2016.

Soman K.P, Ramanathan. R, "Digital Signal and Image Processing – The Sparse Way", Elsevier, 1st Edition, 2012.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (Minimum 2)	Internal	30
Quizzes (Minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID212	Introduction to IoT	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- To provide hands-on experience in IoT concepts such as sensing, actuation, and communication.
- To develop program skills in Arduino and Raspberry-PI programming for IoT applications.
- To introduce the process of interfacing actuators and sensing devices to Arduino and Raspberry PI.
- To impart the knowledge of networking concepts that enable wired and wireless communication among devices for IoT applications.
- To introduce cloud platforms for storing and implementing IoT applications.

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

CO1	Familiarize with the fundamental concepts of Internet of Things. .
CO2	Develop skills in programming and hardware platform like Arduino and Raspberry-PI for IOT applications.
CO3	Familiarize with the design and implementation of IOT protocols and connecting devices for IOT application.
CO4	Analyse and integrate the IOT applications to cloud service.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	2	2		1	1	1	1	-	-			1	1	1	1
CO2	2	3	2	2	2	1	2	-	-	-	1	2	2	3	1
CO3	2	3	1	3	2	1	1	-	-	-	1	2	1	2	1
CO4	2	3	2	2	2	1	2	-	-	-	1	2	1	2	2

Syllabus

Unit 1

Introduction to IOT Overview of machine-to-machine communication - Sensing – Actuators-Basics of Networking- Introduction to Micro-Controllers-Introduction to Embedded systems.

Unit 2

Basics of networking for device-to-device communication ,Communication Protocols – wired and wireless communication – Network Topology-Sensor Networks-Introduction to Arduino and Raspberry-PI-Introduction to IOT protocols-MQTT-COAP-Wi-Fi and Bluetooth connections in Arduino-Raspberry-PI Ethernet and Wi-Fi connectivity

Unit 3

Programming Arduino and Raspberry-PI Introduction to Arduino programming – Arduino GPIO's – Arduino Digital and Analog Input & Output - Interfacing Sensors to Arduino – Interfacing communication devices to Arduino – Configuring Raspberry-PI- Introduction to python-Programming Raspberry-PI using python-Raspberry-PI GPIO's- Interfacing sensors to Raspberry-PI- Communicating Arduino and Raspberry-PI using ethernet / Bluetooth/ Wi-Fi- Remote Actuation and control of motors, LED's and Relays using Arduino and Raspberry-PI.

Unit 4

Introduction to cloud and IOT cloud Services - Cloud services for IOT storage-Introduction to cloud services to visualize IOT data- Streaming IOT data to cloud-Plot and Visualize data using cloud tools- Adding IOT devices to cloud- Integrating Arduino and Raspberry-PI to ThingSpeak /IBM Watson.

Textbooks/References:

The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press).

Singh, R., Gehlot, A., Gupta, L. R., Singh, B., & Swain, M. (2019). Internet of things with Raspberry Pi and Arduino. CRC Press.

Amrita Vishwa Vidyapeetham
Strickland, James R. "Raspberry Pi for Arduino Users." *Raspberry Pi for Arduino Users -Building IoT and Network Applications and Devices*,(2018).

Singh, Rajesh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, and Mahendra Swain. *Internet of things with Raspberry Pi and Arduino*. CRC Press, 2019.

Wallace, Shawn, Matt Richardson, and Wolfram Donat. *Getting started with raspberry pi*. Maker Media, Inc., 2021.

Banzi, Massimo, and Michael Shiloh. *Getting started with Arduino*. Maker Media, Inc., 2022.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (Minimum 3)	Internal	30
Quizzes (Minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	20

23AID213	Operating Systems	L-T-P-C: 3- 0- 2- 4
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Course Objectives

- To give insight about design and development of Operating Systems
- To introduce the concepts of process creation and synchronization.
- To introduce the memory management techniques used by the Operating System.
- To understand the adaptation of the concepts by modern Operating Systems.

Course Outcomes

After completing this course, students will be able to

CO1	Illustrate the use of system calls to perform basic Operating System functionalities.
CO2	Apply the algorithms for resource management
CO3	Analyze the usage of Synchronization techniques.
CO4	Analyze memory management techniques.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	2	3	2	2	1	-	-	-	2	2	-	1	1	2	1
CO2	2	3	3	2	1	-	-	-	2	2	-	2	1	2	1
CO3	2	2	3	2	1	-	-	-	2	2	-	2	1	2	1
CO4	2	2	3	1	1	-	-	-	2	2	-	2	1	2	1

Syllabus

Unit 1

Amrita Vishwa Vidyapeetham.

BTC-AIE

B.Tech Curriculum June 2021

Operating systems, structure, operating systems services, system calls. Process and Processor management: Process concepts, process scheduling and algorithms, threads, multithreading. CPU scheduling and scheduling algorithms.

Unit 2

Process synchronization, critical sections, Deadlock: Shared resources, resource allocation and scheduling, resource graph models, deadlock detection, deadlock avoidance, deadlock prevention algorithms, mutual exclusion, semaphores, monitors, wait and signal procedures. Memory management: contiguous memory allocation, virtual memory, paging, page table structure, demand paging, page replacement policies, thrashing, segmentation.

Unit 3

Disk scheduling algorithms and policies, File management: file concept, types and structures, directory structure, Case study on Unix (about process management, Thread management and Kernel) and Mobile OS – iOS and Android – Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System)

Textbook / References

Silberschatz and Galvin, “Operating System Concepts”, 10th Edition, Wiley India, 2018.

Tannenbaum A S, “Modern Operating Systems”, Prentice Hall India, 2003.

W. Stallings, “Operating Systems: Internals and design Principles”, Pearson Ed., LPE, 6th Ed., 2009

X. M.J. Bach, “Design of Unix Operating system”, Prentice Hall, 1986

Evaluation Pattern

Assessment	Internal/External	Weightage(%)
Assignments (Minimum 3)	Internal	30
Quiz(Minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term project/End semester examination	External	30

23AID214	Database Management Systems	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- This course aims to understand the concepts of database design, database languages, database-system implementation and maintainance
- The course will provide knowledge of the design and development of databases for AI applications using SQL and python
- The course will provide an understanding of various databases system including modern databases systems apt for AI and ML applications

Course Outcomes

After completing this course, students will be able to

CO1	Formulate relational algebraic expressions, SQL and PL/SQL statements to query relational databases.
CO2	Build ER models for real world databases.
CO3	Design a normalized database management system for real world databases.
CO4	Apply the principles of transaction processing and concurrency control
CO5	Use high-level right database for AI and ML applications .

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	3	3	-	-	-	-	-	-	-	-	-	1
CO2	1	3	3	3	3	-	-	-	-	-	-	-	-	-	1
CO3	2	3	2	3	-	-	-	2	2	2	2	-	-	1	2
CO4	1	1	1	2	-	-	-	-	-	-	-	-	-	-	-
CO5	1	1	-	-	-	-	-	-	-	-	-	-	-	1	2

Syllabus

Unit 1

Introduction: Overview of DBMS fundamentals – Overview of Relational Databases and Keys. Relational Data Model: Structure of relational databases – Database schema – Formal Relational Query Languages – Overview of Relational Algebra and Relational Operations. Database Design: Overview of the design process - The E-RModels – Constraints - Removing Redundant Attributes in Entity Sets - E-R Diagrams - Reduction to Relational Schemas - Entity Relationship Design Issues - Extended E-R Features – Alternative E-R Notations – Overview of Unified Modelling Language (UML).

Unit 2

Relational Database Design: Features of Good Relational Designs - Atomic Domains and 1NF – Decomposition using Functional Dependencies: 2NF, 3NF, BCNF and Higher Normal Forms. Functional Dependency Theory - Algorithm for Decomposition – Decomposition using multi-valued dependency: 4NF and 4NF decomposition. Database design process and its issues. SQL: review of SQL – Intermediate SQL – Advanced SQL.

Unit 3

Transactions: Transaction concept – A simple transaction model - Storage structure - Transaction atomicity and durability - Transaction isolation – Serializability – Recoverable schedules, Cascade less schedules. concurrency control: Lock-based protocols – Locks, granting of locks, the two-phase locking protocol, implementation of locking, Graph-based protocols. Deadlock handling: Deadlock prevention, Deadlock detection and recovery. Case Study: Different types of high-level databases – MongoDB, Hadoop/Hbase, Redis, IBM Cloudant, Dynamo DB, Cassandra and Couch DB etc. Tips for choosing the right database for the given problem.

Text Books / References

Silberschatz A, Korth HF, Sudharshan S. Database System Concepts. Sixth Edition, TMH publishing company limited; 2017.

Garcia-Molina H, Ullman JD, Widom J. Database System; The complete book. Second Edition, Pearson Education India, 2011

Elmasri R, Navathe SB. Fundamentals of Database Systems. Fifth Edition, Addison Wesley

Evaluation Pattern

Assessment	Internal / External	Weightage (%)
Assignments(minimum 3)	Internal	30
Quiz(minimum 2)	Internal	20
Midterm Examination	Internal	20
Project / End Semester Examination	External	30

Course Objectives

- Focus in this course is on the basic understanding of user interface design by applying HTML, CSS and Java Script.
- On the completion of the course, students will be able to develop basic web applications .
- This course will serve as the foundation for students to do several projects and other advanced courses in computer science.

Course Outcomes

After completing this course, students will be able to

CO1	Apply the basics of World Wide Web concepts during web development.
CO2	Develop webpage GUI using HTML5 technology.
CO3	Develop GUI using CSS and Java Scrip
CO4	Develop a simple web application using html, CSS and JavaScript.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	2	2	2	-	-	2	2	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	3	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	3	-	-	-	-	-	-
CO4	-	2	3	3	3	2	2	3	3	3	2	-	-	-	-
CO5	2	2	3	2	3	-	-	3	2	-	-	-	-	-	-

Syllabus**Unit 1**

Introduction to Web – Client/Server - Web Server - Application Server- HTML Basics- Tags - Adding Web Links and Images- Creating Tables-Forms - Create a Simple Web Page - HTML 5 Elements - Media – Graphics.

Unit 2

CSS Basics –Features of CSS – Implementation of Borders - Backgrounds- CSS3 - Text Effects -Fonts -Page Layouts with CSS.

Unit 3

Introduction to Java Script –Form Validations – Event Handling – Document Object Model - Deploying an application.

Text Books / References

Kogent Learning Solutions Inc. Html5 Black Book: Covers Css3, Javascript, Xml, Xhtml, Ajax, PhpAndJquery. Second Edition, Dreamtech Press; 2013

Tittel E, Minnick C. Beginning HTML5 and CSS3 For Dummies. Third edition, John Wiley & Sons; 2013.

Powell TA, Schneider F. JavaScript: the complete reference. Paperback edition, Tata McGraw-Hill; 2012.

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

22ADM201	Strategic Lessons from Mahabharata	L-T-P-C: 1 0 0 1
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Syllabus

Unit 1 – Unit 4

Mahābhārata - A Brief Summary

A Preamble to the Grand Itihāsa

The Unbroken Legacy

Dharmic insights of a butcher

Unit 5 - 8

The Vows we take: Pratijñā

Mahābhārata - The Encyclopaedia for Kingship and Polity Acumen

Karna: The Maestro that Went Wide of the Mark

Strategical Silhouette of An Extraordinary Peace Mission

Unit 9 -11

Yajñaseni, A Woman from Fire.

Popular Regional Tales

Death and Deathlessness

Unit 12 -14

Mahabharata- An All-Encompassing Text

Mahabharata- Whats and What Nots

Mahābhārata in Adages

Text Books / References

The Mahabharata by Bibek Debroy (Translator)

Some exemplary characters of Mahabharata by Geeta press.

Epic India: by C V Vaidya

The Mahabharata as a History and Drama: by Rai Promatha Nath Mullick

The Mahabharata- A Criticism: by C V Vaidya

The Mahabharata Abridged:by C V Vaidya

23LSE211	LIFE SKILLS FOR ENGINEERS II	L-T-P-C: 1-0-2-2
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Pre-requisite(s): An inquisitive mind, basic English language skills, knowledge of high school level

mathematics, Anna Vidyapeetham.

BTC-AIE

B.Tech Curriculum June 2021

Course Objectives

- Assist students in inculcating Soft Skills and developing a strong personality.
- Help them improve their presentation skills.
- Aid them in developing their problem solving and reasoning skills.
- Facilitate them in improving the effectiveness of their communication.

Course Outcomes

CO1: Soft Skills: To develop greater morale and positive attitude to face, analyse, and manage emotions in real life situations, like placement process.

CO2: Soft Skills: To empower students to create better impact on a target audience through content creation, effective delivery, appropriate body language and overcoming nervousness, in situations like presentations, Group Discussions and interviews.

CO3: Aptitude: To analyze, understand and employ the most suitable methods to solve questions on arithmetic and algebra.

CO4: Aptitude: To investigate and apply suitable techniques to solve questions on logical reasoning and data analysis.

CO5: Verbal: To learn to use more appropriate words in the given context. To have a better understanding of the nuances of English grammar and become capable of applying them effectively.

CO6: Verbal: To be able to read texts critically and arrive at/ predict logical conclusions. To learn to organize speech and incorporate feedback in order to convey ideas with better clarity.

CO-PO Mapping

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

Syllabus

Soft Skills

Communication: Process, Language Fluency, Non-verbal, Active listening. Assertiveness vs. aggressiveness. Barriers in communication. Digital communication

Presentations: Need, importance, preparations, research and content development, structuring and ensuring flow of the presentation. Ways and means of making an effective presentation: Understanding and connecting with the audience – using storytelling technique, managing time, appropriate language, gestures, posture, facial expressions, tones, intonations and grooming. Importance of practice to make an impactful presentation.

Aptitude

Problem Solving II

Equations: Basics, Linear, Quadratic, Equations of Higher Degree and Problems on ages.

Logarithms, Inequalities and Modulus: Basics

Time and Work: Basics, Pipes & Cistern, and Work Equivalence.

Time, Speed and Distance: Basics, Average Speed, Relative Speed, Boats & Streams, Races and Circular

tracks.

Logical Reasoning: Arrangements, Sequencing, Scheduling, Venn Diagram, Network Diagrams, Binary Logic, and Logical Connectives.

Verbal

Vocabulary: Aid students learn to use their vocabulary to complete the given sentences with the right words. Usage of more appropriate words in different contexts is emphasized.

Grammar (Basic–intermediate): Help students master usage of grammatical forms and enable students to identify errors and correct them.

Reasoning: Emphasize the importance of avoiding the gap (assumption) in arguments/ statements/ communication.

Reading Comprehension (Basics): Introduce students to smart reading techniques and help them understand different tones in comprehension passages.

Speaking Skills: Make students be aware of the importance of impactful communication through individual speaking activities in class.

Writing Skills: Introduce formal written communication and keep the students informed about the etiquette of email writing.

Reference(s)

1. Students' Career Planning Guide, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
2. Soft Skill Handbook, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
3. Adair. J., (1986), *"Effective Team Building: How to make * winning team"*, London, U.K
4. Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
9. Cracking the New GRE 2012
10. Kaplan's – GRE Comprehensive Programme
11. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
12. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
13. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.
14. How to Prepare for Data Interpretation for the CAT, Arun Sharma.

Evaluation Pattern: 50:50

Assessment	Internal	External
Continuous Assessment (CA) – Soft Skills	30	–
Continuous Assessment (CA) – Aptitude	10	25
Continuous Assessment (CA) – Verbal	10	25
Total	50	50

*CA – Can be presentations, speaking activities and tests.

SEMESTER 5

23MAT303	Mathematics for Intelligent Systems 5	L-T-P-C:2-0-2-3
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Course Objectives

- To introduce students to the concepts of probabilistic graphical models and their applications in various fields.
- To teach students the methods of representation learning in Bayesian Networks.
- To enable students to perform inference in Markov Networks and Markov Random Fields.
- To provide an appreciation of probabilistic reasoning required for AI.

Course Outcomes

After completing this course, students will be able to

CO1	Model complex systems using the basics of probabilistic graphical models.
CO2	Develop a mathematical foundation of Bayesian Networks and their applications in real-world scenarios.
CO3	Develop directed and undirected graphical models.
CO4	Apply graphical models to real-world problems such as image recognition, natural language processing, and recommendation systems.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	3	2	3	-	-	-	3	2	-	3	3	-	3
CO2	3	3	3	2	3	-	-	-	3	2	-	3	3	-	3
CO3	3	3	3	2	3	-	-	-	3	2	-	3	3	-	3
CO4	3	3	3	2	3	-	-	-	3	2	-	3	2	-	3

Syllabus

Unit 1

Introduction to probabilistic graphical models, Probabilistic AI, Introduction to Bayesian Networks, Representation Learning in Bayesian Networks, Inference in Bayesian Networks

Unit 2

Markov Networks, Independencies in Markov Networks, Hidden Markov Models

Unit 3

Markov Random Fields (MRF), Decision Networks, From Bayesian Networks to Markov Networks

Text Books / References

Artificial Intelligence: A modern Approach, S J Russell and P Norvig, Pearson (3rd edition), 2010.

'Machine Learning: A Probabilistic Perspective', Kevin Murphy and Francis Bach, Penguin Publishers, 2012
Amrita Vishwa Vidyapeetham. BTC-AIE B.Tech Curriculum June 2021

Probabilistic graphical models: principles and techniques. Koller, Daphne, and Nir Friedman. MIT press, 2009.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (Minimum 3)	Internal	30
Quiz(Minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term project/End semester examination	External	30

23AID301

Computer Vision

L-T-P-C: 2- 0- 2- 3

Course Objectives

- To introduce students to the state-of-the-art algorithms in image analysis and object recognition.
- Give an exposure to video analysis techniques for object tracking and motion estimation.
- To build good understanding on the computer vision concepts and techniques to be applied for robotic vision applications.
- Enable students to apply the vision algorithms and develop applications in the domain of image analysis and robotic navigation.

Course Outcomes

After completing this course, students will be able to

CO1	To implement different image segmentation approaches
CO2	To use different deep learning based object detection algorithms for real time applications
CO3	To use various deep learning based object tracking algorithms on video data
CO4	To implement 3D reconstruction algorithms for real time applications

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	2	3	2	3	2	1	2	3	3	2	3	3	1	1
CO2	3	2	3	2	3	2	1	2	3	3	2	3	3	1	1
CO3	3	2	3	2	3	2	1	2	3	3	2	3	3	1	1
CO4	3	2	3	2	3	2	1	2	3	3	2	3	3	1	1

Syllabus

Unit 1

Image Segmentation Algorithms: contextual, non-contextual segmentation, texture segmentation. Feature Detectors and Descriptors, Feature Matching-Object Recognition, Face detection (Viola Jones), Face Recognition.

Unit 2

Modern computer vision architectures based on deep convolutional neural networks, The Use of Motion in Segmentation Optical Flow & Tracking Algorithms, YOLO, DeepSORT: Deep Learning to Track Custom Objects in a Video, Action classification with convolutional neural networks, RNN, LSTM

Amrita Vishwa Vidyapeetham.

BTC-AIE

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Unit 3

Markov Random Fields (MRF), Decision Networks, From Bayesian Networks to Markov Networks Image registration, 2D and 3D feature-based alignment, Pose estimation, Geometric intrinsic calibration, - Camera Models and Calibration: Camera Projection Models - Projective Geometry, transformation of 2-d and 3-d, Internal Parameters, Lens Distortion Models, Calibration Methods Geometry of Multiple views - Stereopsis, Camera and Epipolar Geometry, Fundamental matrix; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration., Introduction to SLAM (Simultaneous Localization and Mapping).

Text Books / References

Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach, "Deep Learning (Adaptive Computation and Machine Learning series)", January 2017, MIT Press.

Richard Szelinski, "Introduction to Computer Vision and its Application", 2010.

E. Trucco and A. Verri, "Introductory techniques for 3D Computer Vision", Prentice Hall, 1998.

Marco Treiber, "An Introduction to Object Recognition Selected Algorithms for a Wide Variety of Applications", Springer, 2010.

Forsyth and Ponce, "Computer Vision: A Modern Approach", Second Edition, Prentice Hall, 2011.

R. C. Gonzalez, R. E. Woods, 'Digital Image Processing', 4th edition Addison-Wesley, 2016.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (Minimum 2)	Internal	30
Quizzes (Minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID302	Big Data Analytics	L-T-P-C:2-0-2-3
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Course Objectives

- This course aims at introducing the concept of data structure hierarchy.
- It will also expose the students to the basic and higher order data structures.
- Further the students will be motivated to apply the concept of data structures to various engineering problems.

Course Outcomes

After completing this course, students will be able to

CO1	Implement functional and object-oriented programs in Scala, including using higher-order functions, pattern matching, and type classes														
CO2	Create and maintain a Spark deployment, including cluster configuration, resource allocation, and job monitoring														
CO3	Deploy of Spark for various use cases, such as ETL, data warehousing, and real-time analytics.														
CO4	Analyze real-world data sets and extract meaningful insights using statistical and machine learning techniques														

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	2	3	-	-	-	3	2	3	3	-	-	-
CO2	3	3	3	3	3	-	-	-	3	2	3	3	-	-	-
CO3	3	2	3	3	3	-	-	-	3	2	3	3	-	-	-

CO4	3	3	3	2	3	-	-	-	3	2	3	3	-	-	-
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Syllabus

Unit 1

Introduction to Big Data Analytics: Definition, characteristics, and importance of big data, tools and technologies for big data analytics, State-of-the-art computing paradigms/platforms, Hadoop ecosystem in Brief, Mapper, Reducer.

Unit 2

Introduction to Functional Programming (FP), FP concepts in Scala Programming, Mutable and Immutable Data structures, Scala Collections, Type Hierarchy, Higher Order Functions, Closures, ConsList, Tail Recursion, Object Oriented Programming in Scala, Introduction to concurrency

Unit 3

Basic entity classes and objects in Scala, Spark Architecture, Spark Cluster, Resilient Distributed Datasets (RDDs), Spark Transformations and Actions APIs, DataFrames and Datasets in Spark, Basic Operations on RDDs and DataFrames, lazy evaluations and optimization, Directed Acyclic Graph (DAG)

Unit 4

Introduction to Machine Learning with Spark, MLlib and its algorithms, Building a Machine Learning Pipeline in Spark, Case Study in Healthcare, Finance, etc.

Text Books / References

'Learning Spark: Lightning-Fast Big Data Analysis', Holden Karau, Andy Konwinski, Patrick Wendell and Matei Zaharia, O'Reilly; 1st edition, 2015

'Programming in Scala: A Comprehensive Step-by-Step Guide', Martin Odersky, Lex Spoon and Bill Venners, Artima Inc; Version ed. edition, 2008

'High Performance Spark: Best Practices for Scaling and Optimizing Apache Spark', Holden Karau, Rachel Warren, O'Reilly; 1st edition, 2017

'Scala for the Impatient', Cay S. Horstmann, Addison-Wesley; 2nd edition, 2017

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (Minimum 3)	Internal	30
Quiz (Minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term project/End semester examination	External	30

23AID303	Quantum Computing & Algorithms	L-T-P-C:2-0-2-3
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Course Objectives

- Studying the structural units of quantum computers of the future, forming an understanding of the differences between quantum bits and classical bits.
- Study of basic quantum logical operations and algorithms for processing quantum information.

Course Outcomes

After completing this course, students will be able to

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CO1	The basic principles of quantum computing.
CO2	The fundamental differences between conventional computing and quantum computing.
CO3	Several basic quantum computing algorithms.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	3	2	3	-	3	3	3	-	-	-	-	-	-
CO2	3	3	3	2	3	2		-	3	-	-	-	-	-	-
CO3	3	3	3	2	3	-	2	-	3	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Syllabus

Unit 1

Review of the principles of quantum computation, The Deutsch Jozsa Algorithm, Bernstein Vazirani Algorithm, Simmons Algorithm

Unit 2

Shor's Algorithm, Grover's Search, Grover's algorithm Programming

Unit 3

NISQ-era quantum algorithms, Variational Quantum Algorithms

Unit 4

Variational Quantum Eigen solver, Quantum Generative Adversarial Networks (QGANs)

Unit5.

Applications

Text Books / References

Bernhardt, Chris. Quantum computing for everyone. Mit Press, 2019.

Yuly Billing, Quantum Computing for High School Students.

Quantum Computation and Quantum Information, M. A. Nielsen & I. Chuang, Cambridge University Press (2000).

Gilbert Strang, Introduction to Linear Algebra, Fifth Edition, Wellesley-Cambridge Press, 2016.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (Minimum 3)	Internal	30
Quiz (Minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term project/End semester examination	External	30

Course Objectives

- Familiarize student with architectural overview of modern HPC and GPU based heterogeneous architectures, focusing on its computing power versus data movement needs.
- Familiarize the students working with cloud platforms and services to configure and use computational resources and storage.
- To educate students how to write efficient parallel programming and GPU programming.
- To discuss various application of HPC computational techniques in computational science.

Course Outcomes

After completing this course, students will be able to

CO1	Apply high-performance computing in different research field.
CO2	Design OpenMPI programme and CUDA programme
CO3	Simulate on cloud computing system.
CO4	Evaluate how the convergence of HPC and AI is transforming the data science.

CO-PO Mapping

PO/P SO	PO 1	PO2	PO3	PO4	PO5	PO 6	PO7	PO 8	PO 9	PO 10	PO1 1	PO1 2	PSO 1	PSO2	PSO3
CO															
CO1	3	2	-	2	2	3	2	-	-	2	1	3	1	1	-
CO2	2	3	3	3	3	-	1	-	2	1	2	3	3	3	1
CO3	2	2	3	2	3	1	1	-	2	1	2	3	2	2	1
CO4	2	2	1	2	3	2	1	1	2	1	2	3	3	3	3

Syllabus

Unit 1

Introduction to basic architecture and OS concepts –architecture of parallel computing–shared and distribution memory in parallel computing – parallel algorithm – performance metrics of parallel algorithm.

Unit 2

Introduction to OpenMP – essentials of OpenMP – data sharing and synchronization – efficient OpenMP for matrix computing – Introduction to MPI and distributed memory parallel computing – communicating using MPI – Matrix representation of physical system and parallel matrix solvers – domain decomposition techniques

Unit 3

Overview of GPU architecture and its evolution –introduction to GPGPU and CUDA – CUDA programming –thread execution in CUDA programming – matrix computing in CUDA -introduction to cuBLAS and cuDNN libraries for linear algebra and deep learning - case studies of GPU: accelerated applications in scientific computing, data analytics, and machine learning

Unit 4

Introduction to cloud computing and its importance – benefits and challenges of cloud computing - types of cloud services (IaaS, PaaS, SaaS) and their characteristics - cloud computing architecture and its components - cloud storage and its types - cloud networking and its challenges - cloud security and its importance - cloud application - benefits and challenges of HPC and AI - synergy between HPC and AI - training and inference of AI models using HPC

Text Books / References

"High Performance Computing: Modern Systems and Practices" by Thomas Sterling and Matthew Anderson

"CUDA by Example: An Introduction to General-Purpose GPU Programming" by Jason Sanders and Edward Kandrot

"Parallel Programming with MPI" by Peter S. Pacheco

Comer, D. (2021). *The Cloud Computing Book: The Future of Computing Explained*. CRC Press

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (Minimum 2)	Internal	20
Quiz(Minimum 2)	Internal	20
Mini Project	Internal	20
Mid-Term Examination	Internal	10
Term project/End semester examination	External	30

23AID305	Control System	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- This course introduces the fundamentals of control systems through a hands-on approach involving programming tools such as MATLAB.
- This course familiarizes concepts of control systems, such as open-loop, closed-loop, and feedback systems.
- This course enables the students to judge the performance and stability of control systems

Course Outcomes

After completing this course, students will be able to

CO1	Explain the fundamental principles that govern control systems.
CO2	Apply analytical techniques to evaluate and characterize basic control systems.
CO3	Evaluate the performance and stability of control systems
CO4	Apply control system theory to practical applications in engineering.

CO-PO Mapping

PO/P SO	PO 1	PO2	PO3	PO4	PO5	PO6	P O 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	PSO 1	PSO2	PSO3
CO															
CO1	3	3	2	1	3	-	-	-	3	3	-	2	3	2	1
CO2	3	3	3	2	3	1	-	-	3	3	-	2	2	2	1
CO3	3	3	3	2	3	-	-	-	3	3	-	2	2	2	1
CO4	3	3	3	2	3	1	-	-	3	3	-	3	3	2	1

Syllabus

Unit 1

Introduction to Control Systems and Frequency Domain Methods, Definition and types of control systems, Mathematical modelling of systems, Block diagram and signal flow graph representation of systems, Feedback and control system characteristics, Stability

analysis and root locus techniques, Frequency response analysis, Bode plot and Nyquist plot, PID controllers Lead-lag compensators, Design of classical controllers using root locus.

Unit 2

State Space Methods State space analysis and design, State-Space representation of control systems: state variables, state-space models, Multivariable control systems: MIMO systems, decoupling, Controllability and observability, Pole placement and observer design, Linear quadratic regulator (LQR) Optimal control, Introduction to nonlinear control

Unit 3

Applications of Control Systems, Control of mechanical systems, Control of electrical systems, Control of chemical and biological systems, Introduction to optimal control for aerospace system

Text Books / References

S. L. Brunton and J. N. Kutz, "Data-driven science and engineering: Machine learning, dynamical systems, and control", Cambridge University Press, 2022. ISBN 9781108422093.

Ogata Katsuhiko, "Modern control engineering", Prentice Hall, 2010. ISBN 9780136156734.

M. F. Golnaraghi, B. C. Kuo, and M. F. Golnaraghi, "Automatic control systems" Wiley, 2010. ISBN 9780470048962.

N. Nise, "Control systems engineering", 6th ed. John Wiley & Sons, 2017. ISBN 9780470917695.

G. F. Franklin, J. D. Powell, and M. L. Workman, "Digital control of dynamic systems", Vol. 3, Ellis Kagle Press, 1998. ISBN 9780979122606.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (Minimum 3)	Internal	30
Quiz (Minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term project/End semester examination	External	30

23LSE301

LIFE SKILLS FOR ENGINEERS III

L-T-P-C: 1-0-2-2

Pre-requisite(s): Willingness to learn, communication skills, basic English language skills, knowledge of high school level mathematics.

Course Objectives

- Help students understand corporate culture, develop leadership qualities and become good team players
- Assist them in improving group discussion skills
- Help students to sharpen their problem solving and reasoning skills
- Empower students to communicate effectively

Course Outcomes

CO1 – Soft Skills: To improve the inter-personal communication and leadership skills, vital for arriving at win-win situations in Group Discussions and other team activities.

CO2 – Soft Skills: To develop the ability to create better impact in a Group Discussions through examination, participation, perspective-sharing, ideation, listening, brainstorming and consensus.

CO3 – Aptitude: To identify, investigate and arrive at appropriate strategies to solve questions on

geometry, statistics, probability and combinatorics.

CO4 – Aptitude: To analyze, understand and apply suitable methods to solve questions on logical reasoning.

CO5 – Verbal: To be able to use diction that is more refined and appropriate and to be competent in spotting grammatical errors and correcting them.

CO6–Verbal: To be able to logically connect words, phrases, sentences and thereby communicate their perspectives/ideas convincingly.

CO–PO Mapping

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

Syllabus

Soft Skills

Professional Grooming and Practices: Basics of corporate culture, key pillars of business etiquette – online and offline: socially acceptable ways of behavior, body language, personal hygiene, professional attire and Cultural adaptability and managing diversity. Handling pressure, multi-tasking. Being enterprising. Adapting to corporate life: Emotional Management (EQ), Adversity Management, Health consciousness. People skills, Critical Thinking and Problem solving.

Group Discussions: Advantages of group discussions, Types of group discussion and Roles played in a group discussion. Personality traits evaluated in a group discussion. Initiation techniques and maintaining the flow of the discussion, how to perform well in a group discussion. Summarization/conclusion.

Aptitude

Problem Solving III

Geometry: 2D, 3D, Coordinate Geometry, and Heights & Distance.

Permutations & Combinations: Basics, Fundamental Counting Principle, Circular Arrangements, and Derangements.

Probability: Basics, Addition & Multiplication Theorems, Conditional Probability and Bayes' Theorem.

Statistics: Mean, Median, Mode, Range, Variance, Quartile Deviation and Standard Deviation.

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Logical Reasoning: Blood Relations, Direction Test, Syllogisms, Series, Odd man out, Coding

\& Decoding, Cryptarithmic Problems and Input – Output Reasoning.

Verbal

Vocabulary: Create an awareness of using refined language through idioms and phrasal verbs. **Grammar (Upper Intermediate–Advanced):** Train Students to comprehend the nuances of Grammar and empower them to spot errors in sentences and correct them.

Reasoning: Enable students to connect words, phrases and sentences logically.

Oral Communication Skills: Aid students in using the gift of the gab to interpret images, do a video synthesis, try a song interpretation or elaborate on a literary quote.

Writing Skills: Practice closet tests that assess basic knowledge and skills in usage and mechanics of writing such as punctuation, basic grammar and usage, sentence structure and rhetorical skills such as writing strategy, organization, and style.

Reference(s)

1. Students" Career Planning Guide, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
2. Soft Skill Handbook, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
3. Adair. J., (1986), *"Effective Team Building: How to make * winning team"*, London, U.K
4. Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Public Sector – Engineer Management Trainee Recruitment Exam (General English)
9. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
10. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
11. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
12. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.
13. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
14. How to Prepare for Logical Reasoning for the CAT, Arun Sharma.
15. Quantitative Aptitude for Competitive Examinations, R S Aggarwal.
16. A Modern Approach to Logical Reasoning, R S Aggarwal.
17. A Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal.

Evaluation Pattern: 50:50

Assessment	Internal	External
Continuous Assessment (CA) – Soft Skills	30	–
Continuous Assessment (CA) – Aptitude	10	25
Continuous Assessment (CA) – Verbal	10	25
Total	50	50

*CA – Can be presentations, speaking activities and tests.

SEMESTER 6

23MAT313	Mathematics for Intelligent Systems 6	L-T-P-C:2-0-2-3
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Course Objectives

- To introduce students to the concept of Neuro-symbolic AI and its significance in artificial intelligence.
- To provide an overview of knowledge graphs and their applications in various domains

Course Outcomes

After completing this course, students will be able to

CO1	Develop intelligent systems using the concept of Neuro-Symbolic AI.
CO2	Develop knowledge representation and reasoning techniques in Neuro-Symbolic AI.
CO3	Apply the concepts of logical neural networks and Markov random fields in Neuro-Symbolic AI
CO4	Develop hybrid models that combine different AI approaches, such as Neuro-Symbolic AI and deep learning

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	3	2	3	-	-	-	3	2	-	3	3	-	3
CO2	3	3	3	2	3	-	-	-	3	2	-	3	3	-	3
CO3	3	3	3	2	3	-	-	-	3	2	-	3	3	-	3
CO4	3	3	3	2	3	-	-	-	3	2	-	3	2	-	3

Syllabus

Unit 1

Introduction to Neuro-Symbolic AI: Definition and overview of Neuro-Symbolic AI- Advantages and disadvantages of Neuro-Symbolic AI- Applications of Neuro-Symbolic AI.

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Unit 2

Knowledge Representation and Reasoning: Reasoning in neuro-symbolic AI - Types of reasoning. Logical Neural Networks-Markov Random Fields-Hybrid Models

Unit 3

Explainable AI, Multi-Modal Neuro-Symbolic AI, Future Directions in Neuro-Symbolic AI

Text Books / References

Bouneffouf, Djallel, and Charu C. Aggarwal. "Survey on Applications of Neurosymbolic Artificial Intelligence." *arXiv preprint arXiv:2209.12618* (2022).

Neuro-Symbolic Artificial Intelligence: The Next Big Step by Daniele Magazzeni and Tomas Petricek.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID311	Analog Computing	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- Learn the principles of analog computing.
- Learn the concepts of Hybrid computing.
- Apply machine learning in Hybrid computing.

Course Outcomes

After completing this course, students will be able to

CO1	Understand the principles of analog computing
CO2	Understand the concepts of Hybrid computing (Analog and digital computing
CO3	Computation using Hybrid computing
CO4	Apply machine learning in Hybrid computing

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	-	-	-	-	-	3	3	-	-	-	-	2	-	-	-
CO2	-	-	-	-	-	1	-	3	-	-	-	2	-	-	-
CO3	-	-	-	-	-	3	3	3	-	-	-	2	-	-	-
CO4	-	-	-	-	-	3	3	3	-	-	-	2	-	-	-

Syllabus

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Unit 1

Introduction to analog computer, direct versus indirect analogies, A short history of analog computing, Characteristics of analog computers, Computing elements – machine units, summer, integrators, free elements, potentiometers, function generators, multiplication, comparators and switches, Input/Output devices.

Unit 2

Analog computer operation, basic programming – radioactive decay, analytical solutions, using an analog computer, scaling, harmonic functions, sweep, Mathematical pendulum, Straight forward implementation, variants, Mass-spring-damper system, analytical solution, using an analog computer, RLC-circuit

Unit 3

Inverse functions, square root, division, power and polynomials, low pass filter, triangle/square wave generator, Ideal diode, absolute value, limiters, dead space, hysteresis, Bang-bang, Minimum/Maximum holding circuits, sample and hold, time derivative, time delay, historic approaches to delay, digitization, sample and hold circuits, analog delay network.

Unit 4

Inverse Chemical kinetics, damped pendulum with external force, MATHIEU'S equation, Introduction, Scaling and programming, VANDER POL's equation, Programming, Solving the one dimensional SCHRODINGER equation, Ballistic trajectory, Charged particle in a magnetic field, RUTHERFORD scattering, Celestial mechanics, Bouncing ball, Zombie apocalypse, ROSSLER attractor, LORENZ attractor, another Lorenz attractor, CHAU attractor, Nonlinear chaos, AIZAWA attractor, NOSE-HOOVER oscillator, rotating spiral, flow around an airfoil, Heat transfer, Two dimensional heat transfer, systems of linear equations, Human-in-the-loop, Inverted pendulum, Double pendulum

Unit 5

Hybrid computing - Hybrid controllers, Basic operations, shell trajectory, data gathering, training an AI with analog computer.

Textbooks / References

Analog and Hybrid computer programming, Bernd Ulmann, CPI books GmbH, Leck

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID312	Reinforcement Learning	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- This course will provide a solid introduction to the field of reinforcement learning.
- It will also make the students learn about the core challenges and approaches, including exploration and exploitation.
- The course will make the students well versed in the key ideas and techniques for reinforcement learning.

Course Outcomes

After completing this course, students will be able to

CO1	Formulate an application problem as a reinforcement learning problem
CO2	Implement common reinforcement learning algorithms using Python/Matlab
CO3	Evaluate reinforcement learning algorithms on the metrics such as regret, sample complexity, computational complexity, empirical performance, and convergence
CO4	Evaluate different approaches for addressing exploration vs exploitation challenge in terms of

	performance, scalability, complexity of implementation, and theoretical guarantees
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CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	2	2	2	2	2	-	-	1	-	-	-	2	3	-	1
CO2	2	2	2	2	2	-	-	1	-	-	-	2	3	-	1
CO3	1	1	1	1	1	-	-	1	-	-	-	1	-	3	1
CO4	1	1	1	1	1	-	-	1	-	-	-	1	-	3	1

Syllabus

Unit 1

Introduction to Reinforcement Learning – History of Reinforcement Learning - Elements of Reinforcement Learning – Limitations and scope

Unit 2

Multi-armed Bandits – Finite Markov Decision Processes – Dynamic Programming – Policy evaluation – Policy improvement – Policy Iteration – Value Iteration

Unit 3

Monte Carlo Methods – Monte Carlo prediction – Monte Carlo control – Incremental Implementation – Temporal-Difference Learning – TD prediction – Q-Learning - n-step Bootstrapping

Unit 4

Planning and Learning with Tabular Methods – Models and planning – Prioritized sweeping – Trajectory sampling – Heuristic search – Rollout algorithms

Text Books / References

Richard.S.Sutton and Andrew G.Barto, Reinforcement Learning, MIT Press, Second Edition, 2018

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23LSE311	LIFE SKILLS FOR ENGINEERS IV	L-T-P-C: 1-0-2-2
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Pre-requisite(s): Self-confidence, presentation skills, listening skills, basic English language skills, knowledge of high school level mathematics.

Course Objectives

- Help students prepare resumes and face interviews with confidence
- Support them in developing their problem-solving ability
- Assist them in improving their problem solving and reasoning skills
- Enable them to communicate confidently before an audience

Course Outcomes

CO1: Soft Skills: To acquire the ability to present themselves confidently and showcase their knowledge, skills, abilities, interests, practical exposure, strengths and achievements to potential recruiters through a resume, video resume, and personal interview.

CO2: Soft Skills: To have better ability to prepare for facing interviews, analyse interview questions, articulate correct responses and respond appropriately to convince the interviewer of one's right candidature through displaying etiquette, positive attitude and courteous communication.

CO3: Aptitude: To manage time while applying suitable methods to solve questions on arithmetic, algebra and statistics.

CO4: Aptitude: To investigate, understand and use appropriate techniques to solve questions on logical reasoning and data analysis.

CO5: Verbal: To use diction that is less verbose and more precise and to use prior knowledge of grammar to correct/improve sentences.

CO6: Verbal: To understand arguments, analyze arguments and use inductive/deductive reasoning to arrive at conclusions. To be able to generate ideas, structure them logically and express them in a style that is comprehensible to the audience/recipient.

CO-PO Mapping

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

Syllabus

Soft Skills

Teamwork: Value of teamwork in organizations, Definition of a team. Why team? Effective team building. Parameters for a good team, roles, empowerment and need for transparent communication, Factors affecting team effectiveness, Personal characteristics of members and its influence on team. Project Management Skills, Collaboration skills.

Leadership: Initiating and managing change, Internal problem solving, Evaluation and co-ordination, Growth and productivity, Importance of Professional Networking.

Facing an Interview: Importance of verbal & aptitude competencies, strong foundation in core competencies, industry orientation / knowledge about the organization, resume writing (including cover

letter, digital profile and video resume), being professional. Importance of good communication skills, etiquette to be maintained during an interview, appropriate grooming and mannerism.

Aptitude

Problem Solving II

Sequence and Series: Basics, AP, GP, HP, and Special Series.

Data Sufficiency: Introduction, 5 Options Data Sufficiency and 4 Options Data Sufficiency.

Logical reasoning: Clocks, Calendars, Cubes, Non-Verbal reasoning and Symbol based reasoning.

Campus recruitment papers: Discussion of previous year question papers of all major recruiters of Amrita Vishwa Vidyapeetham.

Competitive examination papers: Discussion of previous year question papers of CAT, GRE, GMAT, and other management entrance examinations.

Miscellaneous: Interview Puzzles, Calculation Techniques and Time Management Strategies.

Verbal

Vocabulary: Empower students to communicate effectively through one-word substitution. **Grammar:** Enable students to improve sentences through a clear understanding of the rules of grammar.

Reasoning: Facilitate the student to tap his reasoning skills through Syllogisms, critical reasoning arguments and logical ordering of sentences.

Reading Comprehension (Advanced): Enlighten students on the different strategies involved in tackling reading comprehension questions.

Public Speaking Skills: Empower students to overcome glossophobia and speak effectively and confidently before an audience.

Writing Skills: Practice formal written communication through writing emails especially composing job application emails.

References

1. Students' Career Planning Guide, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
2. Soft Skill Handbook, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
3. Adair, J., (1986), "Effective Team Building: How to make * winning team", London, U.K
4. Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Public Sector – Engineer Management Trainee Recruitment Exam (General English)
9. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
10. A Modern Approach to Verbal Reasoning – R.S. Aggarwal
11. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
12. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
13. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.

14. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
15. How to Prepare for Logical Reasoning for the CAT, Arun Sharma.
16. Quantitative Aptitude for Competitive Examinations, R S Aggarwal.
17. A Modern Approach to Logical Reasoning, R S Aggarwal.
18. A Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal

Evaluation Pattern: 50:50

Assessment	Internal	External
Continuous Assessment (CA) – Soft Skills	30	–
Continuous Assessment (CA) – Aptitude	10	25
Continuous Assessment (CA) – Verbal	10	25
Total	50	50

*CA – Can be presentations, speaking activities and tests.

22ADM101	FOUNDATIONS OF INDIAN HERITAGE	L-T-P-C:2-0-1-2
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Course Objectives

To introduce students to the depths and richness of the Indian culture and knowledge traditions, and to enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields. To equip students with a knowledge of their country and its eternal values.

Course Outcomes

CO1: Increase student understanding of true essence of India's cultural and spiritual heritage. Emancipating Indian histories and practices from manipulation, misunderstandings, and other ideological baggage thus, shows its contemporary relevance.

CO2: Understand the ethical and political strategic concepts to induce critical approach to various theories about India.

CO3: Familiarize students with the multidimension of man's interaction with nature, fellow beings and society in general.

CO4: Appreciate the socio-political and strategic innovations based on Indian knowledge systems. Gives an understanding of bringing Indian teaching into practical life.

CO-PO Mapping

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

Syllabus

Educational Heritage of Ancient India, Life and Happiness, Impact of Colonialism and Decolonization, A timeline of Early Indian Subcontinent, Pinnacle of Selflessness and ultimate freedom, Indian approach towards life, Circle of Life, Ocean of love; Indian Mahatmas, Man's association with Nature, Celebrating life 24/7, Metaphors and Tropes, Become A Strategic Thinker (Games / Indic activity), India: In the Views of Other Scholars and Travellers, Personality Development Through Yoga, Hallmark of Indian Traditions: Advaita Vedanta, Theory of oneness, Conversations on Compassion with Amma.

Textbook(s)

"Foundations of Indian Heritage", In house publication (In print).

Reference(s)

The beautiful tree by Dharampal.

Peasants and Monks in British India by William Pinch.

India, that is Bharat: Coloniality, Civilisation, Constitution by J Sai Deepak.

Awaken Children Dialogues with Mata Amritanandamayi.

Man and Nature by Mata Amritanandamayi Devi.

What Becomes of the Soul After Death, Divine Life Society.

Evaluation Pattern: 50:50

Assessment	Internal	End Semester
Term Project	30	
Mid-term	30	
End Semester		40

SEMESTER 7

19ENV300	Environmental Science	P/F
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Course Objectives

- To study the nature and facts about environment
- To appreciate the importance of environment by assessing its impact on the human world
- To study the integrated themes and biodiversity, pollution control and waste management

Course Outcomes

After completing this course, students will be able to

CO1	Ability to understand aspects of nature and environment
CO2	Ability to analyse impact of environment on human world.
CO3	Ability to comprehend pollution control and waste management

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2	PSO 1	PSO2	PSO 3
CO															
CO1	-	-	-	-	-	3	2	3	-	-	-	-	-	-	-
CO2	-	-	-	-	-	3	2	3	-	-	-	-	-	-	-
CO3	-	-	-	-	-	3	2	3	-	-	-	-	-	-	-

Syllabus

Unit 1

Over view of the global environment crisis – Biogeochemical cycles – Climate change and related international conventions and treaties and regulations – Ozone hole and related International conventions and treaties and regulations – Overpopulation – energy crisis – Water crisis – ground water hydrogeology – surface water resource development.

Unit 2

Ecology, biodiversity loss and related international conventions – treaties and regulations – Deforestation and land degradation – food crisis – water pollution and related International and local conventions – treaties and regulations – Sewage domestic and industrial and effluent treatment – air pollution and related international and local conventions – treaties and regulations – Other pollution (land, thermal, noise).

Unit 3

Solid waste management (municipal, medical, e-waste, nuclear, household hazardous wastes) – environmental management – environmental accounting – green business – eco-labelling – environmental impact assessment – Constitutional – legal and regulatory provisions – sustainable development, Topic modelling

Text Books / References

R. Rajagopalan, "Environmental Studies – From Crisis to Cure", Oxford University Press, 2005, ISBN 0-19-567393-X.

G.T.Miller Jr., "Environmental Science", 11th Edition, Cenage Learning Pvt. Ltd., 2008.

Benny Joseph, "Environmental Studies", Tata McGraw-Hill Publishing company Limited, 2008.

Evaluation Pattern

Assessment	Internal	External
Online Test	-	100
		P/F

19LAW300	Indian Constitution	L-T-P-C: P/F
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Course Objectives

- To know about Indian constitution.
- To know about central and state government functionalities in India
- To know about Indian society

Course Outcomes

After completing this course, students will be able to

CO1	Understand the functions of the Indian government
CO2	Understand and abide the rules of the Indian constitution.
CO3	Understand and appreciate different culture among the people

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	-	-	-	-	-	3	2	3	-	-	-	-	-	-	-
CO2	-	-	-	-	-	3	2	3	-	-	-	-	-	-	-
CO3	-	-	-	-	-	3	2	3	-	-	-	-	-	-	-

Syllabus

Unit 1

Historical Background – Constituent Assembly Of India – Philosophical Foundations Of The Indian Constitution– Preamble – Fundamental Rights – Directive Principles Of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies For Citizens

Unit 2

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

Unit 3

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

Text Books

Durga Das Basu, “Introduction to the Constitution of India “, Prentice Hall of India, New Delhi.

R.C.Agarwal, (1997) “Indian Political System”, S.Chand and Company, New Delhi.

References

Sharma, Brij Kishore, “Introduction to the Constitution of India”, Prentice Hall of India, New Delhi..

Evaluation Pattern

Assessment	Internal	External
Online Test	-	100
		P/F

23AID498	Project Phase – 1	L-T-P-C: 0- 0- 14- 7
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Course Objectives

- Project Phase – 1 aims at helping students to identify the research problems by conducting a thorough literature review
- The course introduces the students to real world problems associated with AI
- The course also aims at helping students to publish scientific articles in peer reviewed scientific publications.

Course Outcomes

After completing this course, students will be able to

CO1	Identify a valid research problem by conducting literature review in the appropriate area
CO2	Identify the appropriate methodology to solve the research problem..
CO3	Apply the AI tools & techniques to solve the identified problem.
CO4	Communicate scientific discoveries through peer-reviewed publications.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	3	3	3	2	2	2	3	3	3	3	2	3	-
CO2	3	3	3	3	3	2	2	2	3	3	3	3	2	3	-
CO3	3	3	3	3	3	2	2	2	3	3	3	3	2	3	-
CO4	3	3	3	3	3	2	2	2	3	3	3	3	-	-	3

publications.

Course Outcomes

After completing this course, students will be able to

CO1	Solve a valid research problem by employing appropriate tools & techniques.
CO2	Implement the appropriate methodology to solve the research problem.
CO3	Apply the AI tools & techniques to solve the identified problem.
CO4	Communicate scientific discoveries through peer-reviewed publications.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	3	3	3	2	2	2	3	3	3	3	2	3	-
CO2	3	3	3	3	3	2	2	2	3	3	3	3	2	3	-
CO3	3	3	3	3	3	2	2	2	3	3	3	3	2	3	-
CO4	3	3	3	3	3	2	2	2	3	3	3	3	-	-	3

Evaluation Pattern

Assessment	Weightage (%)
Internal	70
External	30

ELECTIVES

23AID431	Robotics –Kinematics, Dynamics and Control	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- This course aims to provide students with a solid foundation in the principles of robot kinematics, dynamics, control, navigation, and localization for both industrial and mobile robots.
- This course intends to equip students with the ability to design and analyze common robotic systems using mathematical and computational tools.
- This course aims to give students hands-on experience in programming robots for navigation and control, enabling them to apply their knowledge to practical applications in the field of robotics.

Course Outcomes

After completing this course, students will be able to

CO1	Develop mathematical models for robot kinematics, dynamics, and control systems to solve problems related to robotic systems.
CO2	Implement simple robotic control systems using different types of control algorithms, such as PD, PID, and adaptive control.
CO3	Develop machine learning/deep learning models for solving NLP applications Apply gained knowledge of robotic concepts to design and program robots for tasks such as path/trajectory planning, localization, and obstacle avoidance.
CO4	Use simulation tools to model and analyze the behavior of robotic systems.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	1	2	1	1		3	3		2	2	-	-
CO2	3	3	1	1	2	1	1		3	3		2	2	1	-
CO3	3	3	2	1	2	1	1	1	3	3		2	3	2	1
CO4	3	3	3	3	3	1	1	1	3	3		3	1	1	1

Syllabus

Unit 1: Industrial Robots – Kinematics

Introduction to Industrial Robots and their Applications, Robot Coordinates and Transformations, Forward Kinematics, DH parameters and table, Twists, Inverse Kinematics, Differential kinematics, Trajectory Planning

Unit 2: Industrial Robots - Dynamics and Control

Robot Dynamics, Euler-Lagrange's Equations, Newton-Euler method, Inverse Dynamics and Trajectory Tracking, PD & PID Control, Adaptive Control, Force Control.

Unit 3: Mobile Robots - Kinematics, Navigation, and Localization

Introduction to Mobile Robots and their Applications, Mobile Robot Kinematics, Robot Navigation and Path Planning, Localization Techniques, Simultaneous Localization and Mapping (SLAM)

Craig J J. *Introduction to Robotics: Mechanics and Control*. Pearson Publishing, 2017.

Spong M.W., Hutchinson S. and Vidyasagar M, *Robot Modeling and Control*, Wiley, 2006

Saha S K, *Introduction to Robotics*, McGraw Hill publishing, 2014

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID432	Introduction to ROS2	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- This course aims to introduce students to the fundamentals of Robotic Operating System (ROS2) and Gazebo simulation, including key concepts such as nodes, topics, services, and actions, as well as the development of ROS2 packages.
- This course aims to equip students with the knowledge and skills required to apply ROS2 to mobile and industrial robots, including navigation, SLAM, robot arm control, perception, and communication.
- This course aims to provide students with hands-on experience working with ROS2 and Gazebo, allowing them to design, implement, and test robotic applications using these tools.

Course Outcomes

After completing this course, students will be able to

CO1	Program ROS2 packages and utilize ROS2 concepts such as nodes, topics, services, and actions to control, perceive, and communicate with mobile and industrial robots.
CO2	Apply ROS2 to mobile robots to navigate, use SLAM, and control them effectively.
CO3	Apply ROS2 to industrial robots to control robotic arms and perform real world tasks within a simulation environment.
CO4	Evaluate the performance of chatbots using various metrics and techniques. Use Gazebo to simulate robotic applications and test their code effectively, improving the overall proficiency with ROS2.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	1	1	3	1	1	2	1	1	1	1		2	1		
CO2	3	3	3	2	3	1		1	3	3		2	2	2	2
CO3	3	3	3	2	3	1		1	3	3		2	2	2	2
CO4	1	2	2	2	3	-			3	3		2	2	2	1

Syllabus

Unit 1: Introduction to ROS2

Overview of ROS2 architecture and communication protocols, Comparison with ROS1, setting up ROS2 environment and creating a ROS2 package, Introduction to ROS2 command-line tools, Basic ROS2 concepts such as nodes, topics, messages, and services, Introduction to Gazebo simulator.

Unit 2: Advanced ROS2 Concepts

ROS2 middleware and communication mechanisms, ROS2 launch files and parameter management, ROS2 package dependencies and ROS2 ecosystem, Advanced ROS2 concepts such as actions and transformations.

Unit 3: ROS2 Applications in Mobile and Industrial Robotics

Introduction to ROS2-based mobile robot navigation, Overview of ROS2-based industrial robot control, Integration of ROS2 with sensors and actuators for mobile and industrial robots, ROS2-based robot perception and manipulation.

Text Books / References

Rico, F. M. *A Concise Introduction to Robot Programming with ROS2*. CRC Press; 2023.

Nehmzow U. *Mobile robotics: a practical introduction*. Springer Science & Business Media; 2012.

P. Corke, *Robotics, Vision, and Control*, Springer, 2011.

Ros2 Humble Tutorial: <https://docs.ros.org/en/humble/Tutorials.html>

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID433	NLP for Robotics	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- The course aims to introduce spoken language technology with an emphasis on dialog and conversational systems
- The course helps in establishing the understanding of Deep learning and other methods for automatic speech recognition, speech synthesis systems for robotics

Course Outcomes

After completing this course, students will be able to

CO1	Demonstrate understanding of acoustic phonetics in the context of spoken language.
CO2	Analyze different types of dialog systems and their applications.
CO3	Apply AI techniques used in dialog systems.
CO4	Implement automatic speech recognition, text-to-speech synthesis, and evaluation.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	3	2	2	1	1	2	2	1	3	2	0	2
CO2	3	3	3	3	2	2	1	2	2	3	2	3	0	0	0
CO3	3	3	3	3	3	2	1	2	3	2	2	3	2	2	0
CO4	3	3	3	3	3	2	1	2	3	3	2	3	2	2	1

Unit 1

Introduction and Acoustic Phonetics, Overview of dialog: Human conversation. Task-oriented dialog. Dialog systems, Machine Learning in Dialog- Recurrent NNs, Attention, Transformers

Unit 2

Automatic Speech Recognition, Foundation models for spoken language-Using the Speech Brain ASR toolkit, Advanced ASR

Unit 3

Text to Speech (TTS): Overview. Text normalization, Spectrogram prediction, Vocoding, TTS, Evaluation.

Text Books / References

Dan Jurafsky and James H. Martin. *Speech and Language Processing*, (3rd ed. draft), available at <https://web.stanford.edu/~jurafsky/slp3/>

Yoav Goldberg. *A Primer on Neural Network Models for Natural Language Processing*. Available at <https://u.cs.biu.ac.il/~yogo/nlp.pdf>

Ian Goodfellow, Yoshua Bengio, and Aaron Courville. *Deep Learning*. MIT Press. Available at <https://www.deeplearningbook.org/>

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID434	Robotics Vision	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- This course introduces the geometry of image formation and its use for 3D reconstruction and calibration.
- This course introduces the analysis of patterns in visual images that are used to reconstruct and understand objects and scenes.

Course Outcomes

After completing this course, students will be able to

CO1	Apply image formation and camera calibration for various applications.
CO2	Analyze and select image features and apply for image matching.
CO3	Develop image recognition algorithms
CO4	Develop stereo vision applications for distance estimation.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															

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CO1	3	3	2	-	2	2	1	1	1	-	-	-	-	-	-
CO2	3	3	2	3	3	3	2	1	2	1	-	-	-	-	-
CO3	3	3	3	3	3	3	2	3	3	2	-	-	-	-	-
CO4	3	3	1	2	3	2	1	1	1	1	-	-	-	-	-

Syllabus

Unit 1

Introduction, Image Formation – geometric primitives and transformations, photometric image formation, digital camera, Camera calibration. Edge Detection, Segmentation.

Unit 2

Feature Detection and Matching – points and patches, edges, lines, Feature-Based Alignment - 2D, 3D feature-based alignment, pose estimation, Image Stitching, Dense motion estimation – Optical flow - layered motion, parametric motion, Structure from Motion.

Unit 3

Recognition – object detection, face recognition, instance recognition, category recognition, Stereo

Correspondence – Epipolar geometry, 3D reconstruction.

Text Books / References

Szeliski R. Computer Vision: Algorithms and Applications Springer. New York. 2010..

Shapiro LG, Stockman GC. Computer Vision: Theory and Applications. 2001.

Forsyth DA, Ponce J. Computer Vision: a modern approach;2012.

Davies ER. Machine vision: theory, algorithms, practicalities. Elsevier; 2004 Dec 22.

Jain R, Kasturi R, Schunck BG. Machine vision. New York: McGraw-Hill; 1995 Mar 1

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID435	Mobile Robotics	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- This course aims to provide students with a comprehensive understanding of the underlying principles and technologies used in designing, implementing, and controlling autonomous mobile robots.
- This course seeks to equip students with practical skills in perception and control of mobile robots, including sensing and estimation, basic and advanced control techniques, and sensor fusion and localization.
- This course intends to introduce students to advanced topics in mobile robotics, such as path planning and navigation, motion planning and control, multi-robot systems, and human-robot interaction, providing them with the knowledge necessary to develop and implement cutting-edge mobile robotic applications.

Course Outcomes

After completing this course, students will be able to

CO1	Design autonomous mobile robot systems using the fundamental principles and technologies.
CO2	Apply perception and control techniques to mobile robotics, to solve real-world mobile robotic challenges.
CO3	Use advanced techniques in mobile robotics to design mobile robotic systems that can operate in complex and dynamic environments.
CO4	Analyze the capabilities and limitations of mobile robotic systems in the light of potential impact on society and various industries.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	3	2	3	2	2	2	3	3	-	2	2	1	-
CO2	3	3	3	2	3	2	2	2	3	3	-	2	2	2	1
CO3	3	3	3	3	3	2	2	2	3	3	-	2	2	2	2
CO4	3	3	3	3	3	3	2	3	3	3	-	2	2	2	3

Syllabus

Unit 1: Introduction to Mobile Robotics

Introduction to Mobile Robotics, Brief history of Mobile Robotics, Overview of Mobile Robotics applications, Locomotion Systems in Mobile Robotics, Sensors in Mobile Robotics.

Unit 2: Perception and Control

Perception: Sensing and Estimation, Control: Basic and Advanced Techniques, Sensor Fusion and Localization, Mapping and SLAM (Simultaneous Localization and Mapping).

Unit 3: Advanced Topics in Mobile Robotics

Path Planning and Navigation, Motion Planning and Control, Multi-robot Systems, Human-Robot Interaction.

Text Books / References

Siegwart R, Nourbakhsh IR, Scaramuzza D. Introduction to autonomous mobile robots. MIT press; 2011.

Nehmzow U. Mobile robotics: a practical introduction. Springer Science & Business Media; 2012.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

Course Objectives

- This course aims to introduce students to the fundamentals of artificial intelligence and machine learning techniques and their applications to robotics, including perception, planning, and control.
- This course will help students understand the challenges involved in applying AI and machine learning techniques to robotics and develop the ability to design and implement intelligent robotics systems.
- This course will provide students with the knowledge and skills required to apply deep learning algorithms to robotics problems, including object recognition, motion planning, and robot control.

Course Outcomes

After completing this course, students will be able to

CO1	Apply machine learning and deep learning algorithms to solve robotics problems.
CO2	Design intelligent agents that can perceive and act in different environments.
CO3	Evaluate different robotics and AI applications and identify their strengths and weaknesses.
CO4	Implement deep learning models for robotics tasks.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	1	3	-	-	2	3	2	-	2	3	3	2
CO2	3	3	1	1	3	1	-	-	3	3	-	2	3	3	3
CO3	3	3	3	2	3	2	2	2	3	3	-	2	3	3	3
CO4	3	3	3	2	3	-	-	-	3	3	-	2	3	3	2

Syllabus

Unit 1: Introduction to AI for Robotics

Overview of AI for robotics, Robotics components and their interactions, Sensing and perception in robotics, Planning and decision-making in robotics, Control systems and robotics.

Unit 2: Machine Learning for Robotics

Supervised learning and its applications in robotics, Unsupervised learning and its applications in robotics, Reinforcement learning and its applications in robotics, Transfer learning in robotics

Unit 3: Deep Learning for Robotics

Neural networks and deep learning, Convolutional Neural Networks for Perception in Robotics, Recurrent Neural Networks for Robotics Planning, Deep Reinforcement Learning for Robotics Control

Text Books / References

Govers, F. X. *Artificial Intelligence for Robotics*. Packt Publishing; 2018

Nehmzow U. *Mobile robotics: a practical introduction*. Springer Science & Business Media; 2012.

P. Corke, *Robotics, Vision, and Control*, Springer, 2011.

P. Antsaklis and K. Passino, *An Introduction to Intelligent and Autonomous Control*, Kluwer, 1993.
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D. Kortenkamp, R. Bonasso, and R. Murphy, ed., *Artificial Intelligence and Mobile Robots*, AAAI Press, 1998.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID441	Introduction to Biomedical Informatics	L-T-P-C: 2- 0 -2- 3
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Course Objectives

- The course is aimed at educating students on the basic concepts and techniques of AI
- This would cover the methods of collecting, cleaning, and preparing biomedical data before processing.
- Introduced different methods for feature set optimization and handling imbalanced biomedical data.
- Describe the role of biomedical informatics in clinical decision-making and the design of clinical decision support systems.

Course Outcomes

After completing this course, students will be able to

CO1	Application of AI and ML to biomedical problems.
CO2	Application data acquisition, integration, retrieval, and manipulation.
CO3	Develop knowledge on different biomedical area, like public health informatics, clinical trials, agro informatics, nutri informatics etc.
CO4	Develop skill to initiate collaborative research with interdisciplinary teams to develop innovative solutions to real-world problems in biomedical informatics using AI techniques and tools.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	2	3	2	3	3	2	-	3	2	-	3	3	-	-
CO2	3	2	3	2	3	3	2	-	3	2	-	3	-	3	2
CO3	3	2	3	2	3	3	2	-	3	2	-	3	-	3	2
CO4	3	2	3	2	3	3	2	-	3	2	-	3	-	2	3

Syllabus

Unit 1

Introduction to Biomedical Informatics – different biomedical data and databases – methods of data integration of heterogenous data – data retrieval and acquisition - Querying biomedical databases using SQL – heterogeneous data standardization.

Unit 2

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Application of data mining and AI techniques in biomedical information – Querying biomedical databases using SQL- Biomedical Imaging Informatics.

Unit 3

Clinical Informatics and Electronic Health Record Systems – AI and mathematical model in clinical trial – community and population health - tackles disease treatment and prevention.

Unit 4

Agro informatics - nutri informatics - ethics of AI in biomedical informatics

Text Books / References

Biomedical Informatics: Computer Applications in Health Care and Biomedicine" by Edward H. Shortliffe and James J. Cimino

"Statistical Methods for Clinical Trials" by J. Rick Turner

"Agro-Informatics and Precision Agriculture" by Manoj Karkee, Qin Zhang, and Shrinivasa K. Upadhyaya

"Public Health Informatics and Information Systems" by J.A. Magnuson and P.G. Fu

Johnson, K. B., & Lorenzi, N. M. (2017). Health Informatics: An Interprofessional Approach. Mosby.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID442	CRISPR/Cas9 Technology	L-T-P-C: 2- 0 -2- 3
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Course Objectives

- The goal of this course is to cover the overview of the relevant background in crispr technology and high-throughput biotechnology, focusing on the available data and their relevance.
- It will then cover the ongoing developments with the focus on the applications of these methods to biomedical data.

Course Outcomes

After completing this course, students will be able to

CO1	Analyze and learn the discovery of Crisper with emphasis to molecular mechanisms.
CO2	Apply the basic concepts on various application of gene therapy.
CO3	Design familiar with experimental design.
CO4	create automated pipelines for identifying the associations between multiple genome editions.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	Amrita	Vishwa	Vidya	Deepa	Sham.	2	3	3		3	BT-C-AE	3		3	3 B.Tech Curriculum June 2021

CO2	3	3	3	2	3	3		3	3	3		3		3	2
CO3	3	3	3	2	3	3		3	3	3		3		3	2
CO4	3	3	3	2	3	3		3	3	3		3		2	3

Syllabus

Introduction to Genetic Engineering - History of Crispr – Crispr in bacteria – Classification of Crispr – General structure of cas9 protein – Mechanism of Crispr cas9 – Applications – Database of Crispr – Case studies.

Textbooks / References

Maximilian Haeussler, Jean-Paul Concordet, CRISPOR Manual, MIT, 2016. Singh et al: A Mouse Geneticist's Practical Guide to CRISPR Applications; Genetics, Vol.199, No.1, 2015.

Ran et al, Genome engineering using the CRISPR-Cas9 system, Nature Protocols, 2013.

Fujihara&Ikawaw, CRISPR/Cas9-Based Genome Editing in Mice by Single Plasmid Injection, Methods Enzymol. 2014.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (Minimum 2)	Internal	30
Quizzes (Minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID443	Introduction Molecular Modelling	L-T-P-C: 2- 0 -2- 3
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Course Objectives

- The course will lay down the basic concepts of computational techniques to analyse the coordinate systems in molecular construction.
- It will explore the concepts initially through basic formats to represent synthetic and biomolecules.
- It will provide an appreciation for the broad application of AI in drug design.
- Goal of the course is to provide a connection between the concepts of organic chemistry and simulation studies.

Course Outcomes

After completing this course, students will be able to

CO1	To develop an understanding of the basic concepts of Machine Learning Techniques in Computer Aided Drug Design.
CO2	To evaluate the suitability of molecular file formats in 2-D and 3-D analysis.
CO3	To connect the concepts of 2-D and 3-D Modeling of Synthetic and Biomolecules.
CO4	To evaluate the biologically active point of biomolecular confirmations.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	2	3				3	2	3	3	3	3	2
CO2	3	3	3	3	3	2			3	2	3	3	3	3	3

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CO3	3	2	3	3	3				3	2	3	3	3	2	3
CO4	3	3	3	2	3				3	2	3	3	3	3	3

Syllabus

Introduction – Structure – Properties - Molecular Formats – SMILES - SMART – Mol – SDF - InChi – Molecular Representation – Chemschetch – Chemistry -42 – Automated De Novo Design – Scalable Engineering of Chemistry - Databases – Pubchem – Drug Bank – ZINC – ADME Constrains – Forcefields – Molecular Mechanics – Quantum Mechanics - Configurations – Boundaries - Confirmations – QSAR – Hansch Equation – Free Wilson Method – CoMFA – CoMSIA – Ligand – Based Drug Design –Molecular Annotation- Pharmacopore – Structure-Based Drug Design - Free-Energy Binding Analysis – 3-D Modeling – Proteins – Pharma AI – Panda Omics: Disease-Target Identification – Synthetic Biology – Prediction – In Clinico: Clinical Outcomes – Chemistry 42: Novel Lead Molecules -Virtual Screening – Docking – MD Simulation.

Textbooks / References

K. Raman (2021) An Introduction to Computational Systems Biology: Systems-Level Modelling of Cellular Networks, Chapman and Hall/CRC, Boca Raton, FL.

Voit E (2012) A First Course in Systems Biology, Garland Science.

Klipp E (2009) Systems Biology, A Textbook, Wiley-VCH.

Newman MEG (2011), "Networks: An Introduction", Oxford University Press.

Weblink: <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/computer-aided-drug-design>

Weblink: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5248982/>

Weblink: <https://jcheminf.biomedcentral.com/articles/10.1186/s13321-019-0351-x>

Weblink: <https://www.frontiersin.org/articles/10.3389/fchem.2018.00057/full>

Weblink: <https://insilico.com/chemistry42>

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID444	Transcriptomics, Proteomics and Metabolomics	L-T-P-C: 2- 0 -2- 3
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Course Objectives

- Introduce students to using artificial intelligence (AI) in transcriptomics, proteomics, and metabolomics research, including machine learning algorithms, data mining techniques, and other computational approaches.
- Teach students how to apply AI techniques to analyse and interpret omics data, including genomic, transcriptomic, proteomic, and metabolomic data, and integrate data from multiple omics platforms.
- Foster students' ability to critically evaluate the strengths and limitations of AI-based approaches in omics research and understand the importance of validation and reproducibility in scientific research.

CO1	Application of AI in omics research.
CO2	Develop the ability to integrate data from multiple omics platforms using AI-based approaches.
CO3	Identify limitations of existing AI-based software tools and overcome the computational limitations of models
CO4	Develop critical thinking and problem-solving skills (real-world problems in biomedical, agriculture etc.) to design and carry out experiments in transcriptomics, proteomics, and metabolomics and analyse and interpret the resulting data.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	1	-	-	2	2	-	1	-	-	-	3	2	-	-
CO2	3	3	3	2	3	2	1	1	2	2	2	3	3	3	2
CO3	3	3	3	2	3	2	1	1	3	2	2	3	2	2	3
CO4	3	3	3	3	3	2	1	1	3	2	3	3	-	2	2

Syllabus

Unit 1

Overview of omics technologies (transcriptomics, proteomics, metabolomics) - history and evolution of omics technologies – the importance of application of AI omics research – the role of omics research in biological research.

Unit 2

Gene expression profiling using microarrays and RNA sequencing - transcriptomics data analysis using bioinformatics tool and AI-based methods - functional annotation of transcripts and pathways - alternative splicing analysis - single-cell transcriptomics and spatial transcriptomics.

Unit 3

Protein separation and identification using mass spectrometry - quantitative proteomics and label-free quantification - proteome analysis using bioinformatics tools and AI-based algorithm - proteins and pathways - protein-protein interactions and network analysis - structural proteomics and protein modifications.

Unit 4

Metabolite identification and quantification using mass spectrometry and NMR - metabolite profiling and metabolic pathway analysis - metabolomics data analysis using bioinformatics tools and AI-based algorithms - metabolic flux analysis and isotopic labelling - metabolomics in systems biology and synthetic biology - metabolomics in disease diagnosis and drug discovery.

Unit 5

Multi-omics data integration and analysis - correlation and causation analysis - AI-based predictive models - biomarker discovery and validation - AI-based method to analyse biomarker data – the future direction of omics research with AI.

Text Books / References

"Transcriptomics and Gene Regulation" by Simon Tavaré and Nancy R. Zhang

"Proteomics: Methods and Protocols" edited by Daniel J. Liebler

"Metabolomics: From Fundamentals to Clinical Applications", edited by Ute Roessner and J. Cameron Thrash

"Integrated Omics Analysis: Methods and Applications" edited by Andrew J. Percy and David S. Wishart

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"Transcriptome Analysis: Methods and Applications" edited by Vinita Chauhan, Rakesh Sharma, and Debmalya Barh

"Proteomics in Systems Biology: Methods and Protocols" edited by Daniel J. Kliebenstein

"Metabolomics in Practice: Successful Strategies to Generate and Analyze Metabolic Data" by Michael Lammerhofer and Wolfram Weckwerth Recent literature

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID445	Introduction to High-Performance Computing	L-T-P-C: 2- 0 -2- 3
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Course Objectives

- Familiarize student with architectural overview of modern HPC and GPU based heterogeneous architectures, focusing on its computing power versus data movement needs.
- Familiarise the students working with cloud platforms and services to configure and use computational resources and storage.
- To educate students how to write efficient parallel programming and GPU programming.
- To discuss various application of HPC computational techniques in computational science.

Course Outcomes

After completing this course, students will be able to

CO1	Apply high-performance computing in different research field.
CO2	Design OpenMPI programme and CUDA programme
CO3	Simulate on cloud computing system.
CO4	Evaluate how the convergence of HPC and AI is transforming the data science.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	2	-	2	2	3	2	-	-	2	1	3	1	1	-
CO2	2	3	3	3	3	-	1	-	2	1	2	3	3	3	1
CO3	2	2	3	2	3	1	1	-	2	1	2	3	2	2	1
CO4	2	2	1	2	3	2	1	1	2	1	2	3	3	3	3

Syllabus

Unit 1

Introduction to basic architecture and OS concepts - multi-core CPUs - high-speed interconnects - overview of High-Performance Computing (HPC) and its importance - hardware and software requirements for HPC - parallel programming and their applications (MPI/OpenMP) – brief introduction to workload manager and job schedulers.

Unit 2

Overview of GPU architecture and its evolution - comparison of CPU and GPU architecture - introduction to CUDA programming and its basic concepts - optimizing CUDA kernels for maximum performance - advanced CUDA programming techniques, such as shared memory, constant memory, and texture memory - introduction to cuBLAS and cuDNN libraries for linear algebra and deep learning - case studies of GPU: accelerated applications in scientific computing, data analytics, and machine learning.

Unit 3

Definition of cloud computing and its importance - Benefits and challenges of cloud computing - types of cloud services (IaaS, PaaS, SaaS) and their characteristics - cloud computing architecture and its components - cloud storage and its types - cloud networking and its challenges - cloud security and its importance - cloud application - benefits and challenges of HPC and AI - synergy between HPC and AI - training and inference of AI models using HPC.

Text Books / References

"High Performance Computing: Modern Systems and Practices" by Thomas Sterling and Matthew Anderson

"CUDA by Example: An Introduction to General-Purpose GPU Programming" by Jason Sanders and Edward Kandrot

"Parallel Programming with MPI" by Peter S. Pacheco

Comer, D. (2021). *The Cloud Computing Book: The Future of Computing Explained*. CRC Press

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2 Assignments)	Internal	20
Quiz (minimum 2 Quizzes)	Internal	20
Min Project	Internal	20
Mid. Term Periodical	Internal	10
End Semester Exam (Theory and Practical)	External	30

23AID446	Genomics Data Science	L-T-P-C: 2- 0 -2- 3
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Course Objectives

- Provide a strong foundation in genomics.
- Teach computational and statistical tools for analysing large-scale genomics data, gene sequence and expression analysis.
- Familiarize students with the tools, algorithm, data structure and principles of contemporary genomics (DNA sequencing, cancer genomics, single-cell sequencing and next-generation sequencing etc.)
- Introduced Python and R for DNA sequencing.

Course Outcomes

After completing this course, students will be able to

CO1	Design sequence assembly in Genomics Data Science.
CO2	Develop the ability to apply advanced computational methods to analyse genomics data.
CO3	Develop the ability to identify the main results from a genomics research study and interpret figures from primary research papers.
CO4	Analyse genomics data and design simulation experiments and interpret results.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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CO															
CO1	3	3	3	3	3	2	1	-	2	-	1	3	3	-	-
CO2	3	3	3	3	3	2	1	-	2	-	1	3	3	3	2
CO3	3	3	3	3	3	2	-	-	2	-	-	3	2	3	2
CO4	3	3	3	3	3	2	1	-	2	-	-	3	-	2	3

Syllabus

Unit 1

Introduction to genomics – functional genomics – gene – different genomics experimental technology (next-generation sequencing, CRISPR/Cas9 etc.) – programming in R

Unit 2

Data cleaning and processing – sequence alignment for gene analysis – gene expression analysis – differential gene expression – Pathway analysis and functional annotation – machine learning in genomics.

Unit 3

Comparative genomics – epigenomics – metagenomics – pharmacogenomics – gene regulatory network analysis.

Unit 4

Precision medicine and personalised genomics – Cancer genomics and analysis – Infectious disease genomics and analysis

Text Books / References

“Bioinformatics: Sequence and Genome Analysis” by David Mount

“Genomics and Personalized Medicine: What Everyone Needs to Know” by Michael Snyder

“Practice Computing for Biologists” by Steven Haddock and Casey Dunn

“Bioinformatics and Functional Genomics” by Jonathan Pevsner

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID447	AI in system biology	L-T-P-C: 2- 0 -2- 3
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Course Objectives

- The goal of this is to cover the basic concept and principles of artificial intelligence and their application in field system biology.
- Explore AI and other computational methods to analyse biological networks and complex biological systems.
- Explore enzyme kinetics, metabolic pathway, flux balance analysis and signal transduction.
- Cover mathematical, statistical and dynamics modelling of biological networks.

Course Outcomes

After completing this course, students will be able to

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CO1	Analysis biological networks
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CO2	Develop the ability to apply ML/DL techniques to understand and analyse biological networks, signal transduction, metabolic network, and gene regulatory network in physiology and pathology.
CO3	Design and simulate network-based mathematical and statistical models.
CO4	Develop pipelines for biochemical pathway analysis based on recent Omics studies and AI developments.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	2	3	-	-	-	3	2	3	3	3	-	-
CO2	3	3	3	3	3	2	-	-	3	2	3	3	-	3	2
CO3	3	2	3	3	3	-	-	-	3	2	3	3	-	3	2
CO4	3	3	3	2	3	-	-	-	3	2	3	3	-	2	3

Syllabus

Unit 1

Introduction to complex systems - cell signalling – metabolic network – experimental technologies - network building analysis - enzyme kinetics – metabolic analysis – flux balance analysis

Unit 2

Modelling, construction and simulation of the biological network using AI - dynamic modelling of biological systems – network structure analysis using AI– ML/DL algorithm to design gene circuit

Unit 3

Modelling the behaviour of single cells using AI – AI accelerated cell and gene therapy – AI to analyse cryo-electron tomogram.

Unit 4

Ethical and legal considerations of AI in System biology - Future directions and opportunities for AI in Biotechnology

Text Books / References

Raman K (2021) An Introduction to Computational Systems Biology: Systems-Level Modelling of Cellular Networks. 1/e ISBN 9781138597327 (Chapman and Hall/CRC)

Voit E (2012) A First Course in Systems Biology. Garland Science, 1/e. ISBN 081534467 Recent literature

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

Course Objectives

- To educate students on fundamentals stages of drug discovery pipeline and how computational and informatics techniques can accelerate the pace of drug discovery.
- To teach them how to encode a molecule into numerical molecular descriptors and strings, allowing computational treatment of molecules.
- Discuss drug-likeness, informatics approaches to the prediction of chemical properties - QSAR, pharmacophores, pharmacokinetics, and pharmacodynamics.
- To teach them how to apply AI / ML techniques and construct validated classification and regression models for biological endpoints.

Course Outcomes

After completing this course, students will be able to

CO1	Explain the drug discovery pipeline and the role of computational drug discovery in the process.
CO2	Construct SMILES Representations of Molecular Structures
CO3	Extract chemical information from Molecular Structures in different chemical file formats.
CO4	Compute different kinds of Molecular Descriptors and Fingerprints, and construct similarity kernels from them.
CO5	Construct validated Classification and Regression models for pharmacological endpoints and evaluate model performance and Domain of Applicability.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	-	-	2	2	3	-	1	1	1	-	-	2
CO2	2	3	3	-	2	-	-	-	-	1	-	1	2	-	-
CO3	2	3	3	-	2	-	-	-	-	1	-	1	2	-	-
CO4	3	2	2	2	3	-	-	1	1	-	-	2	2	2	-
CO5	2	1	3	3	3	-	-	1	1	1	-	2	3	3	2

Syllabus

Unit 1

Why Computational Drug Design? The Drug Discovery pipeline; Chemical Space; Cheminformatics and Virtual High Throughput Screening; Lipinski's Rules of 5 and ADMET Modelling; Pharmacodynamics and pharmacokinetics; Structure-Based and Ligand-Based Drug Design.

Unit 2

Chemical File Formats and Representations; Topological Indices; Substructural Descriptors and 2D fingerprints; Local Molecular Surface Property Descriptors; 3D Shape and Chiral descriptors; Molecular Similarity Measures and Kernels; Chemical and Biological Networks.

Unit 3

Linear Free Energy Relationships; Pharmacophores and Molecular Interaction Fields; Model Validation; Structure Based Methods - Docking & Scoring; Molecular Simulation (Monte-Carlo, Molecular dynamics) – Structure and dynamics properties (normal mode analysis) – Gaussian and Gauss view – Density functional theory.

Unit 4

Linear and Non-Linear Models; Classification, Regression and Ranking; Data preprocessing, Performance Measures and unbalanced datasets; Dimensionality reduction and Feature selection; Evolutionary computing; Kernel methods; Best Practices in Predictive Modeling; Applications of Deep Learning in Pharma.

Text Books / References

Johann Gasteiger, Thomas Engel, *Chemoinformatics: A Textbook* (Wiley-VCH, 2003)

Jürgen Bajorath (Editor), *Chemoinformatics and Computational Chemical Biology (Methods in Molecular Biology)* (Humana Press, 2004)

Andrew R. & Leach, Valerie Gillet, *An Introduction to Chemoinformatics* (Springer International, New Delhi, 2009)

Merz Jr, K.M., Ringe, D. and Reynolds, C.H. (Editors) *Drug design: structure-and ligand-based approaches* (Cambridge University Press, 2010).

N. Sukumar, et al, *Computational Drug Discovery: A Primer* (Ion Cure Press, 2023).

John L. Lamattina, *Drug Truths: Dispelling the Myths about Pharma R&D* (John Wiley, Hoboken, NJ, 2008)

Barry Werth, *The Billion Dollar Molecule: One Company's Quest for the Perfect Drug* (Simon & Schuster, 1995)

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID451	Applied Cryptography	L-T-P-C: 2- 0 -2- 3
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Course Objectives

- To understand the underlying fundamentals of classical and modern cryptography
- To understand about the cryptographic systems used over the Internet.
- To help the students to study cryptographic protocols, common attacks and their prevention.

Course Outcomes

After completing this course, students will be able to

CO1	Analyze the concepts of classical and modern cryptography.
CO2	Analyze the common attacks and the preventive systems.
CO3	Apply appropriate cryptographic techniques to a security engineering problem
CO4	Implement standard security protocols.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	2	-	-	-	-	2	2	-	3	2	2	1
CO2	3	3	3	3	-	-	-	-	2	2	-	3	1	2	1

CO3	3	2	3	3	1	-	-	-	2	2	-	3	2	2	1
CO4	3	2	3	3	-	-	-	-	2	2	-	3	1	2	1

Syllabus

Unit 1

Number theory concepts – Divisibility, GCD, modular exponential, congruence, Chinese remainder theorem. Groups, rings, fields.

Unit 2

Overview of Cryptography, Symmetric key cryptography, stream ciphers, block ciphers, DES and Enhancements, AES, Attacks on block ciphers, Message integrity- Message integrity: definition and applications. Hashing, collision resistance. Public key cryptography- Arithmetic modulo primes, Cryptography using arithmetic modulo primes, Public key encryption Arithmetic modulo composites, RSA, Attacks on RSA, Rabin Cryptosystem, Discrete Logarithm Problem and related Algorithms, ElGamal Cryptosystem

Unit 3

Introduction to Elliptic Curve Cryptography, Digital signatures: definitions and applications, More signature schemes and applications, Identification protocols, Authenticated key exchange and SSL/TLS session setup, Zero knowledge protocols. Key agreement protocols, Diffie-Hellman protocol, variations.

Text Books / References

James Strayer, Elementary Number Theory, Waveland Press, 2002.

Katz, Jonathan, and Yehuda Lindell. Introduction to modern cryptography. Chapman and Hall/CRC, 2014

Katz, Jonathan, Alfred J. Menezes, Paul C. Van Oorschot, and Scott A. Vanstone. Handbook of applied cryptography. CRC press, 1996.

Stallings, William. Cryptography and network security: principles and practice. Upper Saddle River: Pearson, 2017.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID452	Network and Wireless security	L-T-P-C: 2- 0 -2- 3
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Course Objectives

- To understand the various techniques for network protection.
- To gain knowledge on security and privacy issues on various networks.
- To study the use of modern tools and techniques used in analysing various security parameters of the network.

Course Outcomes

After completing this course, students will be able to

CO1	Analyse the network security protocols and standards.
CO2	Evaluate the various network security threats.
CO3	Apply modern tools to simulate network attacks.

CO4	Interpret the ethical aspects of network security.
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CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	2	3	-	-	-	2	2	-	3	1	2	1
CO2	3	3	3	3	3	-	-	-	2	2	-	3	2	2	1
CO3	3	2	3	3	3	-	-	-	2	2	-	3	2	2	1
CO4	3	2	3	3	3	-	-	-	2	2	-	3	1	2	1

Syllabus

Unit 1

Overview of network security principles, concepts, and terminology. Threats to network security, including attacks on confidentiality, integrity, and availability. Network security goals and objectives. IP tables, NAT. Intrusion detection systems, Types. Honeypots.

Unit 2

Network protocols and standards, SSL, TLS, IPsec, HTTPS. Wireless network architecture and protocols, Security risks and threats in wireless networks, Wireless security standards, including WPA and WPA2. Mobile security architecture, Mobile device security risks and threats, Mobile security standards, including iOS and Android.

Unit 3

Common network attacks. Wireshark, packet sniffing. LAN attacks, ARP cache spoofing, ettercap. Analysing network vulnerability using NMAP. Use of metasploit and metasploitable to perform common attacks over the network. Usage of aircrack-ng suite. Legal issues in network security, cyber crime and cyber law. Ethical issues in network security, privacy and intellectual property rights.

Text Books / References

William Stallings, Cryptography and Network Security: Principles and Practice, 8th Edition, Pearson edition, 2020.

Behrouz A. Forouzan, Cryptography & Network Security, McGraw-Hill, 3rd Edition 2015.

Jeremy Faircloth, Penetration Tester's Open Source Toolkit, 4th Edition, 2016.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

Course Objectives

- This course helps the students to understand the basics of intrusion detection and prevention systems, including concepts of intrusion detection, types of intrusions, vulnerabilities, and threats.
- This course helps the students to learn the different types of intrusions and their potential impacts.
- This course also provides methods to explore different techniques and methodologies for intrusion detection and prevention.
- This course will help students to gain practical experience with popular intrusion detection and prevention systems.

Course Outcomes

After completing this course, students will be able to

CO1	Analyze the characteristics of various network attacks and select appropriate intrusion detection and prevention techniques to mitigate the associated risks.
CO2	Configure open-source intrusion detection and prevention systems to detect and prevent network attacks
CO3	Implement machine learning and deep learning models for detecting intrusions
CO4	Analyze the effectiveness of intrusion detection and prevention systems

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	1	1	-	-	2	2	-	2	-	-	-	1	1	2	1
CO2	1	1	1	1	3	2	-	2	-	-	-	2	1	-	1
CO3	3	2	2	2	3	2	-	2	-	-	-	2	3	2	1
CO4	1	1	-	-	1	1	-	1	-	-	-	1	-	1	1

Syllabus

Unit 1

Introduction to Intrusion Detection and Prevention Systems - Overview of Intrusion Detection and Prevention Systems - Types of Intrusions - Goals and Requirements of Intrusion Detection and Prevention Systems - Differences between IDS and IPS

Unit 2

Network Security Fundamentals - Network Security Basics - OSI Reference Model - TCP/IP Protocol Suite - Network Security Threats - Network-Based IDS - NIDS Architecture - NIDS Detection Techniques - Snort: An Open Source NIDS - Snort Rules - Host-Based IDS - HIDS Architecture - HIDS Detection Techniques - OSSEC: An Open Source HIDS - OSSEC Rules - Anomaly Detection - Anomaly Detection and Classification - Machine Learning Techniques for Anomaly Detection

Unit 3

Intrusion Prevention Systems - IPS Architecture and Mechanisms - Signature-Based IPS - Behavior-Based IPS

Text Books / References

Ali A. Ghorbani, Wei Lu, "Network Intrusion Detection and Prevention: Concepts and Techniques", Springer, 2010.

Carl Enrolf, Eugene Schultz, Jim Mellander, "Intrusion detection and Prevention", McGraw Hill, 2004
 Amrita Vishwa Vidyapeetham. BTC-AIE B.Tech Curriculum June 2021

Paul E. Proctor, "The Practical Intrusion Detection Handbook ", Prentice Hall, 2001.

Ankit Fadia and Mnu Zacharia, "Intrusion Alert", Vikas Publishing house Pvt., Ltd, 2007.

Earl Carter, Jonathan Hogue, "Intrusion Prevention Fundamentals", Pearson Education, 2006.

Rafeeq Ur Rehman. Intrusion detection systems with Snort: advanced IDS techniques using Snort, Apache, MySQL, PHP, and ACID. Prentice Hall Professional, 2003.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID454	Software Vulnerability Analysis	L-T-P-C: 2- 0 -2- 3
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Course Objectives

- This course teaches software engineering techniques for building security into software as it is developed.
- This course introduces students to the discipline of designing, developing, and testing secure and dependable software-based systems.
- This course provides hands on experience in software security analysis and development
- This course helps students to learn how to mitigate software vulnerabilities through secure software development practices

Course Outcomes

After completing this course, students will be able to

CO1	Analyse the security risk of a system under development.
CO2	Apply secure coding practices to prevent common vulnerabilities from being injected into software.
CO3	Design security requirements (which include privacy requirements).
CO4	Validate security requirements.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	2	1	2	1	2	2	-	2	-	-	-	2	-	2	1
CO2	1	2	2	3	3	2	-	1	-	-	-	2	1	1	-
CO3	1	2	3	2	3	2	-	1	-	-	-	2	-	1	-
CO4	-	1	-	-	1	2	-	2	-	-	-	2	-	2	-

Syllabus

Unit 1

Introduction to Software Vulnerability Analysis - Overview of software vulnerabilities - Importance of vulnerability analysis in software development - Types of Software Vulnerabilities

Unit 2

Common types of software vulnerabilities - Code Injection vulnerabilities - Authentication and Authorization vulnerabilities - Input Validation vulnerabilities - Static Analysis - Source code analysis techniques - Dynamic Analysis - Types of dynamic analysis techniques - Binary Analysis - Overview of binary analysis - Reverse engineering techniques

Unit 3

Mitigation Strategies - Overview of software security mitigation strategies - Secure coding practices - Input validation and output encoding - Security testing and verification techniques - Security standards and best practices

Text Books / References

Anley, Chris, John Heasman, Felix Lindner, and Gerardo Richarte. *The shellcoder's handbook: discovering and exploiting security holes*. John Wiley & Sons, 2011.

Takanen, Ari, Jared D. Demott, Charles Miller, and Atte Kettunen. *Fuzzing for software security testing and quality assurance*. Artech House, 2018.

Sikorski, Michael, and Andrew Honig. *Practical malware analysis: the hands-on guide to dissecting malicious software*. no starch press, 2012.

Dowd, Mark, John McDonald, and Justin Schuh. *The art of software security assessment: Identifying and preventing software vulnerabilities*. Pearson Education, 2006.

McGraw, Gary. "Software security." *Building security in*, Addison-Wesley Professional, 2006.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID455	Cybercrime Investigations & Digital Forensics	L-T-P-C: 2 0 2 3
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Course Objectives

- To provide overview of global reach of the Internet and various cybercrimes in various domains.
- This course provides an overview of cybercrime and the digital law enforcement practices put in place to respond to them.
- The course will focus on the types and extent of current cyber-crimes, how the justice system responds to these crimes, the various constitutional protections afforded to computer users, the law and policies that govern cybercrime detection and prosecution, and related technologies.

Course Outcomes

After completing this course, students will be able to

CO1	Enable the student to define and describe the nature and scope of cybercrime.
CO2	Develop knowledge of major incidents of cybercrime and their resulting impact.
CO3	Facilitate the student to analyse and discuss national and global digital law enforcement efforts
CO4	Evaluate the specific AI and ML enabled technology that facilitates cybercrime and digital law enforcement

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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CO															
CO1	2	1	2	2	3	3		3		1		3			2
CO2	2	2	3	2	3	3		3		2		3			2
CO3	2	3	3	2	3	3	2	3	3	2	2	3		2	2
CO4	3	1	3	2	3	2	1	3	2	1	1	1		2	3

Syllabus

Introduction to cybercrime, criminal law, courts, and lawmaking, Types of computer-related crimes, Sources of cybercrime law (substantive and procedural), Technology, cybercrime, and police investigations, Technology and crime, Cyber deviance, cybercrime, and cyber terror, Computer misuse crimes, Malware and automated computer attacks, Malware, DDoS attacks, and Botnets, Digital piracy and Intellectual property theft, Digital piracy, Copyright, trademark, and trade secrets, Pornography, prostitution, and sex crime, The Fourth Amendment, computers, and computer networks, Digital/Computer Forensics -Introduction to digital and computer forensics, Legal issues related to digital investigations, National security and international.

Text Books / References

Thomas J. Holt, Adam M. Bossler, and Kathryn C. Seigfried-Spellar. 2022. Cybercrime and Digital Forensics: An Introduction. Third Edition New York: Routledge. ISBN: 978-0367360078.

Thomas J. Holt, Adam M. Bossler, and Kathryn C. Seigfried-Spellar. 2017. Cybercrime and Digital Forensics: An Introduction. Second Edition New York: Routledge. ISBN: 978-0367360078.

Nate Anderson. 2014. The Internet Police: How Crime Went Online, and the Cops Followed. New York: W.W. Norton & Company, Inc. ISBN: 978-0393349450.

Peter Grabosky. 2016. Cybercrime. Oxford/New York: Oxford University Press. ISBN: 978-0190211554. Kevin F. Steinmetz. 2016. Hacked: A Radical Approach to Hacker Culture and Crime. New York: New York University Press. ISBN: 978-1479869718.

Orin S. Kerr. 2013. Computer Crime Law (3ded.). St. Paul: Thomsen Reuters. ISBN: 978-0314281364. Susan W. Brenner. 2012. Cybercrime and the Law: Challenges, Issues, and Outcomes. Lebanon, NH: Northeastern University Press. ISBN: 978-1555537999.

Ralph D. Clifford. 2011. Cybercrime: The Investigation, Prosecution and Defense of a Computer-related Crime. Durham: Carolina Academic Press. ISBN: 978-1594608537.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

Course Objectives

- The emphasis will be on the techniques for creating functional, usable, and high-performance distributed systems.
- The course focuses on security in networks and distributed systems, and gives a short introduction to cryptography.
- The course covers threats against distributed systems, as well as applicable methods, technologies and standards to protect against these threats.

Course Outcomes

After completing this course, students will be able to

CO1	Understand the distributed systems and threats against distributed systems and how to protect against them
CO2	To have a foundation for designing and developing secure distributed systems, and for evaluating the security of existing solutions.
CO3	To have knowledge of standards, security protocols, technologies, principles, methods and cryptographic mechanisms applicable for securing modern distributed systems.
CO4	Design and Development of AI enabled distributed security systems.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	2	1	3	2	3	2	2		3	2	1	3			
CO2	2	2	3	2	3	2	2	1	3	2	1	3			
CO3	2	3	3	2	3	2	2	1	3	2	1	3			
CO4	3	2	2	2	2	2	2	3	2	1	1	2			

Syllabus

Understanding the Core Concepts of Distributed Systems -distributed systems designs, system constraints, trade-offs and techniques in distributed systems, distributed system for different data and applications, Distributed system security-Access and location transparency, Processes and Communication, naming, Parallelization of tasks - Concurrency and Synchronization, Consistency and Replication, Distributed system Security and network protocols – types of attacks, encryption algorithms, authentication, public key cryptosystems, data verification.

Text Books / References

Anderson, Ross. *Security engineering: a guide to building dependable distributed systems*. John Wiley & Sons, 2020.

Andrew S. Tannenbaum and Maarten Van Steen, “*Distributed Systems: Principles and Paradigms*”, Second Edition, Pearson, 2007.

Belapurkar, Abhijit, Anirban Chakrabarti, HarigopalPonnapalli, Niranjana Varadarajan, Srinivas Padmanabhuni, and Srikanth Sundararajan. *Distributed systems security: issues, processes and solutions*. John Wiley & Sons, 2009.

George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, “*Distributed Systems: Concepts and Design*”, Fifth Edition, Addison Wesley, 2011.

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID461	Fundamentals and Analysis of Power Systems	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- To familiarize with various components of power systems, including generators, transformers, transmission lines, distribution systems, and loads
- To perform load flow studies and how to simulate using software tools.
- To acquire knowledge about fault analysis and stability analysis
- Understand the fundamentals of power system protection and power quality

Course Outcomes

After completing this course, students will be able to

CO1	Identify and describe the various components of power systems, including generators, transformers, transmission lines, distribution systems, and loads.
CO2	Perform load flow analysis to determine the steady-state operating conditions of power systems and understand the flow of active and reactive power in the network.
CO3	Analyse fault conditions in power systems, calculate fault currents and voltages, and design appropriate protection schemes to ensure system safety and reliability.
CO4	Identify power quality issues such as voltage sag, swell, flicker, harmonics, and propose solutions to maintain the desired quality of power supply.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	2	2	3	1	-	-	3	2	3	3	2	1	1
CO2	3	3	3	3	3	3	-	3	2	3	3	3	2	3	2
CO3	3	2	3	3	3	2	2	-	3	2	3	3	2	2	3
CO4	3	3	3	3	2	2	2	-	3	2	3	3	3	1	2

Overview of power systems, types of power generation, power systems components, transmission lines, transmission line parameters, insulators, cables, grading, complex power calculations, power factor correction.

Unit 2 Load flow analysis and power system control

Load flow analysis, Gauss Siedel Method, Newton Raphson method, Fast decoupled method, load frequency control, automatic voltage regulator, MATLAB experiments on load flow and power system control.

Unit 3 Power system Protection, stability and security

Types of faults, symmetrical unsymmetrical faults, power system stability and dynamics, power quality, power system security, Assessment of stability, protection and quality using MATLAB and python

Textbooks / References

“Power System Analysis and Design” by J. Duncan Glover, Mulukutla S. Sarma, and Thomas J. Overbye, Cengage Learning (6th Edition), 2022

“Electric Energy Systems Theory - An Introduction” by O.I.Elgerd., McGraw-Hill, 1988.

“Power Systems Analysis” by A.R.Bergen and Vijay Vittal, Pearson Education Asia, 2001.

“Power System Stability and Control” by P.Kundur, Mc Graw Hill, 1994.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID462	Sustainable Energy Technologies	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- To understand global energy challenges and recognize the need for sustainable energy technologies as a solution
- To gain knowledge about renewable energy sources and understand their characteristics
- To familiarize energy storage technologies
- To analyse sustainable transportation solutions and energy management challenges

Course Outcomes

After completing this course, students will be able to

CO1	Able to describe the basic principles of sustainable energy technologies and their significance in addressing global energy challenge
CO2	Able to evaluate and categorize renewable energy source.
CO3	Able to familiarize energy storage technologies and its basic operations
CO4	Competent to understand basic concepts of smart grid, energy management and sustainable transportation options.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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CO															
CO1	3	3	2	2	3	1	-	-	3	2	3	3	2	1	1
CO2	3	3	3	3	3	3	-	3	2	3	3	3	2	3	2
CO3	3	2	3	3	3	2	2	-	3	2	3	3	2	2	3
CO4	3	3	3	3	2	2	2	-	3	2	3	3	3	1	2

Syllabus

Unit 1 Introduction to sustainable energy

Overview of global energy challenges and the need for sustainable energy technologies, Environmental influences of conventional energy sources, United Nations Framework Convention on Climate Change (UNFCCC) sustainable development. Definition and criteria for sustainable energy technologies.

Unit 2 Renewable Energy Sources

Solar Energy, Wind Energy, Biomass, Geothermal energy, Hydropower, Energy Storage Technologies like battery, pumped hydro storage and thermal energy storage.

Unit 3 Sustainable transportation, smart grid and energy management

Electric Vehicles: Battery Electric and Plug-in Hybrid Vehicles, Fuel Cell Vehicles and Hydrogen Infrastructure, Alternative Fuels: Biofuels, CNG, and Hydrogen, Introduction to Smart Grid Technologies, Demand Response and Energy Management Systems, Microgrids and Decentralized Energy Systems

Textbooks / References

“Energy and the Challenge of Sustainability, World Energy assessment, UNDP, NewYork 2000.

Thamas B Johansson et al, “Renewable Energy Sources for fuel and electricity”, Earthscan Publishers, London, 1993.

J W Twidell and A D Weir, “Renewable Energy Resources”, ELBS, 1998.

N K Bansal, M Kleemann and M Mellis, “Renewable Energy Resources and conversion Technology”, Tata McGraw Hill, 1990.

G N Tiwari, M K Ghosal, “Fundamentals of Renewable Energy Sources”, Narosa Publishing House.

Kastha D, Banerji S and Bhadra S N, “ Wind Electrical Systems”, Oxford University Press, New Delhi, 1998.

Tony Burton, David Sharpe, Nick Jemkins and Ervin Bossanyi., “Wind Energy Hand Book”, John Wiley & Sons, 2004.

Chetan S. Solanki, “Solar Photovoltaics: Fundamentals, Technologies and Applications”, Second Edition, PHI Publications, 2011.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

Course Objectives

- The course shall teach the students to analyse power system stability using both traditional and data-driven techniques.
- The course aims to enable students to understand and develop control strategies that can improve power system stability.
- By the end of the course, students should be able to simulate and analyse power system stability using synchronous machine models.
- The course intends to equip students with the critical thinking and problem-solving skills needed to tackle power system stability challenges.

Course Outcomes

After completing this course, students will be able to

CO1	Comprehend the fundamentals of power system stability
CO2	Apply mathematical modelling techniques to simulate power system stability
CO3	Familiarize and compare different techniques for improving power system stability
CO4	Apply data-driven techniques for power system stability analysis and improvement

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	2	2	-	1	1	1	2	-	-	-	-	2	1	-	-
CO2	2	3	2	2	2	1	2	-	-	-	1	2	3	-	2
CO3	2	3	2	2	2	1	1	-	-	-	1	2	2	-	2
CO4	2	3	3	2	2	1	2	-	-	-	1	2	3	-	3

Syllabus

Unit 1

Introduction to Power System Stability: Definition, types, and causes of power system instability - Overview of power system modelling - Synchronous generator models - Excitation system models - Governor models - Load models.

Unit 2

Power System Stability Analysis: Small-signal stability analysis - Transient stability analysis - Critical clearing time - Voltage stability - Basics of power system control

Unit 3

Improving Power System Stability: Power System Stabilizers - FACTS and HVDC systems for power system stability - Microgrids for power system stability - Data-driven Techniques for power system stability

Text Books / References

Prabha Kundur, Power System Stability and Control, 1998

John Grainger and William D. Stevenson Jr., Power System Analysis, 1994

Harry G. Kwatny, Karen Miu-Miller, Power System Dynamics and Control, 2016

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID464	Micro Grids	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- To enable students to identify and analyse the benefits and hurdles of Microgrids in various industries and applications.
- To equip students with the ability perform comparative analysis of different control strategies and energy management systems.
- To develop the skillset towards applying optimization techniques for modelling and analysing Microgrids to achieve optimal performance.
- To develop the knowledge and proficiency for incorporating AI and ML-based to Microgrid optimization and control problems

Course Outcomes

After completing this course, students will be able to

CO1	Gain a critical comprehension of Microgrid technology, comprising its structure, constituents, and usage.
CO2	Acquaint themselves with various control tactics and energy management systems for Microgrids.
CO3	Utilize optimization methods to design and evaluate Microgrids for attaining optimal performance
CO4	Assess and incorporate advanced areas in Microgrid optimization and control, involving artificial intelligence and machine learning, to enhance Microgrid effectiveness and dependability.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	2	2	-	1	1	1	2		-	-		2	1	-	1
CO2	2	3	2	2	2	1	2		-	-	1	2	2	-	1
CO3	2	3	2	2	2	1	1		-	-	1	2	3	-	3
CO4	2	3	3	2	2	1	2		-	-	1	2	3	1	3

Syllabus

Unit 1

Introduction to Microgrids: Introduction - Overview of Microgrid architecture and components - Advantages and challenges of Microgrids - Applications of Microgrids in different industries

Unit 2

Microgrid Control : Control strategies for Microgrids - Energy management systems for Microgrids - Microgrid stability analysis and control - Microgrid protection and islanding

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Unit 3

Unit 4

Text Books / References

Haitham Abu-Rub, Mariusz Malinowski, and Kamal Al-Haddad, "Power Electronics for Renewable Energy Systems, Transportation, and Industrial Applications", 2014

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID465	Intelligent Energy Management Systems	L-T-P-C: 2- 0- 2- 3
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- The course aims to help the students to identify and describe the fundamental concepts and principles of intelligent energy management.
- Students will learn to differentiate and categorize the key components of intelligent energy management systems, including sensors, controllers, and algorithms.
- The course will enable students to apply data analysis techniques to extract insights and trends from energy usage data and propose opportunities for energy savings and efficiency improvements.
- Students will learn to evaluate and compare potential benefits and challenges associated with implementing intelligent energy management in different contexts.

After completing this course, students will be able to

CO1	Identify and explain the key components of intelligent energy management systems and their application in optimizing energy consumption, using data analytics tools and techniques
CO2	Analyse energy usage data using various data analytics techniques to identify opportunities for energy savings and efficiency improvements and develop recommendations for implementation.
CO3	Evaluate the benefits and challenges of implementing intelligent energy management systems in buildings and other applications, using quantifiable metrics and data-driven approaches
CO4	Formulate simple intelligent energy management systems, using data analytics tools and techniques to optimize energy consumption and efficiency.

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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CO															
CO1	2	1	-	1	-	1	2	-	-	-	-	1	1	-	1
CO2	2	3	2	2	2	1	2	-	-	-	1	2	2	-	2
CO3	2	2	2	2	2	1	3	-	-	-	1	2	3	-	3
CO4	3	3	3	3	2	1	2	-	-	-	1	2	3	-	3

Syllabus

Unit 1

Introduction to Energy Management: Overview - Types of energy management systems - Key components of intelligent energy management systems – Types of controllers and algorithms used in energy management systems - Algorithms for energy management and optimization - Data analytics techniques for energy management.

Unit 2

Energy Efficiency: Concepts of energy efficiency - Techniques for improving energy efficiency - Measurement and verification of energy savings using data analytics.

Unit 3

Demand Response: Introduction - Techniques for implementing demand response programs - Data-driven approaches to demand response.

Unit 4

Renewable Energy Integration & Storage: Challenges and opportunities for renewable energy integration with data-driven approaches - Overview of energy storage technologies - Integration of energy storage into energy management systems - Benefits and challenges of energy storage with data-driven approaches.

Text Books / References

Craig B. Smith and Kelly Parmenter, "Energy Management Principles, Second Edition", 2015

James Momoh, "Smart Grid: Fundamentals of Design and Analysis", 2012

Lawrence E. Jones, "Renewable Energy Integration: Practical Management of Variability, Uncertainty, and Flexibility in Power Grids", 2017

Pengwei Du and Ning Lu, "Energy Storage for Smart Grids: Planning and Operation for Renewable and Variable Energy Resources (VERs)", 2014

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

Course Objectives

- The course aims to enable students to understand the fundamental concepts of power quality management.
- The course shall empower the students to identify the various sources of power quality problems.
- The course aims to equip students with the ability to analyse power quality data and draw conclusions about the nature of the issues.
- Finally, the course shall enable students to develop data-driven solutions for power quality problems.

Course Outcomes

After completing this course, students will be able to

CO1	Identify and diagnose common power quality problems, their sources, effects, and significance.
CO2	Analyse the impact of various power quality problems on electrical systems and equipment.
CO3	Evaluate different power quality improvement techniques, towards the design optimal solutions
CO4	Interpret power quality data and formulate data-driven solutions for the quality improvement.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	2	3	1	3	2	1	2	-	-	-	-	2	2	-	2
CO2	2	2	1	3	2	1	2	-	-	-	1	2	1	-	1
CO3	2	3	2	3	2	1	1	-	-	-	2	2	3	-	2
CO4	3	3	3	3	2	1	2	-	-	-	1	2	3	-	3

Syllabus

Unit 1

Introduction to Power Quality Management: Definition and importance of power quality - Power quality terminology and units of measurement - Common power quality problems and their sources - Effects of power quality problems on electrical systems and equipment - Power quality indices and their significance – Power quality standards - Overview of power quality measurements and monitoring

Unit 2

Power Quality Problems: Harmonics and their causes - Harmonic distortion and its impact on electrical systems and equipment - Filtering techniques for mitigating harmonics – Voltage sags and swells: Overview, causes, effects and mitigation - Transient over- and under-voltages: Overview, causes, effects and mitigation

Unit 3

Power Quality Improvement Techniques: Overview and comparison of different techniques and their effectiveness - Reactive Power Compensation: overview and design - Active Power Filtering: overview and design – Energy storage for power quality improvement - Analysis and interpretation of power quality data.

Text Books / References

Ewald F. Fuchs and Mohammad A.S Masoum, “Power Quality in Power Systems and Electrical Machines” .Pearson Education, 2008

Bhim Singh, Ambrish Chandra, and Kamal Al-Haddad , “Power Quality Problems and Mitigation Techniques” , 2014

Amrta Vishwa Vidyapeetham, Jos Arrillaga, Bruce C. Smith, Neville R. Watson, and Alan R. Wood, “Power System Harmonic Analysis” ,2013

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J. Benesty, M. M. Sondhi and Y. Huang, "Handbook of speech processing", Springer, 2008.

Daniel Jurafsky, James H Martin, Speech & language processing, preparation [cited 2020 June 1] Available from: <https://web.stanford.edu/~jurafsky/slp3> (2018).

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID471	Speech Processing	L-T-P-C: 2- 0-2- 3
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Course Objective

- To understand the principles of speech processing, human speech production and perception system.
- To estimate excitation and vocal tract features using time and frequency domain processing techniques.
- To explore the various conventional, machine learning and deep learning models for speech classification, recognition, synthesis, and detection tasks

Course Outcomes

After completing this course, students will be able to

CO1	Analyse the acoustic/articulatory characteristics of different speech regions and speech sounds
CO2	Apply time and frequency domain processing techniques to speech signals
CO3	Analyse and extract relevant spectral parameters and temporal parameters of speech signal
CO4	Evaluate the performance of a model or algorithm (conventional/Machine learning/Deep learning) developed for a speech technology application

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	3	3	2	1	1	1	2	3	1	2	1	1	1
CO2	3	3	3	3	3	1	1	1	2	2	1	2	3	2	1
CO3	3	3	3	3	3	1	1	1	2	2	1	2	3	2	2
CO4	3	3	3	3	3	2	1	2	2	2	1	3	3	3	3

Syllabus

Unit 1

Introduction to Speech Processing, Overview of the human speech production system, acoustic and physiological mechanisms of speech production, glottal signal characteristics and source features, significance of glottal activity regions, speech signal characteristics, acoustic/articulatory characteristics of different speech sounds -vowels and consonants.

Unit 2 Amrita Vishwa Vidyapeetham.

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Short time processing of speech for estimation of excitation and vocal tract features - Time Domain processing- Energy, magnitude, zero crossing rate, STACF, Linear Prediction Analysis, Frequency domain processing and Spectro-temporal representation of speech signal- Narrowband, wideband spectrograms, Cepstral Analysis, Melspectrogram, MFCC feature extraction.

Unit 3

Speech data preparation and feature engineering, machine learning versus deep learning models in speech classification tasks (age, gender, dialect/accent), Automatic speech recognition (ASR) - statistical models- Hidden Markov Models (HMMs) for ASR, Deep learning speech recognition pipeline (end-to-end models), overview of other speech technology applications such as emotion recognition, speaker recognition, speech synthesis, and speech pathology detection.

Text Books / References

'Fundamentals of Speech Recognition', L. Rabiner, Biing-Hwang Juang and B. Yegnanarayana, Pearson Education Inc. 2009

'Speech Communication', Douglas O'Shaughnessy, University Press, 2001

'Discrete Time Speech Signal Processing', Thomas F Quatieri, Pearson Education Inc., 2004

Hannun, Awni, et al. "Deep speech: Scaling up end-to-end speech recognition." *arXiv preprint arXiv:1412.5567* (2014).

Collobert, Ronan, Christian Puhrsch, and Gabriel Synnaeve. "Wav2letter: an end-to-end convnet-based speech recognition system." *arXiv preprint arXiv:1609.03193* (2016).

Gulati, Anmol, et al. "Conformer: Convolution-augmented transformer for speech recognition." *arXiv preprint arXiv:2005.08100* (2020).

Shen, Jonathan, et al. "Natural TTS synthesis by conditioning wavenet on mel spectrogram predictions." *2018 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP). IEEE, 2018*

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID472	Text Analytics	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- The main objective of the course is to understand the leading trends and systems in Natural Language Processing.
- This course will help the students to understand the basic representations used in syntax, the semantics of Natural Language Processing.
- This course will help the students to understand and explore the models used for word/sentence representations for various NLP applications.
- This course will help the students to implement deep learning algorithms in Python and learn how to train deep networks for NLP applications.

Course Outcomes

After completing this course, students will be able to

CO1	Apply modern tools for solving problems in computational linguistics	B.Tech Curriculum June 2021
CO2	Implement word representation models to solve NLP problems	

CO3	Develop machine learning/deep learning models for solving NLP applications
CO4	Evaluate the performance of NLP models

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	1	2	1	2	3	-	-	1	-	-	-	2	1	-	1
CO2	2	2	2	2	3	1	-	1	-	-	-	2	3	2	1
CO3	3	2	2	2	3	1	-	1	-	-	-	2	3	2	1
CO4	-	-	-	1	2	1	-	1	-	-	-	1	-	2	1

Syllabus

Unit 1

Computational linguistics- Introduction, syntax, semantics, morphology, collocation and other NLP problems.

Unit 2

Word representation: One-hot encoding, Bag-of-Words (BoW) Dictionary: Term Frequency – Inverse Document Frequency (TF-IDF), Language Model-n-gram – Neural Network-based word embedding algorithms

Unit 3

Sequences and sequential data: Machine learning and deep learning for NLP, Sequence to sequence modelling - BERT, GPT, Graph NLP, Hidden Markov Model, Conditional Random Field, Topic modelling

Unit 4

Applications of NLP: Part-of-Speech tagging, Named Entity recognition, Dependency parsing, - Sentiment Analysis, Machine translation, Question answering, Text summarization, Evaluation metrics for NLP models and Visualization

Text Books / References

Daniel Jurafsky, James H Martin, Speech & language processing, preparation [cited 2020 June 1] Available from: <https://web.stanford.edu/~jurafsky/slp3> (2018).

Christopher Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing, MIT press, 1999.

Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, O'Reilly Media, Inc., 2009.

Jason Browlee, Deep Learning for Natural Language Processing: Develop Deep Learning Models for your Natural Language Problems (Ebook), Machine Learning Mastery, 2017

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

- To Understand Document as Vector
- Performance evolution metric for IR
- Learn to write code for text indexing and retrieval.
- Learn to evaluate information retrieval systems
- Learn about text similarity measure
- Understanding about search engine

Course Outcomes

After completing this course, students will be able to

CO1	Use various techniques to represent a document as a vector
CO2	Implement IR systems using various techniques
CO3	Apply methods to evaluate IR systems
CO4	Develop applications

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	3	3	3	3	3	3	1	-	3	3	2	3	3	1	1
CO2	3	3	3	2	3	2	-	-	3	3	2	3	3	2	2
CO3	3	3	3	3	2	1	-	-	3	3	3	3	3	3	3
CO4	3	3	3	3	2	1	-	-	3	3	3	3	2	3	3

Syllabus

Unit 1

Goals and history of IR, impact of web in IR, basic concepts- query, document, corpus, text representation and evaluation, Boolean model, TF-IDF, vector-space retrieval models, Probabilistic retrieval models

Unit 2

Text similarity metrics, Tokenizing, language models, KL-divergence, performance metrics, reference collections and evaluation of IR systems, query languages for IR, relevance feedback, query expansion-local and global

Unit 3

Web search, web crawling, link analysis – hits, page rank, matrix decompositions and latent semantic indexing, Deep learning for IR- word embeddings, neural language models

Text Books / References

Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008. <http://nlp.stanford.edu/IR-book/information-retrieval-book.html>

ChengXiang Zhai, Statistical Language Models for Information Retrieval (Synthesis Lectures Series on Human Language Technologies), Morgan & Claypool Publishers, 2008.

Stefan Buettcher, Charles L. A. Clarke, Gordon V. Cormack, Information Retrieval: Implementing and Evaluating Search Engines, MIT Press. (2010)

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID474	Introduction to Chat bots	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- This course helps the students to develop a functional chatbot that can respond to user queries and complete simple tasks.
- Apply NLP techniques to improve the chatbot's ability to understand and respond to user input.
- Apply appropriate evaluation metrics to assess the performance of a chatbot.
- Evaluate the performance of a chatbot and make necessary adjustments to improve its functionality.
- Critically analyze and evaluate the ethical implications of using chatbots in various contexts, and propose ethical solutions to address these issues.

Course Outcomes

After completing this course, students will be able to

CO1	Implement chatbots with different frameworks
CO2	Develop machine learning/deep learning models for chatbots
CO3	Apply Natural Language Processing techniques to enhance chatbot capabilities
CO4	Evaluate the performance of chatbots using various metrics and techniques.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	2	1	2	1	3	2	-	1	-	-	-	2	1	-	1
CO2	2	2	2	3	3	2	-	2	-	-	-	2	3	1	1
CO3	1	1	1	2	3	2	-	2	-	-	-	2	3	1	1
CO4	-	-	-	1	2	1	-	1	-	-	-	1	-	2	1

Syllabus

Unit 1

Introduction to chatbots - definition and characteristics of chatbots - brief history of chatbots - types of chatbots - Use cases and applications

Unit 2

Natural Language Processing (NLP) for Chatbots - Understanding language processing - Syntax and Semantics - Pre-processing and Tokenization - Fundamental Methods of NLP for Building Chatbots

Aniltha Vishwa Vidyaapeetham.

B.Tech AIE

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Unit 3

Machine Learning/Deep Learning for Chatbots - Machine Learning/Deep Learning Algorithms used in chatbots - Data collection and annotation - Training and evaluation of chatbots - Designing and Implementing Chatbots - Designing conversational interfaces - Implementing chatbots using frameworks like Dialogflow, Rasa, etc. - Integration with different messaging platforms

Unit 4

Ethics in Chatbot Development - Responsible AI and ethics - Bias and fairness considerations in chatbot development - Human-in-the-loop approaches for chatbot development

Text Books / References

Sumit Raj, *Building Chatbots with Python Using Natural Language Processing and Machine Learning, First Edition, Apress Berkeley, CA, 2019 (Softcover ISBN 978-1-4842-4095-3).*

Srini Janarthanam. *Hands-on chatbots and conversational UI development: build chatbots and voice user interfaces with Chatfuel, Dialogflow, Microsoft Bot Framework, Twilio, and Alexa Skills. Packt Publishing Ltd, 2017.*

Shevat, Amir. *Designing bots: Creating conversational experiences. " O'Reilly Media, Inc.", 2017.*

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID475	Machine Translation and Sequence-to-Sequence Models	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- The main objective of the course is to obtain basic understanding and implementation skills for modern methods for machine translation
- This course introduces different approaches to build machine translation systems
- This course helps the students to understand various evaluation metrics used for assessing the performance of a machine translation model
- This courses introduces different deep learning architectures used for implementing the machine translation system.

Course Outcomes

After completing this course, students will be able to

CO1	Implement a statistical machine translation system
CO2	Implement a neural machine translation system using RNN-based encoder-decoder architecture
CO3	Implement a neural machine translation system using transformer-based encoder-decoder architecture
CO4	Evaluate the performance of machine translation models

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															
CO1	2	2	2	2	2	3	-	-	-	1	1	1	3	3	3

CO2	2	2	3	2	3	-	-	-	1	-	1	1	3	1	1
CO3	2	2	3	2	3	-	-	-	1	-	1	1	3	1	1
CO4	-	-	1	-	1	-	-	-	-	-	-	1	-	3	-

Syllabus

Introduction - Machine Translation Overview – Language Models – Rule based Machine Translation – Statistical Machine Translation – Encoder-decoder models – Attention mechanism - Neural Machine Translation – Phrase based models – Tree based models – Subword level models – Transformer networks - Evaluation metrics

Text Books / References

Daniel Jurafsky, James H Martin, Speech & language processing, preparation [cited 2020 June 1] Available from: <https://web.stanford.edu/~jurafsky/slp3> (2018).

Philipp Koehn, Statistical machine translation. Cambridge University Press, 2009..

Philipp Koehn, Neural machine translation. Cambridge University Press, 2020.

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID476	Speech Recognition and Understanding	L-T-P-C: 2- 0- 2- 3
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Course Objectives

- The main objective of the course is to give an introduction to recognition and understanding of the speech
- This course introduces different approaches to build a speech recognition system
- This course helps the students to understand language model and acoustic models required for building a speech recognition system
- This courses introduces different deep learning architectures used for implementing the end to end automatic speech recognition system

Course Outcomes

After completing this course, students will be able to

CO1	Implement language and acoustic models required for a speech recognition system
CO2	Develop a feature extraction model for speech recognition
CO3	Implement a speech recognition model
CO4	Develop a deep learning based end to end speech recognition model

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO															

CO1	2	2	2	2	2	-	-	1	-	-	-	2	3	1	1
CO2	2	2	2	2	2	-	-	1	-	-	-	2	3	1	1
CO3	2	2	2	2	2	-	-	1	-	-	-	2	3	1	1
CO4	2	2	2	2	2	-	-	1	-	-	-	2	3	1	1

Syllabus

Introduction of speech recognition - Overview of speech recognition systems - Speech recognition formulations - Feature extraction – Alignment – Hidden Markov Model - Advanced acoustic modelling - Language model - Deep learning for speech recognition - Advanced neural network architectures for acoustic model - End-to-end ASR

Text Books / References

- L. R. Rabiner, B. H. Juang and B. Yegnanarayana, "Fundamentals of speech recognition", Pearson Education, 2009.*
- J. R. Deller, Jr., J. H. L. Hansen and J. G. Proakis Discrete-Time Processing of Speech Signals, Wiley-IEEE Press, NY, USA, 1999.*
- D. O'Shaughnessy, Speech Communications: Human and Machine, Second Edition, University Press, 2005.*
- J. Benesty, M. M. Sondhi and Y. Huang, "Handbook of speech processing", Springer, 2008.*
- Daniel Jurafsky, James H Martin, Speech & language processing, preparation [cited 2020 June 1] Available from: <https://web.stanford.edu/~jurafsky/slp3> (2018).*

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

23AID477

Social Media Text Analysis

L-T-P-C: 2- 0- 2- 3

Course Objectives

- The main objective of the course is to give an introduction to the key concepts about social media text data
- This course introduces machine/deep learning and topic modelling approaches to build a social media text classification model
- This course helps the students to monitor consumers and competitors and glean deeper consumer insights based on advanced social media data modelling
- This course helps the students to make better business decisions by leveraging social media data

Course Outcomes

After completing this course, students will be able to

CO1	Analyze social media text data
CO2	Implement a sentiment analysis model using machine/deep learning algorithms
CO3	Implement a topic model for social media text categorization
CO4	Analyze a social network

CO-PO Mapping

Amrita Vishwa Vidyapeetham.

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PO/	PO	PO	PO	PO		PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
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PSO	1	2	3	4	PO5	6	7	8	9	10	11	12	1	2	3
CO															
CO1	-	-	-	1	2	1	-	1	-	-	-	1	-	2	-
CO2	2	2	2	2	2	-	-	1	-	-	-	2	3	2	1
CO3	2	2	2	2	2	-	-	1	-	-	-	2	3	2	1
CO4	1	1	1	2	2	1	-	1	-	-	-	2	1	-	1

Syllabus

Introduction to Social Media Analytics - Social media data collection - Processing unstructured and semi-structured data – Monitoring user engagement in social media - Identifying Opinions through Sentiment Analysis and Topic Modeling - Social Network Analysis and Metrics - Identifying Influencers in Social Network

Text Books / References

Szabo, G., G. Polatkan, O. Boykin & A. Chalkiopoulos, Social Media Data Mining and Analytics, Wiley, ISBN 978-1-118-82485-6, 2019

Golbeck, Jennifer. Analyzing the social web. Newnes, 2013.

Finger, L. & Dutta, S., Ask, Measure, Learn: Using Social Media Analytics to Understand and Influence Customer Behavior. Sebastopol, CA: O'Reilly, 2014

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Assignments (minimum 2)	Internal	30
Quizzes (minimum 2)	Internal	20
Mid-Term Examination	Internal	20
Term Project/ End Semester Examination	External	30

Courses offered under the framework of

Amrita Values Programmes I and II

22AVP201 Message from Amma's Life for the Modern World

Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

22ADM211 Leadership from the Ramayana

Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

22ADM201 Strategic Lessons from the Mahabharata

Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance – Relevance of Mahabharata for modern times.

22AVP204 Lessons from the Upanishads

Introduction to the Upanishads: Sruti versus Smrti – Overview of the four Vedas and the ten Principal Upanishads – The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, SatyakamaJabala, Aruni, Shvetaketu.

22AVP205 Message of the Bhagavad Gita

Introduction to Bhagavad Gita – Brief storyline of Mahabharata – Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga – Theory of Karma and Reincarnation – Concept of Dharma – Concept of Avatar – Relevance of Mahabharata for modern times.

22AVP206 Life and Message of Swami Vivekananda

Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra – Travel across India – Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji's life.

22AVP207 Life and Teachings of Spiritual Masters India

Sri Rama, Sri Krishna, Sri Buddha, AdiShankaracharya, Sri Ramakrishna Paramahansa, Swami Vivekananda, Sri RamanaMaharshi, Mata Amritanandamayi Devi.

22AVP208 Insights into Indian Arts and Literature

The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life – Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India – Arts, Music, Dance, Theatre.

22AVP209 Yoga and Meditation

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

22AVP210 Kerala Mural Art and Painting

Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn

on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

22AVP213 Traditional Fine Arts of India

India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is ‘Únity in Diversity’ and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

22AVP214 Principles of Worship in India

Indian mode of worship is unique among the world civilizations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realization of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

22AVP215 Temple Mural Arts in Kerala

The traditional percussion ensembles in the Temples of Kerala have enthralled millions over the years. The splendor of our temples makes art enthusiast spellbound, warmth and grandeur of color combination sumptuousness of the outline, crowding of space by divine or heroic figures often with in vigorous movement are the characteristics of murals.

The mural painting specially area visual counterpart of myth, legend, gods, dirties, and demons of the theatrical world, Identical myths are popular the birth of Rama, the story of Bhīma and Hanuman, Shiva, as Kirata, and the Jealousy of Uma and ganga the mural painting in Kerala appear to be closely related to, and influenced by this theatrical activity the art historians on temple planes, wood carving and painting the architectural plane of the Kerala temples are built largely on the pan-Indians almost universal model of the Vasthupurusha.

22AVP218 Insights into Indian Classical Music

The course introduces the students into the various terminologies used in Indian musicology and their explanations, like Nadam, Sruti, Svaram – svara nomenclature, Stayi, Graha, Nyasa, Amsa, Thala,– Saptatalas and their angas, Shadangas, Vadi, Samavadi, Anuvadi. The course takes the students through Carnatic as well as Hindustani classical styles.

The course introduces traditional Indian paintings in the light of ancient Indian wisdom in the fields of aesthetics, the Shadanga (Six limbs of Indian paintings) and the contextual stories from ancient texts from where the paintings originated. The course introduces the painting styles such as Madhubani, Kerala Mural, Pahari, Cheriya, Rajput, Tanjore etc.

22AVP220 Insights into Indian Classical Dance

The course takes the students through the ancient Indian text on aesthetics the Natyasastra and its commentary the AbhinavaBharati. The course introduces various styles of Indian classical dance such as Bharatanatyan, Mohiniyattam, Kuchipudi, Odissi, Katak etc. The course takes the students through both contextual theory as well as practice time.

22AVP221 Indian Martial Arts and Self Defense

The course introduces the students to the ancient Indian system of self-defense and the combat through various martial art forms and focuses more on traditional Kerala's traditional KalariPayattu. The course introduces the various exercise technique to make the body supple and flexible before going into the steps and techniques of the martial art. The advanced level of this course introduces the technique of weaponry.

PROFESSIONAL ELECTIVES UNDER SCIENCE STREAM

CHEMISTRY

23CHY240	COMPUTATIONAL CHEMISTRY AND MOLECULAR MODELLING	L-T-P-C: 3-0-0-3
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Course Outcomes:

- CO1: Get to understand the structure of molecules using symmetry.
- CO2: Understanding Quantum mechanical approach to calculate the energy of a system.
- CO3: Applying mathematical knowledge and quantum mechanical approach in finding out the characteristics– reactivity, stability, etc., of the molecule.
- CO4: To get a brief idea about molecular mechanics based chemical calculations.
- CO5: To get an idea about general methodology

of molecular modeling.

Syllabus Unit 1

Introduction: Stability, symmetry, homogeneity and quantization as the requirements of natural changes – Born – Haber

cycle – Energetic – kinetics – Principles of spectra.

Computational techniques: Introduction to molecular descriptors, computational chemistry problems involving iterative methods, matrix algebra, Curve fitting.

Molecular mechanics: Basic theory – Harmonic oscillator – Parameterization – Energy equations – Principle of coupling – Matrix formalism for two masses – Hessian matrix – enthalpy of formation – enthalpy of reactions.

Introduction to Quantum mechanics – Schrodinger equation – Position and momentum MO formation – Operators and the Hamiltonian operator – The quantum oscillator Oscillator Eigen value problems – Quantum numbers – labeling of atomic electrons.

Unit 2

Molecular Symmetry: Elements of symmetry – Point groups – Determination of point groups of molecules.

Huckel's MO theory: Approximate and exact solution of Schrodinger equation – Expectation value of energy – Huckel's theory and the LCAO approximation – Homogeneous simultaneous equations – Secular matrix – Jacobi method – Eigen vectors: Matrix as operator – Huckel's coefficient matrix – Wheeland's method – Hoffmann's EHT method – Chemical applications such as bond length, bond energy, charge density, dipole moment, Resonance energy.

Unit 3

Self consistent fields: Elements of secular matrix – Variational calculations – Semi empirical methods – PPP self consistent field calculation – Slater determinants – Hartree equation – Fock equation – Roothaan – Hall equation – Semi empirical models and approximations.

Ab-initio calculations: Gaussian implementations – Gamess – Thermodynamic functions – Koopman's theorem – Isodesmic reactions, DFT for larger molecules – Computer aided assignments/mini projects with softwares – Introduction to HPC in Chemical calculations.

Molecular modelling software engineering – Modeling of molecules and processes

Signals and signal processing in Chemistry – QSAR studies and generation of molecular descriptors – Applications of chemical data mining – Familiarization with open source softwares useful for molecular modeling – Introduction to molecular simulation – M.D. simulation.

TEXTBOOKS:

K. I. Ramachandran, G Deepa and K Namboori, "Computational Chemistry and Molecular Modeling – Principles and Applications", Springer-Verlag, Berlin, Heidelberg, 2008, ISBN-13 978-3-540-77302-3.

1. *Donald W Rogers, "Computational Chemistry Using PC", Wiley, (2003).*
2. *Alan Hinchliffe, "Chemical Modeling from atoms to liquids", Wiley, (2005).*

REFERENCES:

1. *James B Foresman and Aeleen Frisch-Gaussian, "Exploring Chemistry with Electronic Structure Method", Inc., Pittsburgh, PA, 2nd edition, (2006).*
2. *A C Philips, "Introduction to Quantum mechanics", Wiley, (2003).*
3. *Wolfram Koch, Max C. Holthausen, "A Chemist's guide to Density Functional Theory", Wiley, VCH, 2nd edition, (2001).*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Outcomes:

CO1: Understand the fundamental concepts of electrochemistry through electrode potential and reaction kinetics CO2: Learn the application of the electrochemical principles for the functioning and fabrication of industrial batteries and fuel cells

CO3: Acquire knowledge in solving numerical problems on applied electrochemistry CO4: Analysis and practical problem solving in fabrication of batteries and fuel cells CO5: Application of concepts and principle in industrial electrochemical processes CO6: Evaluation of comprehensive knowledge through problem solving

Syllabus Unit**1**

Background Theory: Origin of potential – electrical double layer – reversible electrode potential – standard hydrogen

electrode – emf series – measurement of potential – reference electrodes (calomel and silver/silver chloride) indicator and ion selective electrodes – Nernst equation – irreversible processes – kinetic treatment – Butler–Volmer equation – Overpotential, activation, concentration and IR overpotential – its practical significance – Tafel equation and Tafel plots – exchange current density and transfer coefficients.

Unit 2

Batteries: Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc–carbon (Leclanche type), zinc alkaline (Duracell), zinc/air, zinc–silver oxide batteries; lithium primary cells – liquid cathode, solid cathode and polymer electrolyte types and lithium–ferrous sulphide cells (comparative account).

Secondary batteries: ARM (alkaline rechargeable manganese) cells, Lead acid and VRLA (valve regulated (sealed) lead acid), nickel–cadmium, nickel–zinc, nickel–metal hydride batteries, lithium ion batteries, ultra thin lithium polymer cells (comparative account). Advanced Batteries for electric vehicles, requirements of the battery – sodium–beta and redox batteries.

Unit 3

Reserve batteries and Fuel cells: Reserve batteries – water activated, electrolyte activated and thermally activated batteries – remote activation – pyrotechnic materials. Fuel Cells: Principle, chemistry and functioning – carbon, hydrogen– oxygen, proton exchange membrane (PEM), direct methanol(DMFC), molten carbonate electrolyte (MCFC) fuel cells and outline of biochemical fuel cells.

Electrochemical Processes: Principle, process description, operating conditions, process sequence and applications of Electroforming – production of waveguide and plated through hole (PTH) printed circuit boards by electrodeposition; Electroless plating of nickel, copper and gold; Electropolishing of metals; Anodizing of aluminium; Electrochemical machining of metals and alloys.

TEXTBOOKS:

1. *Derek Pletcher and Frank C. Walsh, "Industrial Electrochemistry", Blackie Academic and Professional, (1993).*
2. *Dell, Ronald M Rand, David A J, "Understanding Batteries", Royal Society of Chemistry, (2001).*

REFERENCES:

1. *Christopher M A, Brett, "Electrochemistry – Principles, Methods and Applications", Oxford University, (2004).*
2. *Watanabe T, "Nano-plating: microstructure control theory of plated film and data base of plated film microstructure", Elsevier, Oxford, UK (2004).*
3. *Kanani N, "Electroplating and electroless plating of copper and its alloy", ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).*
4. *Lindon David, "Handbook of Batteries", McGraw Hill, (2002).*
5. *Curtis, "Electroforming", London, (2004).*

6. Rumyantsev E and Davydov A, "Electrochemical machining of metals", Mir, Moscow, (1989).

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Objectives:

To provide the basic knowledge about fuels, rocket propellants and explosives.

Course Outcomes:

CO1: Understand the types of fuels and variation in their properties
CO2: Able to analyze the fuel content

CO3: Obtain knowledge in identifying a proper fuel as per the requirement
CO4: Ability to know the preparation and working of propellants and explosives

Syllabus Unit**1**

Fuels – Solid fuels – Classification, preparation, cleaning, analysis, ranking and properties – action of heat, oxidation,

hydrogenation, carbonization, liquefaction and gasification.

Liquid fuels – Petroleum – origin, production, composition, classification, petroleum processing, properties, testing – flow test, smoke points, storage and handling.

Secondary liquid fuels – Gasoline, diesel, kerosene and lubricating oils. Liquid fuels – refining, cracking, fractional distillation, polymerization. Modified and synthetic liquid fuels. ASTM methods of testing the fuels.

Unit 2

Gaseous fuels – Types, natural gas, methane from coal mine, water gas, carrier gas, producer gas, flue gas, blast furnace gas, biomass gas, refinery gas, LPG – manufacture, cleaning, purification and analysis. Fuels for spark ignition engines, knocking and octane number, anti knock additives, fuels for compression, engines, octane number, fuels for jet engines and rockets.

Unit 3

Combustion: Stoichiometry, thermodynamics. Nature and types of combustion processes – Mechanism – ignition temperature, explosion range, flash and fire points, calorific value, calorific intensity, theoretical flame temperature. Combustion calculations, theoretical air requirements, flue gas analysis, combustion kinetics – hydrogen – oxygen reaction and hydrocarbon – oxygen reactions.

Rocket propellants and Explosives – classification, brief methods of preparation, characteristics; storage and handling.

TEXTBOOK:

1. *Fuels and Combustion*, Samir Sarkar, Orient Longman Pvt. Ltd, 3rd edition, 2009.

REFERENCES:

1. *Fuels – Solids, liquids and gases – Their analysis and valuation*, H. Joshua Philips, Bio-bliolife Publisher, 2008.
2. *An introduction to combustion: Concept and applications – Stephen R Turns*, Tata Mc. Graw Hill, 3rd edition, 2012.
3. *Fundamentals of Combustion*, D P Mishra, 1st edition, University Press, 2010
4. *Engineering Chemistry – R. Mukhopadhyay and Sriparna Datta*, Newage International Pvt. Ltd, 2007.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Objectives:

1. Understand the principles of green chemistry and its contribution to the development of sustainable products
2. Possess knowledge of the migration from a hydrocarbon-based economy to carbohydrate-based economy
3. Evaluate the deficiencies of traditional process and acknowledge the invent of new processes
4. Distinctly map the culmination of academic research to industrial chemistry

Course Outcomes:

CO1: Understand the evolving concept of Green Chemistry and its application to the manufacture of sustainable products

CO2: Appreciate the need for Renewable energy and Feed stock along with carbon sequestration through the fundamentals of Green Chemistry Techniques

CO3: Develop a coherence to evaluate systematic deficiencies in traditional Chemical science process and products CO4: Undertake a purposeful Journey through the microscopic domain of academic research to the macroscopic domain of Industrial chemistry

Syllabus Unit**1**

Our environment and its protection, chemical pollution and environmental regulations, environmental chemistry, pollution prevention strategies, challenges to the sustainability of chemical industry, Pollution Prevention Act 1990, USA, Green Chemistry and its 12 principles, toxicity of chemicals, material safety data sheet (MSDS), concept of zero pollution technologies, atom economy, functional toxicity vs non-functional toxicity, alternative solvents, energy minimization, microwave and sonochemical reactions, renewable feed stock, carbon dioxide as a feed stock.

Unit 2

Greener strategies of the synthesis of ibuprofen synthesis, teriphthalic acid etc. phase behaviour and solvent attributes of supercritical CO₂, use of supercritical carbon dioxide as a medium chemical industry, use of ionic liquids as a synthetic medium, gas expanded solvents, superheated water, etc. Synthesis of various chemicals from bio mass, polycarbonate synthesis and CO₂ fixation, green plastics, green oxidations, etc.

Unit 3

Processes involving solid catalysts – zeolites, ion exchange resins, Nafion/silica nano composites and enhanced activity. Polymer supported reagents, green oxidations using TAML catalyst, membrane reactors. Green chemistry in material science, synthesis of porous polymers, green nanotechnology.

REFERENCES:

1. *Hand Book of Green Chemistry and Technology; by James Clarke and Duncan Mac-quarrie; BlakwellPublishing.*
2. *Anastas, P. T., Warner, J. C. Green Chemistry: Theory and Practice, Oxford University Press Inc., NewYork, 1998.*
3. *Matlack, A. S. Introduction to Green Chemistry Marcel Dekker: New York, NY, 2001.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Outcomes:

CO1: To develop an understanding of principle and working of the range of instrumental methods in analytical chemistry

CO2: To provide an understanding and skills in contemporary methods of separation and appropriate selection of instruments for the successful analysis of chemical compounds

CO3: To impart skills in the scientific method of planning, conducting, reviewing, reporting experiments and problem solving in chemical analysis.

Syllabus Unit**1**

Error Analysis and Sampling: Accuracy – Precision – Classification of Errors – Minimization of errors – Standard

deviation – Coefficient of variance – F-test – t-test – Significant figures. Sampling – Basis of sampling, Sampling and physical state – Safety measures of sampling.

Separation Techniques: Brief outline of column, paper and thin layer chromatography – Ion exchange methods – principle and application – HPLC.

Unit 2

Gas chromatography – principle and applications – gel chromatography.

Electroanalytical techniques: Potentiometry – Potentiometric titration – determination of equivalence point – acid base, complexometric, redox and precipitation titrations – merits and demerits. Voltammetry – Cyclic voltammetry – basic principle and application – Polarography – introduction – theoretical principles – migration current – residual current – half wave potential – instrumentation – analytical applications.

Unit 3

Spectro-chemical techniques: UV-VIS spectrophotometry – principle – Beer's Law application – photometric titration – single and double beam spectrophotometer – instrumentation of IR – sample handling – IR applications – H – NMR – Instrumentation and applications – principle – instrumentation

– applications of atomic absorption spectroscopy.

Thermal and Diffraction techniques: Principles and applications of DTG – DTA DSC – X-ray – Electron Diffraction Studies – SEM, TEM.

TEXTBOOKS:

1. *Willard H W, Merritt J R, "Instrumental Methods of Analysis", 6th edition, Prentice Hall, (1986).*
2. *Skoog Douglas A, West Donald, "Fundamentals of Analytical Chemistry", 7th edition, New York Addison, Wesley, (2001).*

REFERENCES:

1. *"Vogel's Textbook of Quantitative Chemical Analysis", 5th edition, ELBS, (1989).*
2. *Kaur. H, "Instrumental Methods of Chemical Analysis", Goel Publisher, (2001).*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23CHY245

BATTERIES AND FUEL CELLS

L-T-P-C: 3-0-0-

Course Objective:

To provide sound knowledge on the application of electrochemistry in energy storage systems.

Course Outcome

CO1: Understand the fundamental concepts of electrochemistry through electrode potential and reaction kinetics CO2: Learn the application of the electrochemical principles for the functioning and fabrication industrial batteries

and fuel cells

CO3: Analysis of practical problem solving in fabricating batteries and fuel cells CO4: Evaluation of comprehensive knowledge through problem solving

Syllabus Unit

1

Background Theory: Origin of potential – electrical double layer – reversible electrode potential – standard hydrogen

electrode – emf series – measurement of potential – reference electrodes (calomel and silver/silver chloride) indicator and ion selective electrodes – Nernst equation – irreversible processes – kinetic treatment – Butler–Volmer equation – Overpotential, activation, concentration and IR overpotential – its practical significance – Tafel equation and Tafel plots – exchange current density and transfer coefficients.

Unit 2

Batteries: Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc–carbon (Leclanche type), zinc alkaline (Duracell), zinc/air batteries; Lithium primary cells – liquid cathode, solid cathode and lithium–ferrous sulphide cells (comparative account).

Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel–cadmium, nickel–zinc, nickel– metal hydride batteries, lithium ion batteries, ultrathin lithium polymer cells (comparative account). Advanced Batteries for electric vehicles, requirements of the battery – sodium–beta and redox batteries.

Unit 3

Fuel Cells: Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspects of the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells.

Membranes for fuel cells: Nafion – Polymer blends and composite membranes; assessment of performance – recent developments.

Fuels for Fuel Cells: Hydrogen, methane, methanol – Sources and preparation, reformation processes for hydrogen – clean up and storage of the fuels – use in cells, advantages and disadvantages of using hydrogen as fuel.

TEXTBOOKS:

1. Dell, Ronald M Rand, David A J, '*Understanding Batteries*', Royal Society of Chemistry, (2001).
2. M. Aulice Scibioh and B. Viswanathan '*Fuel Cells – principles and applications*', University Press, India (2006).

REFERENCES:

1. Kanani N, '*Electroplating and electroless plating of copper and its alloy*', ASM International, Metals Park,

OH and Metal Finishing Publications, Stevenage, UK (2003).

2. *Curtis, 'Electroforming', London, (2004).*
3. *F. Barbir, 'PEM fuel cells: theory and practice', Elsevier, Burlington, MA, (2005).*
4. *G. Hoogers, 'Fuel cell handbook', CRC, Boca Raton, FL, (2003).*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Outcome:

CO1: Development of skill in identifying the nature and type

of corrosion
CO2: Understanding the mechanism of various types of corrosion

CO3: Analysing the problem and find out a solution to combat corrosion in any sort of environment.

CO-PO Mapping

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

Syllabus Unit**1**

Basic principles: Free energy concept of corrosion – different forms of corrosion – Thermodynamic & Kinetic aspects of corrosion: The free energy criterion of corrosion possibility – Mechanism of Electrochemical corrosion – Galvanic and Electrochemical series and their significance.

Corrosion Control: Materials selection – metals and alloys – metal purification – non metallic – changing medium.

Unit 2

Anodic and cathodic protection methods – Coatings – metallic and other inorganic coatings –

organic coatings – straycurrent corrosion – cost of corrosion control methods.

Corrosion protection by surface treatment: CVD and PVD processes – Arc spray – Plasma spray –

Flame spray. Corrosion Inhibitors: Passivators – Vapour phase inhibitor.

Unit 3

Stress and fatigue corrosion at the design and in service condition – control of

bacterial corrosion. Corrosion protection: Automobile bodies – engines – building

construction.

TEXTBOOKS:

1. *Fontana and Mars G, "Corrosion Engineering", 3rd edition, McGraw Hill, (1987).*
2. *Uhlig H H and Reviees R W, "Corrosion and its Control", Wiley, (1985).*

REFERENCES:

1. *ASM Metals Handbook, "Surface Engineering", Vol. 5, ASM Metals Park, Ohio, USA, (1994).*
2. *ASM Metals Handbook, "Corrosion", Vol. 13, ASM Metals Park, Ohio, USA, (1994).*
3. *Brain Ralph, "Material Science and Technology", CRC Series, Boston, New York.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

PHYSICS

23PHY240

ADVANCED CLASSICAL DYNAMICS

L-T-P-C: 3-0-0-3

Course Outcomes:

CO1: Able to use the Lagrangian formalism to solve simple dynamical system

CO2: Able to understand Hamiltonian formalism and apply this in solving dynamical systems

CO3: Able to apply Lagrangian formalism in bound and scattered states with specific reference to Kepler's laws and Scattering states

CO4: Able to solve problems in the Centre of Mass frame and connect it to Laboratory

Frame of Reference CO5: Understand and solve problems in rigid body rotations applying of Euler's equations.

CO-PO Mapping

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

Syllabus Unit

1

Introduction to Lagrangian dynamics

Survey of principles, mechanics of particles, mechanics of system of particles, constraints, D'Alembert's principle and Lagrange's equation, simple applications of the Lagrangian formulation, variational

principles and Lagrange's equations, Hamilton's principles, derivation of Lagrange's equations from Hamilton's principle, conservation theorems and symmetry properties.

Unit 2

Central field problem

Two body central force problem, reduction to the equivalent one body problem, Kepler problem, inverse square law of force, motion in time in Kepler's problem, scattering in central force field, transformation of the scattering to laboratory system, Rutherford scattering, the three body problem.

Rotational kinematics and dynamics

Kinematics of rigid body motion, orthogonal transformation, Euler's theorem on the motion of a rigid body.

Unit 3

Angular momentum and kinetic energy of motion about a point, Euler equations of motion, force free motion of rigid body.

Practical rigid body problems

Heavy symmetrical spinning top, satellite dynamics, torque-free motion, stability of torque-free motion – dual-spin spacecraft, satellite maneuvering and attitude control – coning maneuver – Yo-yo despin mechanism – gyroscopic attitude control, gravity– gradient stabilization.

TEXTBOOKS:

1. *H. Goldstein, Classical Mechanics, Narosa Publishing House, New Delhi, 1980, (Second Edition)*
2. *H. Goldstein, Charles Poole, John Safko, Classical Mechanics, Pearson education, 2002 (Third Edition)*
3. *Howard D. Curtis, Orbital Mechanics for Engineering Students, Elsevier, pp.475 – 543*
4. *Anderson John D, Modern Compressible flow, McGraw Hill.*

REFERENCE BOOKS:

1. *D. A. Walls, Lagrangian Mechanics, Schaum Series, McGraw Hill, 1967.*
2. *J. B. Marion and S. T. Thornton, Classical dynamics of particles and systems, Ft. Worth, TX: Saunders, 1995.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Outcomes

CO1: To understand the nature of interaction between atoms in crystalline solid materials that determines their dielectric, magnetic and electrical properties.

CO2: Analyze the relation between the macroscopic dielectric constant and the atomic structure of an insulator.

CO3: Fundamental concepts of magnetic fields required to illustrate the magnetic dipoles. This forms the basis to understand the magnetic properties of dia, para, ferro, antiferro and ferri magnetic materials.

CO4: Fundamentals concerned with conduction mechanism in metals and superconductors.

CO5: Understand the basics for classification of materials based on its conductivity, nature of chemical bonds in Si and Ge, carrier density, energy band structure and conduction mechanism in intrinsic and extrinsic semiconductors.

CO-PO Mapping

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

Syllabus Unit

1

Conducting materials: The nature of chemical bond, crystal structure Ohm's law and the relaxation time, collision time, electron scattering and resistivity of metals, heat developed in a current carrying conductor, thermal conductivity of metals, superconductivity.

Semiconducting materials: Classifying materials as semiconductors, chemical bonds in Si and Ge and its consequences, density of carriers in intrinsic semiconductors, conductivity of intrinsic semiconductors, carrier densities in n type semiconductors, n type semiconductors, Hall effect and carrier density.

Unit 2

Magnetic materials: Classification of magnetic materials, diamagnetism, origin of permanent, magnetic dipoles in matter, paramagnetic spin systems, spontaneous magnetization and Curie Weiss law, ferromagnetic domains and coercive force, anti ferromagnetic materials, ferrites and its applications.

Unit 3

Dielectric materials: Static dielectric constant, polarization and dielectric constant, internal field in solids and liquids, spontaneous polarization, piezoelectricity.

PN junction: Drift currents and diffusion currents, continuity equation for minority carriers, quantitative treatment of

the p-n junction rectifier, the n-p-n transistor.

TEXTBOOK:

1. *A J Decker, "Electrical Engineering materials", PHI, New Delhi, 1957.*

REFERENCES:

1. *A J Decker, "Solid State Physics", Prentice Hall, Englewood Cliffs, NJ 1957.*
2. *C Kittel, "Introduction to solid state Physics", Wiley, New York, 1956 (2nd edition).*
3. *Allison, Electronic Engineering materials and Devices, Tata Mc Graw Hill*
4. *F K Richtmyer E H Kennard, John N Copper, "Modern Physics", Tata Mc Graw Hill, 1995 (5th edition).*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Unit 1

Review of some basic concepts and principle of laser.

Introduction to light and its properties: Reflection, refraction, interference, diffraction and polarization. Photometry

- calculation of solid angle. Brewster's law. Snell's law and, its analysis.

Introduction to LASERS: Interaction of radiation with matter – induced absorption, spontaneous emission, stimulated emission. Einstein's co-efficient (derivation). Active material. Population inversion – concept and discussion about different techniques. Resonant cavity.

Unit 2

Properties of LASERS

Gain mechanism, threshold condition for PI (derivation), emission broadening – line width, derivation of FWHM natural emission line width as deduced by quantum mechanics – additional broadening process: collision broadening, broadening due to dephasing collision, amorphous crystal broadening, Doppler broadening in laser and broadening in gases due to isotope shifts. Saturation intensity of laser, condition to attain saturation intensity.

Properties – coherency, intensity, directionality, monochromaticity and focussibility. LASER transition – role of electrons in LASER transition, levels of LASER action: 2 level, 3 level and 4 level laser system.

Unit 3

Types of LASERS

Solid state LASER: (i) Ruby LASER – principle, construction, working and application. (ii) Neodymium (Nd) LASERS. gas LASER: (i) He-Ne LASER – principle, construction, working and application. (i) CO₂

LASER – principle, construction, working and application.

Liquid chemical and dye LASERS. Semiconductor LASER: Principle, characteristics, semiconductor diode LASERS, homo-junction and hetero-junction LASERS, high power semiconductor diode LASERS.

Applications in Communication field:

LASER communications: Principle, construction, types, modes of propagation, degradation of signal, analogue communication system, digital transmission, fiber optic communication.

Applications of LASERS in other fields:

Holography: Principle, types, intensity distribution, applications. laser induced fusion. Harmonic generation. LASER spectroscopy. LASERS in industry: Drilling, cutting and welding. Lasers in medicine: Dermatology, cardiology, dentistry and ophthalmology.

REFERENCES:

1. *William T Silfvast, "Laser Fundamentals", Cambridge University Press, UK (2003).*
2. *B B Laud, "Lasers and Non linear Optics", New Age International (P) Ltd., New Delhi.*

3. *Andrews, "An Introduction to Laser Spectroscopy (2e)", Ane Books India (Distributors).*
4. *K R Nambiar, "Lasers: Principles, Types and Applications", New Age International (P) Ltd., New Delhi.*
5. *T Suhara, "Semiconductor Laser Fundamentals", Marcel Dekker (2004).*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Outcomes

CO1: Understand, Comprehend and acquaint with concepts of NanoPhysics

CO2: To familiarize the material's property changes with respect to the dimensional confinements.

CO3: Acquire knowledge on the modern preparation process and analysis involved in the nanomaterial's research
CO4: To learn about the technological advancements of the nano-structural materials and devices in the engineering

applications

CO-PO Mapping

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

Syllabus Unit 1

Introduction

Introduction to nanotechnology, comparison of bulk and nanomaterials – change in band gap and large surface to volume ratio, classification of nanostructured materials. Synthesis of nanomaterials – classification of fabrication methods – top down and bottom up methods.

Basic concepts – excitons, effective mass, free electron theory and its features, band structure of solids. Bulk to nanotransition – density of states, potential well – quantum confinement effect – weak and strong confinement regime. Electron confinement in infinitely deep square well, confinement in two and three dimension. Blue shift of band gap

– effective mass approximation. Vibrational properties of solids – phonon confinement effect and presence of surface modes.

Unit 2

Tools for characterization:

Structural – X-ray diffraction, transmission electron microscope, scanning tunneling microscope, atomic force microscope. Optical – UV – visible absorption and photoluminescence techniques, Raman spectroscopy.

Nanoscale materials – properties and applications:

Carbon nanostructures – structure, electrical, vibration and mechanical properties. Applications of carbon nanotubes

Unit 3

Field emission and shielding – computers – fuel cells – chemical sensors – catalysis – mechanical reinforcement. Quantum dots and Magnetic nanomaterials – applications.

Nanoelectronics and nanodevices:

Impact of nanotechnology on conventional electronics. Nanoelectromechanical systems (NEMSs) – fabrication (lithography) and applications. Nanodevices – resonant tunneling diode, quantum cascade lasers, single electron transistors – operating principles and applications.

TEXTBOOKS:

1. *Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, Nanoscale Science and Technology, John Wiley and Sons Ltd 2004.*
2. *W. R. Fahrner (Ed.), Nanotechnology and Nanoelectronics, Springer 2006.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Outcomes:

CO1: Understand, comprehend and acquaint with the basics working principles and governing equations of electronic devices like diodes, Bipolar junction transistors, Mosfet and heterojunction transistors

CO2: Analyze and Solve physics problems pertaining to various process like charge conduction across semiconductor device.

CO3: Apply the knowledge for the development and design of new methods to determine semiconductor parameters and devices

Syllabus Unit**1**

Introduction: Unit cell, Bravais lattices, crystal systems, crystal planes and Miller indices, symmetry elements. Defects and imperfections – point defects, line defects, surface defects and volume defects

Electrical conductivity: Classical free electron theory – assumptions, drift velocity, mobility and conductivity, drawbacks. quantum free electron theory – Fermi energy, Fermi factor, carrier concentration. Band theory of solids – origin of energy bands, effective mass, distinction between metals, insulators and semiconductors.

Unit 2

Theory of semiconductors: Intrinsic and extrinsic semiconductors, band structure of semiconductors, carrier concentration in intrinsic and extrinsic semiconductors, electrical conductivity and conduction mechanism in semiconductors, Fermi level in intrinsic and extrinsic semiconductors and its dependence on temperature and carrier concentration. Carrier generation – recombination, mobility, drift-diffusion current. Hall effect.

junction capacitance and voltage breakdown.

Unit 3

Bipolar junction transistor, p-n-p and n-p-n transistors: principle and modes of operation, current relations. V-I characteristics. Fundamentals of MOSFET, JFET. Heterojunctions – quantum wells.

Semiconducting devices: Optical devices: optical absorption in a semiconductor, e--hole generation. Solar cells – p-n junction, conversion efficiency, heterojunction solar cells. Photo detectors – photo conductors, photodiode, p-i-n diode. Light emitting diode (LED) – generation of light, internal and external quantum efficiency.

Modern semiconducting devices: CCD – introduction to nano devices, fundamentals of tunneling devices, design considerations, physics of tunneling devices.

TEXTBOOKS:

1. *C Kittel, "Introduction to Solid State Physics", Wiley, 7th Edn., 1995.*
2. *D A Neamen, "Semiconductor Physics and Devices", TMH, 3rd Edn., 2007.*

REFERENCES:

1. *S M Sze, "Physics of Semiconductor Devices", Wiley, 1996.*
2. *P Bhattacharya, "Semiconductor Opto- Electronic Devices", Prentice Hall, 1996.*
3. *M K Achuthan & K N Bhat, "Fundamentals of Semiconductor Devices", TMH, 2007.*
4. *J Allison, "Electronic Engineering Materials and Devices", TMH, 1990.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Outcomes:

After completion of the course students should be able to

CO1: Get a broad knowledge of scientific and technical methods in astronomy and astrophysics. CO2: Apply mathematical methods to solve problems in astrophysics.

CO3: Develop critical/logical thinking, scientific reasoning and skills in the area of modern astrophysics.

CO-PO Mapping:

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

Syllabus Unit**1**

Historical introduction: Old Indian and western – astronomy – Aryabhatta, Tycho Brahe, Copernicus, Galileo – Olbers paradox – solar system – satellites, planets, comets, meteorites, asteroids.

Practical astronomy – telescopes and observations & techniques – constellations, celestial coordinates, ephemeris. Celestial mechanics – Kepler's laws – and derivations from Newton's laws.

Sun: Structure and various layers, sunspots, flares, faculae, granules, limb darkening, solar wind and climate.

Unit 2

Stellar astronomy: H-R diagram, color-magnitude diagram – main sequence – stellar evolution – red giants, white dwarfs, neutron stars, black holes – accretion disc – Schwartzchild radius – stellar

masses Saha-Boltzman equation – derivation and interpretation.

Variable stars: Cepheid, RR Lyrae and Mira type variables – Novae and Super novae. Binary and multiple star system

- measurement of relative masses and velocities. Interstellar clouds – Nebulae.

Unit 3

Galactic astronomy: Distance measurement – red shifts and Hubble's law – age of the universe, galaxies – morphology

- Hubble's classification – gravitational lens, active galactic nuclei (AGNs), pulsars, quasars.

Relativity: Special theory of relativity – super-luminal velocity – Minkowski space – introduction to general theory of relativity – space – time metric, geodesics, space-time curvature. Advance of perihelion of Mercury, gravitational lens.

Cosmology: Cosmic principles, big bang and big crunch – cosmic background radiation – Nucleo-synthesis – planklength and time, different cosmic models – inflationary, steady state. Variation of G. anthropic principle.

REFERENCES:

1. *"Textbook of Astronomy and Astrophysics with elements of Cosmology", V. B. Bhatia, Narosa publishing 2001.*
2. *William Marshall Smart, Robin Michael Green "On Spherical Astronomy", (Editor) Carroll, Bradley W Cambridge University Press , 1977*
3. *Bradley W. Carroll and Dale A. Ostlie. "Introduction to modern Astrophysics" Addison-Wesley, 1996.*
4. *Bradley W. Carroll and Dale A. Ostlie, "An Introduction to Modern Astrophysics" Addison-Wesley*

Publishing Company, 1996

5. *'Stellar Astronomy' by K. D Abhayankar.*
6. *'Solar Physics' by K. D Abhayankar.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

MATHEMATICS

23MAT240

STATISTICAL INFERENCE

L-T-P-C: 3-0-0-3

Syllabus

Unit 1

Introduction to Statistics: Data Collection and Descriptive Statistics, Populations and Samples, describing data sets, summarizing data sets, Normal Data Sets, Paired Data Sets and the Sample Correlation Coefficient. Review of Random Variables and Distributions, Distributions of Sampling Statistics, The Sample Mean, The Central Limit Theorem, The Sample Variance, Sampling Distributions from a Normal Population, Distribution of the Sample Mean, Joint Distribution of $\bar{X}$ and S^2 , Sampling from a Finite Population.

Unit 2

Parameter Estimation: Introduction, Maximum Likelihood Estimators, Interval Estimates, Estimating the Difference in Means of Two normal populations, Approximate Confidence Interval for the Mean of a Bernoulli random variable, Confidence Interval of the Mean of the Exponential Distribution, Evaluating a Point Estimator, The Bayes Estimator. Hypothesis Testing: Introduction, Significance Levels, Tests Concerning the Mean of a Normal Population, Testing the Equality of Means of Two Normal Populations, Hypothesis Tests Concerning the Variance of a Normal Population, Tests Concerning the Mean of a Poisson Distribution.

Unit 3

Regression: Introduction, Least Squares Estimators of the Regression Parameters, Distribution of the Estimators, Statistical Inferences about the Regression Parameters, the Coefficient of Determination and the Sample Correlation Coefficient, Analysis of Residuals, transforming to Linearity, Weighted Least Squares, Polynomial Regression, Multiple Linear Regression, Predicting Future Responses, Logistic Regression Models for Binary Output Data.

TEXTBOOK:

1. *Ross S.M., Introduction to Probability and Statistics for Engineers and Scientists, 3rd edition, Elsevier Academic Press.*

REFERENCES:

1. *Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons Inc., 2005*
2. *Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.*
3. *Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 8th Edition, Pearson Education Asia, 2007.*
4. *Hogg, R.V., Tanis, E.A. and Rao J.M., Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Syllabus

Unit 1

Elements of Game theory, examples, Strategic Games, 2 Player Strategy Games, payoffs, Minimax, Weak and Strong Domination, Saddle Points, Nash Equilibrium, Prisoner's Dilemma, Stag Hunt, Matching pennies, BOS, Multi NE, Cooperative and Competitive Games, Strict and Non Strict NE, Best response functions for NE.

Unit 2

Combinatorial games, Winning and losing positions, Subtraction Game, 3-Pile and K-Pile Games, Proof of Correctness, Variations of K-Pile Games, Graph Games, Construction, Proof of finiteness, SG theorem for sum of games.

Unit 3

Cournot's Oligopoly, Bertrand's Oligopoly, Electoral Competition, Median Voter Theorem, Auctions, role of knowledge, Decision making and Utility Theory, Mixed Strategy Equilibrium, Extensive Games with Perfect Information, Stackelberg's model of Duopoly, Buying Votes, Committee Decision making, Repeated Games, Prisoner's Dilemma, Supermodular Game and Potential games

TEXTBOOK:

1. *Martin Osborne, An Introduction to Game Theory, Oxford University Press.*

REFERENCES:

1. *Thomas Ferguson, Game Theory, World Scientific, 2018.*
2. *Stef Tijs. Introduction to Game Theory, Hindustan Book Agency.*
3. *Allan MacKenzie, Game Theory for Wireless Engineers, Synthesis Lectures On Communications.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Syllabus**09 (a) Roots finding methods:**

Roots of Transcendental and Polynomial Equations: Bisection method, Iteration methods based on first degree equation, Rate of convergence, system of nonlinear equations.

09 (b) Interpolations:

Interpolation and Approximation: Lagrange, Newton's Divided Difference, Newton's Forward and Backward interpolations.

07 (b) Multivariable optimization (2 Credits)

Optimality criteria – unidirectional search – direct search methods – gradient based methods. Lagrangian and Kuhn– Tucker conditions.

TEXTBOOK:

1. *Edwin K.P. Chong, Stanislaw H. Zak, "An introduction to Optimization", 2nd edition, Wiley, 2013.*
2. *M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical methods for scientific and Engineering computation, New Age International Publishers, 2007, 5th edition.*

REFERENCES:

1. *Kalyanmoy Deb, "Optimization for Engineering Design: Algorithms and Examples, Prentice Hall, 2002.*
2. *S.S. Rao, "Optimization Theory and Applications", Second Edition, New Age International (P) Limited Publishers, 1995.*

Evaluation Pattern

		Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

FREE ELECTIVES OFFERED UNDER MANAGEMENT STREAM COMMON TO ALL

23MNG331

FINANCIAL MANAGEMENT

L-T-P-C: 3-0-0-

PROGRAMS

Course Objectives

- Understand the overview of financial management
- Inculcate methods and concepts on valuation
- Familiarize with working capital management, financial analysis and planning

Course Outcomes

CO1: Understand and apply time value concept of money and use this for investment criteria decisions.

CO2: Evaluate the risk and return for various alternatives of investment.

CO3: Apply the capital budgeting techniques and evaluate the investment decisions.

CO4: Understand working capital management, cash and liquidity management and financial

statements. **CO/PO Mapping**

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

Syllabus Unit

1

Introduction: Financial Management an overview – Financial Decisions in a firm – Goal of FM – Function of the financial system.

Unit 2

Fundamental Valuation Concepts: Time value of money – Risk and Return. Capital Budgeting: Techniques of capital budgeting investment criteria– NPV – Benefit Cost Ratio – IRR – Payback Period – ARR – Investment appraisal in Practice – Estimation of Project cost flows.

Unit 3

Working Capital Management: Current Assets – Financing Ruling – Profit Criterion. Cash and Liquidity Management. Working Capital Financing.

Financial Analysis and Planning: financial instruments, sources of long-term, intermediate term and short term finance. Analyzing Financial Performance – Break – even analysis and Leverages – Financial Planning and Budgeting.

Mergers and Takeovers–International trade.

TEXT BOOKS

1. Chandra, P., *'Financial Management: Theory and Practice'*, 9e, TMH, 2017.
2. Denzil Watson & Antony Head, *'Corporate Finance– Principles and Practice'*, 2e, Pearson Education Asia, 2016.
3. R L Varshney & K L. Maheshwari, *'Managerial Economics'*, S Chand & Sons, 22e, 2014.

REFERENCE BOOKS

1. *Stephen Blyth, 'An Introduction to Corporate Finance ', McGraw Hill Book Company, 2014.*
2. *Eugene F. Brigham & Louis C. Gapenski, 'Financial Management – Theory and Practice', 14e, 2015.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignments, Projects, and Reports

Course Objectives

- Understand the complexity and key issues in supply chain management.
- Describe logistics networks, distribution planning, routing design and scheduling models.
- Familiarize dynamics of supply chain and the role of information in supply chain.
- Understand the issues related to strategic alliances, global supply chain management, procurement and outsourcing strategies.

Course Outcomes

CO1: Analyze the complexity and key issues in supply chain management

CO2: Evaluate single and multiple facility location problems, logistics network configuration, vehicle routing and scheduling models

CO3: Analyze inventory management models and dynamics of the supply chain

CO4: Develop the appropriate supply chain through distribution requirement planning and strategic alliances

CO5: Identify the issues in global supply chain management, procurement and outsourcing strategies

CO/PO Mapping

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

Introduction: Introduction to SCM–the complexity and key issues in SCM – Location strategy – facility location decisions – single facility and multiple location models.

Logistics: Logistics Network Configuration – data collection–model and data validation– solution techniques–network configuration DSS – Transport strategy – Service choices: single service and inter modal services – vehicle routing and scheduling models – traveling salesman problems – exact and heuristic methods.

Unit 2

Inventory: Inventory Management and risk pooling–managing inventory in the SC. Value of Information–bullwhipeffect–lead time reduction.

Supply Chain Integration: Supply chain integration–distributed strategies–push versus pull systems. Distribution Requirements Planning – DRP and demand forecasting, DRP and master production scheduling. DRP techniques –time–phased order point – managing variations in DRP – safety stock determination–Strategic alliances–third party logistics–distribution integration.

Unit 3

Issues in SCM: Procurement and outsourcing strategies – framework of e–procurement. International issues in SCM– regional differences in logistics. Coordinated product and supply chain design– customer value and SCM.

TEXT BOOK

Simchi-Levi,D.,Kaminsky,P.,Simchi-Levi,E., Shankar,R., 'Designing and Managing the Supply Chain: Concepts,Strategies, and Cases', Tata McGraw Hill, 2008.

REFERENCE BOOKS

1. Christopher, M., 'Logistics and Supply Chain Management: Strategies for reducing Cost and Improving Service', PH, 1999.
2. Ballou, M., 'Business logistics / Supply chain management', Pearson Education, 2003.
3. Vollmann, T.E., 'Manufacturing Planning and Control for Supply Chain Management', 5e, McGraw Hill, 2005.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignments, Projects, and Reports

23MNG333**MARKETING MANAGEMENT****L-T-P-C: 3-0-0-****Course Objective**

To educate the students to apply concepts and techniques in marketing so that they become acquainted with the duties of a marketing manager with an emphasis to make the students exposed to the development, evaluation, and implementation of marketing management in a variety of business environments.

Course Outcomes

On successful completion of the Course students will be able to:

CO1: Illustrate key marketing concepts, theories and techniques for analysing a variety of marketing situations

CO2: Identify and demonstrate the dynamic nature of the environment in which marketing decisions are taken and appreciate the implication for marketing strategy determination and implementation

CO3: Develop the ability to carry out a research project that explores marketing planning and strategies for a specific marketing situation

CO4: Understand the need and importance of sales promotions and make use of advertising

CO5: Manage a new product development process from concept to commercialization.

CO6: Illustrate the importance of modern trends in retailing and marketing logistics

CO/PO Mapping

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

CO2		1	3	3		2	1			2	2	2			
CO3	1	1	1	3	2	2	2		2	2	2	3			
CO4			2	2		2	1	1		3	3	3			
CO5	1	1	3	2		1	1			1	2	3			
CO6	1	1	3	2		1	1			1	2	3			

Syllabus Unit

1

Marketing Process: Definition, Marketing process, dynamics, needs, wants and demands, value and satisfaction, marketing concepts, environment, mix. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy.

Buying Behaviour and Market Segmentation: Major factors influencing buying behaviour, buying decision process, business buying behaviour. Segmenting consumer and business markets, market targeting.

UNIT 2

Product Pricing and Marketing Research: Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

UNIT 3

Developing New Products – Challenges in new-product Development – Effective organizational arrangements – Managing the development Process: ideas – Concept to strategy – Development to commercialization – The consumer- adoption process.

Advertising Sales Promotion and Distribution: Characteristics, impact, goals, types, and sales promotions– point of

purchase– unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing.

TEXT BOOKS

1. *Kolter, P., 'Marketing Management', Pearson Education 2001.*
2. *Ramasamy and Namakumari, 'Marketing Environment: Planning, implementation and control the Indian context', 1990.*

REFERENCE BOOKS

1. *Paul, G.E. and Tull, D., 'Research for marketing decisions', Prentice Hall of India, 1975.*
2. *Tull, D.S. and Hawkins, 'Marketing Research', Prentice Hall of India-1997.*
3. *Kotler, P. and Armstrong, G., 'Principles of Marketing' Prentice Hall of India, 2000.*
4. *Skinner, S.J., 'Marketing', All India Publishers and Distributors Ltd. 1998.*
5. *Govindarajan, M., 'Industrial marketing management', Vikas Publishing Pvt. Ltd, 2003.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignments, Projects, and Reports

23MNG334**PROJECT MANAGEMENT****L-T-P-C: 3-0-0-****Course Objectives**

- To discuss the project life cycle and build a successful project from pre-implementation to completion.
- To introduce different project management tools and techniques

Course Outcomes

CO1: Appraise the selection and initiation of individual projects and its portfolios in an enterprise. **CO2:** Analyze the project planning activities that will predict project costs, time schedule, and quality. **CO3:** Develop processes for successful resource allocation, communication, and risk management.

CO4: Evaluate effective project execution and control techniques that results in successful project completion

CO/PO Mapping

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

Syllabus Unit**1**

Overview of Project Management: Verities of project, Project Features, Project Life Cycle – S-Curve, J-C **Project Selection:** Project Identification and Screening – New ideas, Vision, Long-term objectives, SWOT Analysis (Strength, Weakness, Opportunities, Threats).

Project Appraisal – Market Appraisal, Technical Appraisal, Economic Appraisal, Ecological Appraisal, and Financial Appraisal – Payback, Net Present Value (NPV), Internal Rate of Returns (IRR).

Project Selection – Decision Matrix, Technique for Order Preference using Similarity to Ideal Solution (TOPSIS), Simple Additive Weighting (SAW).

Unit 2

Project Presentation: WBS, Project Network – Activity on Arrow (A-O-A), Activity on Node (A-O-N). **Project Scheduling:** Gant Chart, Critical Path Method (CPM), Project Evaluation & Review Technique (PERT). **(6hrs)**

Linear time cost trade-offs in project – Direct cost, indirect cost, Project crashing
Resource Consideration – Profiling, Allocation, Levelling.

Introduction to project management software: Primavera/ Microsoft project

Unit 3

Project Execution: Monitoring control cycle, Earned Value Analysis (EVA), Project Control – Physical control, Human control, financial control.

Organizational and Behavioral Issues: Organizational Structure, Selection–Project Manager, Leadership Motivation, Communication, Risk Management.

Project Termination: Extinction, Addition, Integration, Starvation.

TEXT BOOKS

1. Jack R. Meredith and Samuel J. Mantel, Jr. – ‘Project Management– A Managerial Approach’ Eighth Edition – John Wiley & Sons Inc – 2012.
2. Arun Kanda – ‘Project Management–A Life Cycle Approach’ PHI Learning Private Limited – 2011

REFERENCE BOOKS

1. *'A Guide to Project Management Body of Knowledge' PMBOK GUIDE, Sixth edition, Project management Institute - 2017*
2. *Ted Klastorin - 'Project Management, Tools, and Trade-Offs' - John Wiley - 2011*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignments, Projects, and Reports

Course Objectives

- To impart knowledge on the fundamentals of costing, pricing methods and strategies.
- To give an overview of production operations planning.
- To summarize various quantitative methods of plant location, layout and lean manufacturing.
- To familiarize the concepts of e-commerce, e-purchasing, MRP and ERP in business

Course Outcomes

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

- CO1:** Understand the concepts of cost and pricing of goods and appraise project proposals
- CO2:** Design and analyze manufacturing and service processes and to measure the work performed.
- CO3:** Understand and analyze the key issues of supply chain Management
- CO4:** Understand the application of lean manufacturing tools and six sigma concepts
- CO5:** Select appropriate plant location and their layout methods
- CO6:** Create capacity plan, aggregate plan, schedule, ERP & MRP systems

CO/PO Mapping

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

1

Engineering Economics: cost concepts – types of costs – cost functions. Cost controls: reduction – tools & applications. Pricing policies – methods – problems. Process design and improvement – process capacity – process layout – process reengineering – job design. Work standards – work measurement – work sampling – problems.

Unit 2

Supply Chain Management – Basic Concepts, SC dynamics, push–pull boundary, integrated supply chain, logistics, customer relationship, supplier relationship – selection, rating and development, procurement, SC metrics and performance measurement – problems. Lean Manufacturing – concepts, wastes – tools viz., pull system, standardized work, takt time, kanban system, JIT, kaizen, SMED, 5S, value stream mapping, benefits of lean and implementation issues. Introduction to Six Sigma. Plant Location – globalization, factors affecting location decisions, facility location– Break–even method, rectilinear, factor–rating and centre of gravity – problems. Plant Layout – types, process layout, product layout, Systematic layout planning (SLP), Line Balancing problems. Capacity Planning – Aggregate Planning

– importance, planning process, methods – problems.

Unit 3

Role of IT in business performance improvement – e–commerce – e–purchasing – Master Production Schedule, inventory lot sizing strategies, MRP basics – MRP explosion, Available to Promise (ATP) inventory – MRP calculations – MRP II – Scheduling – Gantt chart – Introduction to ERP – ERP software – ERP modules – ERP implementation.

TEXT BOOKS

1. *L J Krajewski, L.P.RitzmanMalhotra.M and Samir K. Srivastava, 'Operations Management: Processes and Value chains, 11e, Pearson, 2015.*
2. *R L Varshney& K L. Maheshwari, 'Managerial Economics', S Chand & Sons, 22e, 2014.*

REFERENCE BOOKS

1. *Richard B. Chase, Ravi Shankar, F. Robert Jacobs, 'Operations and Supply Chain Management' McGrawHill Education (India) Private Limited.14e, 2017.*
2. *E S Buffa and R K Sariss, 'Modern Production/Operations Management', Wiley India Private Limited, 8e,2007.*
3. *Harrison.B, Smith.C., and Davis.B., 'Introductory Economics', 2e Pr Macmillan, 2013.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignments, Projects, and Reports.

Course Objectives

Familiarizing the students with quantitative tools and techniques, which are frequently applied in operational decisions

Course Outcomes

- CO1:** Formulate operations research models to optimize resources.
- CO2:** Solve transportation and assignment problems using suitable techniques.
- CO3:** Apply appropriate technique to analyze a project with an objective to optimize resources.
- CO4:** Solve operational problems using decision theory approaches.
- CO5:** Select suitable inventory model for effective utilisation of resources.
- CO6:** Solve Operations Research problems using software package

CO/PO Mapping

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

Syllabus

Unit1

Linear Programming: Formulations – graphical solutions – Simplex Method – Duality, Dual simplex method, Transportation model: Assignment model – Travelling Salesman Problem.

Unit 2

Decision Theory: Decision Trees. Game theory – 2 person zero sum; mixed strategies; $2 \times n$ and $m \times 2$ games. Network Models– Project Networks– CPM / PERT– Project Scheduling – crashing networks and cost considerations–Resource leveling and smoothing – shortest route problem, minimal spanning tree problem, maximal flow problem.

Unit 3

Sequencing model – 2 machines ‘n’ jobs, ‘m’ machines ‘n’ jobs – n jobs 2 machines.

Inventory models: deterministic & probabilistic models. Quantity discounts. Selective Inventory Management Queuing models: Poisson arrival and exponential service times. Single server, multi-server. Queues –infinite and finite capacity queues.

Simulation –Monte Carlo simulation: simple problems

Lab session: Practicing case problems with excel solver/MatLab/LINGO package

TEXT BOOK

Hillier, F.S. and Lieberman, G.J., 'Operations Research', 9e, McGraw Hill, 2010

REFERENCE BOOKS

1. *Taha, H.A., 'Operations Research: an Introduction', 8e, Prentice Hall, New Delhi, 2008.*
2. *Ravindran, A., Phillips, D.J., and Solberg, J.J., 'Operations Research– Principles and Practice', John Wiley & Sons, 2005.*
3. *Wagner, H.M., 'Principles of Operations Research', Prentice Hall, New Delhi, 1998.*

4. *Hardley, G., 'Linear Programming', Narosa Book Distributors Private Ltd 2002.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	15	
*Continuous Assessment(Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignments, Projects, and Reports

23MEE321**INDUSTRIAL ENGINEERING****L-T-P-C: 3-0-0-****Course Objectives**

- To inculcate the concepts of work study and its application to industrial practice
- Impart skills to design, develop, implement, and improve manufacturing/service systems

Course Outcomes

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

CO1: Create value to organizations through the analysis, evaluation, and improvement of work systems using work study and method study

CO2: Develop work systems through motion economy principles

CO3: Apply work measurement techniques to improve productivity, fix wages and incentives

CO4: Apply systematic layout planning techniques and work station design principles based on ergonomics and material handling.

CO/PO Mapping

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

Syllabus Unit**1**

Work System: Elements of work, maintenance of machines, interaction, effect of working conditions and environment, physical and mental fatigue.

Productivity: Productivity, factors affecting production, Measurement of productivity.

Work Study: Definition and scope of work study; Areas of application of work study in industry; Human aspects of work study.

Method Study: Information collection, recording techniques, and processing aids; critical examination; development, installation and maintenance of improved methods.

Unit 2

Motion Economy and Analysis: Principles of motion economy; Motion analysis; Micromotion and Memomotion study; Therbligs and SIMO charts; Normal work area and design of work places; Basic parameters and principles of work design.

Work Measurement: Work measurement techniques; Calculation of standard time, work sampling and predetermined Motion time systems.

Wages and Incentive Schemes: Introduction, wage payment of direct and indirect labour, wage payment plans and incentives, various incentive plans, incentives for indirect labour

Unit 3

Plant Layout: Concept of plant layout, types of layout; factors affecting plant layout.

Ergonomics: Ergonomic Design of equipment and work place. work station design, factors considered in designing a work station, ergonomic design standards – Study of development of stress in human body and their consequences. Case Studies. Production planning and scheduling.

Material Handling: Introduction and functions of material handling equipment, selection of material handling equipment for different requirements, safety requirements.

Recent advances in Industrial Engineering.

TEXT BOOKS

1. Barnes, R, "Motion and Time Study" – Design and Measurement of Work . NY: John Wiley and Sons, 8th Edition, 1985.
2. "Introduction to Work Study", 4ed, International Labor Office, Geneva, 2006.

REFERENCE BOOKS

1. Martand T. Telsang, 'Industrial Engineering and Production Management' S Chand; 2nd Rev Edn 2006.
2. Mahajan M., "Industrial Engineering and Production Management" Dhanpat rai and Sons Publishers, 2005.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continues Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignments, Projects, and Reports

23MEE323**MANAGERIAL STATISTICS****L-T-P-C: 3-0-0-****Course Objective**

To impart the knowledge of basic statistical tools for analysis and interpretation of qualitative and quantitative data for decision making

Course Outcomes

CO1: Apply basic probability and statistics concepts for various business problems

CO2: Perform test of hypothesis

CO3: Compute and interpret the result of regression and correlation analysis for forecasting

CO4: Solve real time problems by applying different decision making methods.

CO/PO Mapping

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

Syllabus Unit**1**

Quantitative methods: Basic terminology in probability, probability rules, conditions of statistical dependence and independence, Bayes Theorem, Discrete Random Variables review of probability distributions, measure of central tendency.

Sampling and sampling distributions: Introduction to sampling, random sampling, design of experiments, introduction to sampling distributions

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Estimation: point estimates, interval estimates and confidence intervals, calculating interval estimates

of mean from large samples, using t test, sample size estimation.

Unit 2

Testing hypothesis: Introduction, basic concepts, testing hypothesis, testing when population standard deviation is known and not known, two sample tests.

Chi-square and analysis of variance: introduction, goodness of fit, analysis of variance, inferences about a population variation

Unit 3

Regression and correlation: Estimation using regression line, correlation analysis, finding multiple regression equation, modelling techniques,

Non parametric methods and time series and forecasting: Sign test for paired data, rank sum test, rank correlation, Kolmogorov – smirnov test, variations in time series, trend analysis, cyclic variation, seasonal variation and irregular variation. Decision theory: Decision tree analysis

TEXT BOOKS

1. *Levin R. I. and Rubin D. S. – ‘Statistics for management’ – Pearson Education – 2007 – 5th Edition*
2. *Montgomery D. C. and Runger G. C. – ‘Applied Statistics and Probability for Engineers’ – John Wiley & Sons – 2002 – 3rd Edition*

REFERENCE BOOKS

1. *Bain.L. J. and Engelhardt M. – ‘Introduction to Probability and Mathematical Statistics’ – Duxbury Press –*

March 2000 – 2nd Edition

2. *Hinkelmann K. and Kempthorne O. – ‘Design and Analysis of Experiments : Volume I’ – John Wiley & Sons, Inc. – December 2007 – 2nd Edition*
3. *Johnson R. A. and Wichern D. W. – ‘Applied Multivariate Statistical Analysis’ – Prentice-Hall, Inc. – December 2001 – 5th Edition*
4. *Myers R. H. – ‘Classical and Modern Regression with Applications’ – PWS-Kent Publishing Company – March 2000 – 2nd Edition*
5. *Devore J. L. – ‘Probability and Statistics for Engineering and the Sciences’ – Brooks/Cole Publishing Company – December 1999 – 5th Edition*
6. *Freund J. E. and Walpole R. E. – ‘Mathematical Statistics’ – Prentice-Hall Inc. – October 1986 – 4th Edition*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignments, Projects, and Reports

Course Objective

To impart knowledge on quality management principles, tools, techniques and quality standards for real life applications

Course Outcomes

CO1: Evaluate the principles of quality management and to explain how these principles can be applied within quality management systems.

CO2: Evaluate the performance measures using various quality and management tools

CO3: Apply the Quality Function Deployment, Taguchi principles, Total Productive Maintenance and Failure Mode and Effect Analysis concepts to solve industrial problems.

CO4: Practice the various quality system in industry.

CO/PO Mapping

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

Syllabus Unit

1

Definition of quality – dimensions of quality. Quality planning – quality costs. Total Quality Management: historical review and principles – leadership – quality council – quality statements – strategic planning – Deming philosophy. Barriers to TQM implementation

Unit 2

Continuous process improvement – Supplier partnership – Performance measures. Seven tools of quality. Statistical fundamentals – Control Charts for variables and attributes – Process capability – Concept of six sigma – New seven management tools

- Benchmarking.

Unit 3

Quality function deployment (QFD) – Taguchi quality loss function – Total Productive Maintenance (TPM) – FMEA. Need for quality systems – ISO 9000:2000 – Elements of quality systems (such as ISO 9000:2000). Implementation of quality system – documentation – quality auditing – QS 9000–ISO 14000

TEXT BOOK

Besterfield D. H. – ‘Total Quality Management’ – Pearson Education Asia – 2015–4th Edition

REFERENCE BOOKS

1. *Evans J. R, and Lindsay W. M. – ‘The Management and Control of Quality’ – South-western (Thomson Learning) – 2002 – 5th Edition*
2. *Feigenbaum A. V. – ‘Total Quality Management – Vol I & II ’ – McGraw Hill – 1991*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignments, Projects, and Reports

Course Objectives

- Understand Lean manufacturing principles and tools
- Inculcate the concepts of value stream mapping
- Familiarize lean implementation practices

Course Outcomes

CO1: Identify key requirements and concepts in lean manufacturing.

CO2: Initiate a continuous improvement change program in a manufacturing organization
CO3: Analyze and improve a manufacturing system by applying lean manufacturing tools
CO4: Build value stream map for improving the productivity

CO5: Improve productivity through lean practices

CO/PO Mapping

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

Syllabus Unit

1

Introduction to Lean and Factory Simulation: History of Lean and comparison to other methods – The 7 Wastes, their causes and the effects – An overview of Lean Principles / concepts / tools – Stockless Production.

The Tools of Lean Manufacturing: Continuous Flow – Continuous Flow Manufacturing and Standard Work Flow – 5S and Pull Systems (Kanban and ConWIP systems) – Error Proofing and Set-up Reduction – Total Productive Maintenance (TPM) – Kaizen Event examples. Toyota production

Unit 2

Value Stream Mapping – Current state: Preparation for building a Current State Value Stream Map – Building a Current State Map (principles, concepts, loops, and methodology) – Application to the factory Simulation scenario.

Unit 3

Value Stream Mapping – Future State: Key issues in building the Future State Map – Process tips in building the map and analysis of the customer loop, supplier loop, manufacturing loop and information loop – Example of completed Future State Maps – Application to factory simulation
Implementation of lean practices – Best Practices in Lean Manufacturing.

TEXT BOOKS

1. *Womack, J.P., Jones, D.T., and Roos, D., 'The Machine that Changed the World', Simon & Schuster, New York, 2007.*
2. *Liker, J.K., 'Becoming Lean', Industrial Engineering and Management Press, 1997.*

REFERENCES BOOKS

1. *Womack, J.P. and Jones, D.T., 'Lean thinking', Simon & Schuster, USA, 2003.*
2. *Rother, M. and Shook, J., 'Learning to see', The Lean Enterprise Institute, Brookline, USA, 2003.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignments, Projects, and Reports

Course Objectives

- This course describes the key aspects of a software project.
- It introduces the basic principles of Engineering Software Projects. Most, if not all, students' complete projects as part of assignments in various courses undertaken. These projects range in size, subject and complexity but there are basic project essentials that need to be understood and practiced for successful team project outcomes.
- The course provides an understanding of the purpose, methods and benefits of process management by exposing the student to the concepts, practices, processes, tools and techniques used in process management for software development.

Course Outcomes

CO 1: To understand the basic concepts, terminologies and issues of software project management.

CO 2: To apply appropriate methods and models for the development of solutions.

CO 3: To analyze the cost-benefits of calculations so as to optimize the selection strategy

CO 4: To evaluate methods, models and technologies towards achieving project success

CO 5: To design and evaluate network planning models with criticality

CO-PO Mapping

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

1

Introduction to Software Project Management– Software Projects – ways of categorizing software projects – problems with software projects – Project Life Cycle– Management –Setting objectives – Stakeholders – Project Team– Step-wise

: An overview of project planning –project Evaluation –Selection Of Appropriate Project Objectives– Software Effort Estimation Techniques, Function Point Analysis–Object Point–COCOMO.

Unit 2

Activity planning-- project schedules – sequencing and scheduling projects – Network planning model – AON and AOA–identifying critical activities–Crashing And Fast Tracking–,Risk management—Categories , Risk planning, Management and Control – Evaluating risks to the schedule. PERT– Resource Allocation, Monitoring and Tracking –Monitoring and control – allocation – identifying resource requirements – scheduling resources – creating critical paths

- publishing schedule – cost schedules– sequence schedule.

Unit 3

Monitoring and control – Visualizing Progress, Earned value analysis, managing people and organizing teams– organizational structures– Planning for small projects. Case Study: PMBOK , Agile Development

TEXT BOOK(S)

Mike Cotterell, Bob Hughes. Software Project Management, Fifth Edition, Tata McGraw-Hill; 2012.

REFERENCE(S)

1. *Roger S. Pressman. Software Engineering – A Practitioner's Approach, Eighth Edition, Tata McGraw–Hill publishers; 2014.*
2. *Jalote P. Software Project Management in practice, Second edition, Person Education; 2003.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Pre-Requisite(s): 19MAT112 Linear Algebra, 19MAT205 Probability and Random Processes

Course Objectives

- This course serves as an introduction to financial engineering including cash flows, financial decision making etc
- It gives a thorough yet highly accessible mathematical coverage of standard and recent topics of introductory investments: fixed-income securities, modern portfolio theory, optimal portfolio growth and valuation of multi-period risky investments.

Course Outcomes

CO1: Apply basic concepts to understand and evaluate cash flows

CO2: Evaluate and arrive at a financial investment decision employing the underlying knowledge of stocks and derivatives

CO3: Analyse and design Portfolio selection methods

CO4: Understand capital market theory for stock performance evaluation

CO-PO Mapping

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

1

Cash Flows and Fixed income securities: Investments and markets – Principal and interest – Present and future values of streams – IRR. Fixed income securities – Market value for future cash – Bond value – Bond details – Yields – Convexity – Duration – Immunization. Bond portfolio management – Level of market interest rates, Term structure of interest-rate theories.

Unit 2

Stocks and Derivatives: Common stock valuation – Present value of cash dividends – Earnings approach – Value versus price – Efficient markets theory – Technical analysis. Analysis of financial statements. Derivatives – futures and options

- Black Scholes formula – Utility functions – Applications in financial decision making.

Unit 3

Portfolio analysis and capital market theory: Covariance of returns – Correlation – Portfolio return – Portfolio standard deviation – Two asset case – Efficient frontier – Optimum portfolio. Capital market theory – Capital market line – Sample diversifications to reduce risk – Characteristic line – Capital asset pricing model. Arbitrage price theory – Stock performance evaluation.

TEXT BOOK(S)

1. *David Luenberger, Investment Science. Second Edition, Oxford University Press; 2013*
2. *Jack Clark Francis, Richard W. Taylor. Investments, Schaum's Outlines, Tata McGraw Hill ;2006.*

REFERENCE(S)

1. Lyuu YD. Financial Engineering and Computation. Cambridge University Press; 2004.

23CSE323

ENGINEERING ECONOMIC ANALYSIS

L-T-P-C: 3-0-0-3

Course Objectives

- Prepare engineering students to analyze and understand the business, impact of economic environment on business decisions

Course Outcomes

CO1: Understand and evaluate the economic theories, cost concepts and pricing policies and draw inferences for the investment decisions for appraisal and profitability

CO2: Appraise the dynamics of the market and market structures and portray implication for profit and revenue maximization

CO3: Employ operations research and allied techniques in managerial economics for an enhanced analysis and decision making

CO-PO Mapping

PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO														
CO1	2	3	2	2		2		2			3	2	3	2
CO2	1	3	2	1		2		2			3	2	3	2
CO3	2	3	2	2		2		2			3	2	3	2

Syllabus Unit

1

Economics: Nature and scope of managerial economics. Economic theory and managerial economics,

Cost Concepts: Types of costs – Cost functions. Cost controls: reduction – Tools & Areas. Pricing policies – methods. Capital budgeting

- cost of capital. Appraising project profitability

Unit 2

The essentials of demand and supply: The law of demand. Market demand curve. Other determinants of market demand. The law of supply. Determinants of market supply. The market mechanism. Price elasticity of demand, Profit and revenue maximization: Optimal input combination. Total revenue maximization.

Unit 3

Market structure: Perfect competition and monopoly. Characteristics of monopolistic competition. Oligopoly Operations Research techniques in managerial economics: Inventory models. Theory of games. Decision theory, Risk and Uncertainty, Measuring risk, Consumer behavior and risk aversion, Decision making under uncertainty with complete ignorance

TEXT BOOK(S)

Webster, T.J. Managerial Economics– Theory and Practice, Elsevier; 2004.

REFERENCE(S)

1. *Panneerselvam, R. Engineering Economics, Second Edition, PHI; 2013.*
2. *R L Varshney, K L. Maheshwari. Managerial Economics, S Chand & Sons; 2014.*
3. *Harrison.B, Smith.C., and Davis.B. Introductory Economics, Second Edition, Pr Macmillan; 2013.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Objectives

- This course is to expose the students to the managerial issues relating to information systems and also understand the role of Business Process Reengineering technique in an organization.
- The course also focus on the management of information technology to provide efficiency and effectiveness or strategy decision making.

Course Outcomes

CO1: Understand the fundamental concepts of Information Systems in business.

CO2: Understand and analyse the strategic role played by Information Systems in e-commerce.

CO3: Analyse management challenges in Global Businesses predominantly dependent on IS functions.

CO-PO Mapping

PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO														
CO1	3												3	2
CO2	2	2			2								3	2
CO3	1	3			2	2					2	1	3	2

Syllabus Unit

1

Introduction to IS –Fundamental concepts–IS in Business– Role of IS –Information system and technologies – Components of IS –resources and activities –Types of IS– E business Applications – Role of BI and Analytics in IS–Functional Business Systems – Marketing Systems, Manufacturing systems, Human Resource Systems, Accounting Systems and Financial Management Systems.–Cross-Functional Enterprise Systems Cross-Functional Enterprise Applications, Enterprise Application Integration, Transaction Processing Systems and Enterprise Collaboration Systems. Enterprise

Unit 2

Electronic Commerce Systems : Scope of e-Commerce, Essential e-Commerce Processes and Electronic Payment Processes – E-commerce Applications & Issues – Decision Support Systems– Business and Decision Support, Decision Support Trends, Management Information Systems, Online Analytical Processing, Decision Support Systems, Executive Information Systems, Enterprise Portals and Decision Support – Knowledge Management Systems. Artificial Intelligence Technologies and its application in Business– Strategic role of IT– Competing with IT, value chain ,reengineering, virtual organization ,knowledge creation–Organizational Planning, The Scenario Approach, Planning for Competitive Advantage, SWOT Business Models and Planning, Business IT Planning, –Business/ IT Strategies and Business Application Planning– Developing and Implementing Business Systems – Implementation Challenges– barriers – change management–: Case Studies

Unit 3

Management challenges–Security, Ethical and Societal Challenges– Ethical Responsibility of Business Professionals, Computer Crime, Privacy Issues, Health Issues, and Societal Solutions– Security Management of IT– Tools of security Management, Internetworked Security Defenses, other security measures –system controls and audits– Enterprise and Global Management of IT– Managing the IS Function and Failures in IT Management – Global IT Management, Cultural, Political and Geo-economic Challenges, Global Business/IT Strategies, Global Business/IT Applications, Global IT Platforms, Global Data Access Issues and Global Systems Development –Case studies

TEXT BOOK(S)

1. O'Brien JA, Marakas GM. *Management information systems*. McGraw-Hill Irwin; 2006.
2. Brien, Marakas G M and Behi R , *MIS, 9th edition, Tata McGraw Hill Special Indian Edition; 2010.*

REFERENCE(S)

Laudon K, Laudon JP. Management Information Systems; 2010

Evaluation Pattern

Assessment	Internal	External
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

FREE ELECTIVES OFFERED UNDER HUMANITIES / SOCIAL SCIENCE STREAMS COMMON TO ALL PROGRAMS

23CUL230	ACHIEVING EXCELLENCE IN LIFE –AN INDIAN PERSPECTIVE	L–T–P–C: 2–0–
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Course Objectives:

The course offers to explore the seminal thoughts that influenced the Indian Mind on the study of human possibilities for manifesting excellence in life. This course presents to the students, an opportunity to study the Indian perspective of Personality Enrichment through pragmatic approach of self analysis and application.

Syllabus Unit

1

Goals of Life – Purusharthas

What are Purusharthas (Dharma, Artha, Kama, Moksha); Their relevance to Personal life; Family life; Social life & Professional life; Followed by a Goal setting workshop;

Yogic way of Achieving Life Goals – (Stress Free & Focused Life)

Introduction to Yoga and main schools of Yoga; Yogic style of Life & Time Management (Work Shop); Experiencing life through its Various Stages

Ashrama Dharma; Attitude towards life through its various stages (Teachings of Amma);

Unit 2

Personality Development

What is Personality – Five Dimensions – Pancha Kosas (Physical / Energy / Mental

/ Intellectual / Bliss); Stress Management & Personality; Self Control & personality; Fundamental Indian Values & Personality;

Learning Skills (Teachings of Amma)

Art of Relaxed Learning; Art of Listening; Developing ‘Shraddha’ – a basic qualification for obtaining Knowledge;

Communication Skills – An Indian Perspective;

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Unit 3

Developing Positive Attitude & Friendliness – (Vedic Perspective);

Achieving Work Excellence (Karma Yoga by Swami Vivekananda & teachings based on Amma); Leadership Qualities – (A few Indian Role models & Indian Philosophy of Leadership);

REFERENCE BOOKS:

1. *Awaken Children (Dialogues with Sri Mata Amritanandamayi) Volumes 1 to 9*
2. *Complete works of Swami Vivekananda (Volumes 1 to 9)*
3. *Mahabharata by M. N Dutt published by Parimal publications – New Delhi (Volumes 1 to 9)*
4. *Universal message of Bhagavad-Gita (An exposition of Gita in the light of modern thought and Modern needs) by Swami Ranganathananda. (Vols.1 to 3)*
5. *Message of Upanishads, by Swami Ranaganathananda published by Bharatiya Vidya Bhavan, Bombay.*
6. *Personality Development – Swami Vivekananda published by Advaita Ashram, Kolkatta.*
7. *Art of Man Making – Swami Chinmayananda published by Chinmaya Mission, Bombay*
8. *Will Power and its Development– Swami Budhananda published by Advaita Ashram, Kolkatta*
9. *Ultimate Success – Swami Ramakrishnananada Puri published by Mata Amritanandamayi Math, Kollam*
10. *Yoga In Daily Life – Swami Sivananda – published by Divine Life Society*
11. *Hindu Dharma – H. H. Sri Chandrasekharandra Saraswati published by Bharatiya Vidya Bhavan, Bombay*
12. *All about Hinduism – Swami Sivananda – Published by Divine Life Society*
13. *The Mind and its Control by Swami Budhananda published by Advaita Ashram, Kolkatta*
14. *Krida Yoga – Vivekananda Kendra, Publication.*
15. *Valmiki Ramayana – Four volumes– published by Parimal Publications, Delhi*

16. *New perspectives in Stress Management – Dr H R Nagendra & Dr R Nagaratna published by Swami Vivekananda Yoga Prakashana, Bangalore.*
17. *Mind Sound Resonance Technique (MSRT) Published by Swami Vivekananda Yoga Prakashana, Bangalore.*
18. *Yoga & Memory – Dr H R Nagendra & Dr. Shirley Telles, published by Swami Vivekananda Yoga Prakashana, Bangalore.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23CUL231**EXCELLENCE IN DAILY LIFE****L-T-P-C: 2-0-0-**

Syllabus

Unit 1

1. The anatomy of 'Excellence'. What is 'excellence'? Is it judged by external factors like wealth?
2. The Great Flaw. The subject-object relationship between individual and world. Pro-mote subject enhance excellence.
3. To work towards excellence, one must know where he is. Our present state... An in-trospective analysis. Our faculties within.

Unit 2

4. The play of the mind. Emotions - convert weakness into strength.
5. The indispensable role of the intellect. How to achieve and apply clear thinking?
6. The quagmire of thought. The doctrine of Karma - Law of Deservance.
7. Increase Productivity, reduce stress.. work patterning.

Unit 3

8. The art of right contact with the world. assessment, expectations.
9. Myths and Realities on key issues like richness, wisdom, spirituality.
10. Collect yourself, there is no time to waste. The blue-print of perfect action.

REFERENCES:

The Bhaja Govindam and the Bhagavad Gita.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
Continuous Assessment (CA)	20	

End Semester		50
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*CA – Can be Quizzes, Assignment, Projects, and Reports.

OBJECTIVES:

This course offers a journey of exploration through the early developments in India of astronomy, mathematics, technologies and perspectives of the physical world. With the help of many case studies, the students will be equipped to understand concepts as well as actual techniques.

Syllabus Unit**1**

1. General introduction: principles followed and sources;
2. Astronomy & mathematics from the Neolithic to the Indus civilization;
3. Astronomy & mathematics in Vedic literature;
4. Vedanga Jyotisha and the first Indian calendars;
5. Shulba Sutras and the foundations of Indian geometry;

Unit 2

1. Astronomy & mathematics in Jain and Buddhist literature;
2. The transition to the Siddhantic period; Aryabhata and his time;
3. The Aryabhatiya: concepts, content, commentaries;
4. Brahmagupta and his advances;
5. Other great Siddhantic savants;
6. Bhaskara II and his advances;

Unit 3

1. The Kerala school of mathematics;
2. The Kerala school of astronomy;
3. Did Indian science die out?;
4. Overview of recent Indian scientists, from S. Ramanujan onward;
5. Conclusion: assessment and discussion;

TEXTBOOK:

Indian Mathematics and Astronomy: Some Landmarks, by S. Balachandra Rao

REFERENCE:

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

OBJECTIVES:

This course offers the foundation necessary to understand Eastern approaches to psychology and spirituality. The course includes experiential components centering on meditation and spiritual practice.

Syllabus Unit**1****Introduction**

Introduction to Modern Psychology

A short history of Modern Psychology – Major Schools of Modern Psychology – The three major forces in Western Psychology – Freudian Psychoanalysis; Behaviourism; Humanistic Psychology.

Introduction to Indian Psychology

What is Yoga? – Rise of Yoga Psychology tradition – Various schools of Yoga Psychology – Universal Goal of all Yoga-schools.

Patanjali Yoga Sutra – 1

Introduction to Rishi Patanjali – Bird view of Yoga-Sutra – Definition of Yoga – Vrittis.

Patanjali Yoga Sutra – 2

Five Kinds of Vrittis – Pramanam – sources of right knowledge – Viparyayah – unfolded belief – Vikalpah – Unfolded belief – Smriti – Memory.

Unit 2

Patanjali Yoga Sutra – 3

Two formulae – Necessity of Abhyasah and Vairagyah – Foundation of Abhyasah – Foundation of Vairagyah.

Patanjali Yoga Sutra – 4

Introduction to Samadhi – Samprajnata–Samadhi – Reasoning in Samprajnata–Samadhi – Reflection in Samprajnata– Samadhi – Bliss in Samprajnata–Samadhi – Sense of Individuality in Samprajnata–Samadhi.

Patanjali Yoga Sutra – 5

Main obstacles in the path of Yoga – other obstructions – removal of obstacles by one – pointedness; by controlling Prana – by observing sense experience – by inner illumination – by detachment from matter – by knowledge of dream and sleep – by meditation as desired.

Patanjali Yoga Sutra – 6

How to make mind peaceful? – Cultivating opposite virtues: happiness – friendliness – misery – compassion – virtue

– gladness – vice – indifference.

Patanjali Yoga Sutra – 7

Five causes of Pain – avidya – ignorance (Root Cause) – asmita – ‘I-Feeling’ – raga – attraction – dwesha – repulsion

– abhinivesha – clinging to life.

Unit 3

Patanjali Yoga Sutra – 8

Necessity of Yoga practice – eight parts of Yoga practice – five Yamas: ahimsa – satya – asteya – brahmacharyam

– aparigraha.

Patanjali Yoga Sutra – 9

Five Niyamas: Soucha – Santhosha – Tapas – Swadyah – Ishwara – Pranidhanam.

Patanjali Yoga Sutra – 10

Asanam – Pranayamah – various kinds of Pranayamah – Pratyaharah – Mastery over the senses. Report review Conclusion

REFERENCES:

1. *The course book will be “The four chapters of Freedom” written by Swami Satyananda Saraswati of Bihar School of Yoga, Munger, India.*
2. *“The message of Upanishads” written by Swami Ranganathananda. Published by Bharathiya Vidya Bhavan.*
3. *Eight Upanishads with the commentary of Sankaracharya, Translated by Swami Gambhirananda, Published by Advaita Ashram, Uttaranjal.*
4. *‘Hatha Yoga Pradipika’ Swami Muktibodhananda, Yoga Publications Trust, Munger, Bihar, India*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23ENG230**BUSINESS COMMUNICATION****L-T-P-C: 1-0-3-****OBJECTIVES:**

To introduce business vocabulary; to introduce business style in writing and speaking; to expose students to the cross-cultural aspects in a globalised world; to introduce the students to the art of persuasion and negotiation in business contexts.

Course Outcomes

CO1: Familiarize and use appropriate business vocabulary and etiquettes in verbal communication in the professional context

CO2: Understand organizational structures, pay structures and performance assessments

CO3: Apply language skills in drafting various business documents and other necessary communications in the business context

CO4: Understand and address cross cultural differences in the corporate environment
CO5: Participate in planned and extempore enactments of various business situations

CO-PO Mapping

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

CO5									2			
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Syllabus Unit

1

Business Vocabulary – Writing: Drafting Notices, Agenda, and Minutes – Reading: Business news, Business articles.

Unit 2

Writing: Style and vocabulary – Business Memorandum, letters, Press Releases, reports – proposals –
Speaking: Conversational practice, telephonic conversations, addressing a gathering, conducting meetings.

Unit 3

Active Listening: Pronunciation – information gathering and reporting – Speaking: Cross-Cultural Issues, Group Dynamics, negotiation & persuasion techniques.

Activities

Case studies & role-plays.

BOOKS RECOMMENDED:

1. Jones, Leo & Richard Alexander. *New International Business English*. CUP. 2003.
2. Horner, David & Peter Strutt. *Words at Work*. CUP. 1996.
3. Levi, Daniel. *Group Dynamics for Teams*. 3 ed. Sage Publications India Pvt. Ltd. New Delhi, 2011.
4. Owen, Roger. *BBC Business English*. BBC. 1996.

5. *Henderson, Greta Lafollette & Price R Voiles. Business English Essentials. 7th Edition. Glencoe / McGrawHill.*
6. *Sweeney, Simon. Communicating in Business. CUP. 2000.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

OBJECTIVES:

To expose the students to the greatness of Indian Thought in English; to develop a sense of appreciation for the lofty Indian Thought; to develop an understanding of the eclectic Indian psyche; to develop an understanding about the societal changes in the recent past.

Syllabus Unit**1 Poems**

Rabindranath Tagore's Gitanjali (1-10); Nizzim Ezekiel's Enterprise; A.K. Ramanujam's Small-Scale Reflections on a Great House.

Unit 2**Prose**

Khushwant Singh's The Portrait of a Lady; Jhumpa Lahiri's Short Story – Interpreter of Maladies.

Unit 3**Drama and Speech**

Vijay Tendulkar's Silence, the Court is in Session; Motivational speeches by Jawaharlal Nehru/ S. Radhakrishnan

/ A. P. J. Abdul Kalam's My Vision for India etc. (any speech).

REFERENCES:

1. Lahiri, Jhumpa. *Interpreter of Maladies*, Harper Collins Publications, 2000.
2. Ramanujan A. K. ed. K. M. George, *Modern Indian Literature: An Anthology*, Vol. I, Sahitya Akademi, 1992.
3. Singh, Khushwant. *The Portrait of a Lady: Collected Stories*, Penguin, 2009.
4. Tagore, Rabindranath. *Gitanjali*, Penguin Books India Pvt. Ltd, 2011.
5. Tendulkar, Vijay. *Five Plays*, Oxford University Press, 1996.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

OBJECTIVES:

To expose the students to different genres of Literature; to hone reading skills; to provide deeper critical and literary insights; to enhance creative thinking; to promote aesthetic sense.

Syllabus Unit**1 Poems**

1. W. H. Auden: Refugee Blues; 2. A. K. Ramanujan: Obituary; 3. William Blake: The Little Black Boy; 4. Gieve Patel: Grandparents at a Family Get-together.

Unit 2**Short Stories**

1. Chinua Achebe: Marriage is a Private Affair; 2. Ruskin Bond: The Thief; 3. Isai Tobolsky: Not Just Oranges; 4. K A Abbas: The Refugee

Unit 3**Prose**

1. A G Gardiner: On The Philosophy of Hats; 2. Robert Lynd: Mispronunciation

Practicals:

Role plays: The Proposal, Chekov / Remember Ceaser, Gordon Daviot / Final Solutions, Mahesh Dattani, Book reviews, Movie reviews.

SUGGESTED READING:

The Old Man and the Sea, Hemingway / Any one of the novels of R.K. Narayan, etc.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

OBJECTIVES:

To introduce the students to the elements of technical style; to introduce the basic elements of formal correspondence; to introduce technical paper writing skills and methods of documentation; to improve oral presentation skills in formal contexts.

Course Outcomes:

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

CO1: Understand and use the basic elements of formal correspondence and methods of documentation
CO2: Learn to edit technical content for grammatical accuracy and appropriate tone and style

CO3: Use the library and internet recourses for research purposes

CO4: Demonstrate the ability to communicate effectively through group mock-technical presentations and other activities

Mapping of course outcomes with program outcomes:

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO														
CO1										3				
CO2										3				
CO3				1										
CO4									3	3				

Syllabus:

Unit 1

Mechanics of writing: Grammar rules – punctuation – spelling rules – tone and style – graphical Representation.

Unit 2

Different kinds of written documents: Definitions – descriptions – instructions – recommendations – manuals – reports – proposals; Formal Correspondence: Letter Writing including job applications with Resume.

Unit 3

Technical paper writing: Library research skills – documentation style – document editing – proof reading – formatting.

Practice in oral communication and Technical presentations

REFERENCES:

1. *Hirsh, Herbert. L "Essential Communication Strategies for Scientists, Engineers and Technology Professionals". II Edition. New York: IEEE press, 2002*
2. *Anderson, Paul. V. "Technical Communication: A Reader-Centred Approach". V Edition. Harcourt Brace College Publication, 2003*
3. *Strunk, William Jr. and White. E B. "The Elements of Style" New York. Alliyen & Bacon, 1999.*
4. *Riordan, G. Daniel and Pauley E. Steven. "Technical Report Writing Today" VIII Edition (Indian Adaptation). New Delhi: Biztantra, 2004.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23ENG234

INDIAN SHORT STORIES IN ENGLISH

L-T-P-C: 2-0-0-

OBJECTIVES:

To help the students learn the fine art of story writing; to help them learn the techniques of story telling; to help them study fiction relating it to the socio- cultural aspects of the age; to familiarize them with different strategies of reading short stories; to make them familiar with the morals and values held in high esteem by the ideals of Indianness.

Syllabus Unit

1

Introduction: Differences between novel and short stories – origin and development of short stories – Rabindranath

Tagore: Kabuliwallah; Mulk Raj Anand: The Gold Watch.

Unit 2

R. K. Narayan: Sweets for Angels; K. A. Abbas: The Refugee; Khushwant Singh: The Mark of Vishnu.

Unit 3

Masti Venkatesha Iyengar: The Curds-Seller; Manohar Malgonkar: Upper Division Love; Romila Thapar: The Spell; Premchand: The Voice of God.

TEXT:

M. G. Narasimha Murthy (ed), Famous Indian Stories. Hyderabad: Orient Black Swan, 2014

REFERENCE:

Mohan Ramanan (Ed), English and the Indian Short Story: Essays in Criticism, Hyderabad, Orient Black Swan, 2000.

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Syllabus Unit

1

Population – Identity

How to introduce yourself (name, age, address, profession, nationality); Numbers; How to ask questions; Grammar – Pronouns – subjects; Regular verbs of 1st group (er) in the present; Être (to be) and avoir (to have) in the present; Interrogative sentence; Gender of adjectives.

Unit 2**The suburbs – At the train station**

Introduce someone; Buy a train ticket or a cinema ticket; Ask for information; Official time; Ask for a price; The city (church, town hall, post office...)

Grammar – Pronouns – subjects (continuation); Gender of adjectives (continuation); Plural of nouns and adjectives; Definite and indefinite articles; Interrogative adjectives; I would like (Je voudrais).

Unit 3**Paris and the districts – Looking for a room**

Locate a room and indicate the way; Make an appointment; Give a price; Ordinal numbers; Usual time; Ask for the time.

Grammar – Imperative mode; Contracted articles (au, du, des); negation.

TEXTBOOK:

Metro St Michel – Publisher: CLE international

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Syllabus Unit

1

The first room of a student

A party to celebrate the 1st room; Description of a room; furniture; Locate objects: prepositions (devant, derrière, dans...), Read advertisement; Appreciation (I like, I prefer,).

Grammar – Perfect past tense with avoir; Possessive adjectives (mon, ton, son...); Demonstrative adjectives (ce, cet, cette); Yes (oui, si).

Unit 2 Small**jobs**

Conversation on the phone; Give Time indications; Answer a job offer; Describe a job; Suggest a meeting time. Grammar – Perfect past tense with être and avoir (continuation); Possessive adjectives (notre, votre, leur); Prepositions (à, pour, avec ...); Pronoun as direct object (le, la, l', les).

Unit 3**University Restaurant**

Inquiry; Express an opinion; Ask questions (continuation); Food, meals, taste, preferences; Nutrition, diet, choose a menu or diet, Expression of quantities (beaucoup, peu).

Grammar – Partitif (expressing quantity) (du, de la, pas de....); Comparison (plus...que, moins....que, autant ...que); Interrogation (continuation), inversion, Est-ce que, qu'est-ce que?.

TEXTBOOK:

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23GER230**GERMAN FOR BEGINNERS I****L-T-P-C: 2-0-0-**

Syllabus

Unit 1

Greetings; Introducing one-self (formal and informal context), saying their name, origin, living place, occupation. Numbers 1–100; Saying the telephone number. Countries and Languages.

Grammar: Structure – W – Questions and Yes/No questions and statements, personal pronouns, verb conjugations. Articles.

Vocabulary: Professions.

Unit 2

Giving the personal details. Name, age, marital status, year of birth, place of birth, etc. Numbers till 1000. Saying a year. Alphabets – spelling a word.

Filling up an application form; In the restaurant – making an order.

Grammar: Definite, indefinite and negative article in nominative. Accusative: indefinite and negative Article Vocabulary: Food items

Unit 3

Numbers above 1000. Orientation in Shopping plazas: asking the price, where do I find what, saying the opinion. Grammar: Accusative – definite article. Adjectives and plural forms. Vocabulary: Furniture and currencies.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	

Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23GER231**GERMAN FOR BEGINNERS II****L-T-P-C: 2-0-0-**

Syllabus

Unit 1

Shopping and orientation in supermarket; Conversation between the customer and salesman; Where one finds what in supermarket; Asking for requests and suggestions.

Grammar: Dative of personal pronouns. Imperative form. Vocabulary: Consumables and measurements;

Unit 2

Appointments; Work and leisure time activities; Time, weekdays, months and seasons; saying the date; fixing up an appointment.

Grammar: Modal verbs; Prepositions with time and place; Ordinal numbers. Vocabulary: Leisure activities, weekdays, months and seasons.

Unit 3

Family and household; Family and relations; household and daily routine. Grammar: Possessive articles; Divisible and indivisible verbs.

Vocabulary: Family circle; Household articles.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	

*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23GER232**PROFICIENCY IN GERMAN LANGUAGE (LOWER)****L-T-P-C: 2-0-0-**

Syllabus

To have an elementary exposure to German language; specifically

1. to have some ability to understand simple spoken German, and to be able to speak it so as to be able to carry on life in Germany without much difficulty (to be able to do shopping, etc.);
2. to be able to understand simple texts, and simple forms of written communication;
3. to have a basic knowledge of German grammar;
4. to acquire a basic vocabulary of 500 words;
5. to be able to translate simple letters with the use of a dictionary; and
6. to have some familiarity with the German life and culture.

(This will not be covered as part of the regular classroom teaching; this is to be acquired by self-study.) Some useful websites will be given.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

23GER233**PROFICIENCY IN GERMAN LANGUAGE (HIGHER)****L-T-P-C: 2-0-0-**

Syllabus

The basic vocabulary and grammar learned in the earlier course is mostly still passive knowledge. The endeavour of this course is to activate this knowledge and develop the skill of communication.

Topics are: Airport, railway station, travelling; shopping; invitations, meals, meeting people; around the house; the human body; colours; professions.

Past and future tenses will be introduced. Applying genitive, dative and accusative. Some German culture. Films.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23HIN230**HINDI I****L-T-P-C: 2-0-0-****OBJECTIVES:**

To teach Hindi for effective communication in different spheres of life – Social context, Education, governance, Media, Business, Profession and Mass communication.

Course Outcomes:

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

CO1: Gain knowledge about the nature and culture of

Hindi language
CO2: Understand the structural aspects of Hindi language

CO3: Apply the knowledge of the grammatical structures to

communicate in Hindi
CO4: Analyse the social significance of modern literature.

CO5: Develop the ability to translate a given text to Hindi

CO-PO Mapping:

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

CO5									2					
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Syllabus Unit

1

Introduction to Hindi Language, National Language, Official Language, link Language etc.

Introduction to Hindi language, Devanagari script and Hindi alphabet.

Shabda Bhed, Roopanthar ki Drishti se– Bhasha – Paribhasha aur Bhed – Sangya – Paribhasha Aur Bhed – Sangyake Roopanthar – kriya.

Unit 2

Common errors and error corrections in Parts of Speech with emphasis on use of pronouns, Adjective and verb in different tenses – Special usage of adverbs, changing voice and conjunctions in sentences, gender & number – General vocabulary for conversations in given context – understanding proper pronunciation – Conversations, Interviews, Short speeches.

Unit 3

Poems – Kabir 1st 8 Dohas, Surdas 1st 1 Pada; Tulsidas 1st 1 Pada; Meera 1st 1 Pada

Unit 4

Letter writing – personal and Formal – Translation from English to Hindi.

Unit 5

Kahani – Premchand: Kafan, Abhilasha, Vidroh, Poos ki rath, Julooos.

BOOKS:

1. *Prem Chand Ki Srvashtrestha Kahaniyam: Prem Chand; Diamond Pub Ltd. New Delhi*
2. *Vyavaharik Hindi Vyakaran ,Anuvad thaha Rachana : Dr. H. Parameswaran, Radha-krishna publishingHouse, New Delhi*
3. *Kamtha Prasad Guru : Hindi Vyakaran, Best Book pub House, New Delhi*
4. *Poetry : Kavya Ras – Ed: T.V. Basker – Pachouri Press; Mathura*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23HIN231**HINDI II****L-T-P-C: 2-0-0-****OBJECTIVES:**

Appreciation and assimilation of Hindi Literature both drisya & shravya using the best specimens provided as an anthology.

Course Outcomes:

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

CO1: Understand the grammatical structures of Hindi
CO2: Understand the post modern trends of literature
CO3: Enhance critical thinking and writing skills

CO4: Identify and analyse different literary and audio-visual material

CO5: Apply fundamental knowledge of Hindi in formal and informal writing

CO-PO Mapping:

PO/PSO															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1									1	2					
CO2									1	2					

C03									1	2				
C04										3				
C05									1	2				

Syllabus:

Unit 1

Kavya Tarang; Dhumil ke Anthim Kavitha [Poet–Dhumil]; Dhabba [Poet–Kedarnath Singh]; Proxy [Poet–Venugopal]; Vakth [Poet–Arun Kamal]; Maachis [Poet–Suneeta Jain].

Unit 2

Communicative Hindi – Moukhik Abhivyakthi

Unit 3

Audio–Visual Media in Hindi – Movies like Tare Zameen par, Paa, Black etc., appreciation and evaluation. Newsreading and presentations in Radio and TV channels in Hindi.

Unit 4

Gadya Manjusha – Budhapa, Kheesa, Sadachar ka Thavis

Unit 5

Translation: Theory and Practice – Letter writing: Formal and Personal – Introduction to Hindi Software.

BOOKS:

1. *Kavay Tarang: Dr. Niranjana, Jawahar Pusthakaalaya, Mathura.*

2. *Gadya Manjusha: Editor: Govind, Jawahar Pusthakalay, Mathura*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23HUM230**EMOTIONAL INTELLIGENCE****L-T-P-C: 2-0-0-**

Syllabus

Unit 1

Emotional Intelligence: Concept of Emotional Intelligence, Understanding the history and origin of Emotional Intelligence, Contributors to Emotional Intelligence, Science of Emotional Intelligence, EQ and IQ, Scope of Emotional Intelligence.

Unit 2

Components of Emotional Intelligence: Self-awareness, Self-regulation, Motivation, Empathy, Social skills. Emotional Intelligence Competencies, Elements of Emotional Intelligence, Models of Emotional Intelligence: The Ability-based Model, The Trait Model of Emotional Intelligence, Mixed Models of Emotional Intelligence.

Unit 3

Emotional Intelligence at Work place: Importance of Emotional Intelligence at Work place? Cost-savings of Emotional Intelligence, Emotionally Intelligent Leaders, Case Studies Measuring Emotional Intelligence: Emotionally Intelligence Tests, Research on Emotional Intelligence, Developing Emotional Intelligence.

REFERENCES:

1. *Daniel Goleman (1996). Emotional Intelligence– Why it can Matter More than IQ. Bantam Doubleday Dell Publishing Group*
2. *Daniel Goleman (2000). Working with Emotional Intelligence. Bantam Doubleday Dell Publishing Group*
3. *Liz Wilson, Stephen Neale & Lisa Spencer-Arnell (2012). Emotional Intelligence Coaching. Kogan Page India Private Limited*

Evaluation Pattern

Assessment

Amrita Vishwa Vidyapeetham.

Internal

BTC-AIE

End Semester

B.Tech Curriculum June 2021

Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23HUM231

GLIMPSES INTO THE INDIAN MIND –THE GROWTH OF MODERN INDIA

L–T–P–C: 2–

0–0–2

Syllabus Unit 1

Introduction

General Introduction; ‘His + Story’ or ‘History’ ?; The concepts of ‘nation’, ‘national identity’ and ‘nationalism’; Texts and Textualities: Comparative Perspectives.

Unit 2

Selected writings / selections from the complete works of the following authors will be taken up for study in achronological order:

Raja Ram Mohan Roy; Dayananda Saraswati; Bal Gangadhar Tilak; Rabindranath Tagore;

Unit 3

Selected writings / selections from the complete works of the following authors will be taken up for study in achronological order:

Swami Vivekananda; Sri Aurobindo; Ananda K. Coomaraswamy; Sister Nivedita; Mahatma Gandhi; Jawaharlal Nehru; B.R. Ambedkar; Sri Chandrasekharendra Saraswati, the Paramacharya of Kanchi; Dharampal; Raja Rao;

V.S. Naipaul.

Conclusion.

REFERENCES:

1. *Tilak, Bal Gangadhar. The Orion / Arctic Home in the Vedas.*
2. *Tagore, Rabindranath. The History of Bharatavarsha / On Nationalism / Greater India.*
3. *Vivekananda, Swami. “Address at the Parliament of Religions”/“The Future of India”/“In Defence of Hinduism” from Selections from the Complete Works of Swami Vivekananda.*
4. *Aurobindo, Sri. The Renaissance in India / On Nationalism.*

5. Coomaraswamy, Ananda K. *Essays in Indian Idealism (any one essay) / Dance of Shiva.*
6. Nivedita, Sister. *"Noblesse Oblige: A Study of Indian Caste" / "The Eastern Mother" from The Web of Indian Life.*
7. Gandhi, Mahatma. *Hind Swaraj.*
8. Nehru, Jawaharlal. *"The Quest" from Discovery of India.*
9. Ambedkar, B. R. *"Buddha and His Dhamma" from Collected Works.*
10. Saraswati, Chandrasekharendra. *"The Sastras and Modern Life" from The Hindu Dharma.*
11. Dharampal. *Bharatiya Chitta, Manas and Kala / Understanding Gandhi.*
12. Naipaul, V. S. *India: A Wounded Civilization / India: A Million Mutinies Now.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Syllabus

Unit 1

Introduction

A peep into India's glorious past

Ancient India – the vedas, the vedic society and the Sanatana Dharma – rajamandala and the Cakravartins – Ramarajya – Yudhisthira's ramarajya; Sarasvati – Sindhu Civilization and the myth of the Aryan Invasion; Classical India – Dharma as the bedrock of Indian society – Vaidika Brahmanya Dharma and the rise of Jainism and Buddhism

– the sixteen Mahajanapadas and the beginning of Magadhan paramountcy – Kautilya and his Arthashastra – Chandragupta Maurya and the rise of the Mauryan empire – Gupta dynasty Indian art and architecture – classical sanskrit literature – Harsavardhana; Trade and commerce in classical and medieval India and the story of Indian supremacy in the Indian ocean region; The coming of Islam – dismantling of the traditional Indian polity – the Mughal empire – Vijayanagara samrajya and days of Maratha supremacy.

Unit 2

India's contribution to the world: spirituality, philosophy and sciences

Indian Philosophy – the orthodox (Vaidika) and the heterodox (atheistic) schools; Ramayana and Mahabharata; Bhagavad Gita; Saints and sages of India; Ancient Indian medicine: towards an unbiased perspective; Ancient Indian mathematics; Ancient Indian astronomy; Ancient Indian science and technology.

The arrival of Europeans, British paramountcy and colonization

What attracted the rest of the world to India?; India on the eve of the arrival of European merchants; The story of colonization and the havoc it wrecked on Indian culture and civilization; Macaulay and the start of the distortion of Indian education and history; Indian economy – before and after colonization: a brief survey; The emergence of modern India.

Women in Indian society

The role and position of women in Hindu civilization; Gleanings from the Vedas, Brihadarnyaka Upanishad, Saptasati Devi Mahatmyam, Ramayana, Mahabharata, Manusmriti, Kautilya's Arthashastra and Mrichchhakatikam of Sudraka; The role and position of Indian women vis-a-vis Islam and European cultures; The great women of India.

Modern India

The national movement for freedom and social emancipation; Swami Vivekananda, Sri Aurobindo, Rabindranath Tagore; Understanding Mahatma Gandhi; A new nation is born as a republic – the pangs of birth and growth; India since Independence – the saga of socio-political movements; Problems facing the nation today; Globalization and Indian Economy; Bharatavarsha today and the way ahead: Regeneration of Indian National Resources.

Conclusion

The Wonder that was India; The 'politics' and 'purpose' of studying India.

REFERENCES:

1. *Parameswaran, S. The Golden Age of Indian Mathematics. Kochi: Swadeshi Science Movement.*
2. *Somayaji, D. A. A Critical Study of Ancient Hindu Astronomy. Dharwar: 1972.*
3. *Sen, S. N. & K. V. Sarma eds. A History of Indian Astronomy. New Delhi, 1985.*
4. *Rao, S. Balachandra. Indian Astronomy: An Introduction. Hyderabad: Universities Press, 2000.*
5. *Bose, D. M. et. al. A Concise History of Science in India. New Delhi: 1971.*
6. *Bajaj, Jitendra & M. D. Srinivas. Indian Economy and Polity. Chennai: Centre for Policy Studies.*
7. *Bajaj, Jitendra & M. D. Srinivas. Timeless India, Resurgent India. Chennai: Centre for Policy Studies.*
8. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre for Policy Studies, 2008.*
9. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*

10. Vivekananda, Swami. *Selections from the Complete Works of Swami Vivekananda*. Kolkata: Advaita Ashrama.
11. Mahadevan, T. M. P. *Invitations to Indian Philosophy*. Madras: University of Madras.
12. Hirianna, M. *Outlines of Indian Philosophy*. Motilal Banarsidass.
13. Tagore, Rabindranath. *The History of Bharatavarsha / On Nationalism / Greater India*.
14. Majumdar, R. C. et. al. *An Advanced History of India*. Macmillan.
15. Mahajan, V. D. *India Since 1526*. New Delhi: S. Chand & Company.
16. Durant, Will. *The Case for India*. Bangalore: Strand Book Stall, 2008.
17. Aurobindo, Sri. *The Indian Renaissance / India's Rebirth / On Nationalism*.
18. Nivedita, Sister. *The Web of Indian Life*. Kolkata: Advaita Ashrama.
19. Durant, Will. *The Story of Civilization. Volume 1 – Our Oriental Heritage*. New York: Simon & Schuster.
20. Ranganathananda, Swami. *Eternal Values for A Changing Society*. Bombay: Bharatiya Vidya Bhavan.
21. Ranganathananda, Swami. *Universal Message of the Bhagavad Gita*. Kolkata: Advaita Ashrama.
22. Seturaman, V. S. *Indian Aesthetics*. Macmillan.
23. Coomaraswamy, Ananda K. *The Dance of Shiva*. New Delhi: Sagar Publications.
24. Coomaraswamy, Ananda K. *Essays on Indian Idealism*. New Delhi: Munshiram Manoharlal.
25. Danino, Michel. *The Invasion That Never Was*.
26. Kautilya. *Arthashastra*.
27. Altekar, A. S. *State and Government in Ancient India*. New Delhi: Motilal Banarsidass.
28. Altekar, A. S. *The Position of Women in Hindu Civilization*. New Delhi: Motilal Banarsidass.
29. Sircar, D. C. *Studies in the Religious Life of Ancient and Medieval India*. New Delhi: Motilal Banarsidass.
30. Sircar, D. C. *Studies in the Political and Administrative Systems in Ancient and Medieval Times*. New Delhi: Motilal Banarsidass.
31. Madhavananda, Swami & R. C. Majumdar eds. *The Great Women of India*. Kolkata: Advaita Ashrama.
32. Dutt, R. C. *The Economic History of India*. London, 1902.
33. Dharampal. *Collected Works*.
34. Dharampal. *Archival Compilations (unpublished)*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	

End Semester		50
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*CA – Can be Quizzes, Assignment, Projects, and Reports.

Syllabus

Unit 1

Introduction

General Introduction; Primitive man and his modes of exchange – barter system; Prehistoric and proto-historic polity and social organization.

Ancient India – up to 600 B.C.

Early India – the vedic society – the varnashramadharma – socio-political structure of the various institutions based on the four purusharthas; The structure of ancient Indian polity – Rajamandala and Cakravartins – Prajamandala; Socio-economic elements from the two great Epics – Ramayana and Mahabharata – the concept of the ideal King (Sri Rama) and the ideal state (Ramarajya) – Yudhishthira's ramarajya; Sarasvati – Sindhu civilization and India's trade links with other ancient civilizations; Towards chiefdoms and kingdoms – transformation of the polity: kingship – from gopati to bhupati; The mahajanapadas and the emergence of the srenis – states and cities of the Indo-Gangetic plain.

Unit 2

Classical India: 600 B.C. – 1200 A.D.

The rise of Magadha, emergence of new religions – Buddhism and Jainism – and the resultant socio-economic impact; The emergence of the empire – the Mauryan Economy and Kautilya's Arthashastra; of Politics and trade – the rise of the Mercantile Community; Elements from the age of the Kushanas and the Great Guptas; India's maritime trade; Dharma at the bedrock of Indian polity – the concept of Digvijaya: dharma-vijaya, lobha-vijaya and asura-vijaya; Glimpses into the south Indian economies: political economies of the peninsula – Chalukyas, Rashtrakutas and Cholas

Medieval India: 1200 A.D. – 1720 A.D.

Advent of Islam – changes in the social institutions; Medieval India – agrarian economy, non-agricultural production and urban economy, currency system; Vijayanagara samrajya and maritime trade – the story of Indian supremacy in the Indian Ocean region; Aspects of Mughal administration and economy; The Maratha and other provincial economies.

Unit 3

Modern India: 1720 – 1947

the Indian market and economy before the arrival of the European traders; Colonisation and British supremacy (dismantling of everything that was 'traditional' or 'Indian') – British attitude towards Indian trade, commerce and economy and the resultant ruining of Indian economy and business – man-made famines – the signs of renaissance: banking and other business undertakings by the natives (the members of the early Tagore family, the merchants of Surat and Porbander, businessmen of Bombay, etc. may be referred to here) – the evolution of the modern banking system; Glimpses into British administration of India and administrative models; The National movement and nationalist undertakings in business and industry: the Tatas and the Birlas; Modern India: the growth of large-scale industry – irrigation and railways – money and credit – foreign trade; Towards partition – birth of two new nations

– division of property; The writing of the Indian Constitution – India becomes a democratic republic – a new polity is in place.

Independent India – from 1947

India since Independence – the saga of socio-political movements; Indian economy since Independence – the fiscal system – the five year plans – liberalisation – the GATT and after; Globalisation and Indian economy; Impact of science and (new/ emerging) technology on Indian economy; Histories of select Indian business houses and business entrepreneurship.

Conclusion

REFERENCES:

1. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture. Kautilya. Arthashastra.*

2. Altekar, A. S. *State and Government in Ancient India*. New Delhi: Motilal Banarsidass.
3. Sircar, D. C. *Studies in the Political and Administrative Systems in Ancient and Medieval Times*. New Delhi: Motilal Banarsidass.
4. Dutt, R. C. *The Economic History of India*. London, 1902.
5. Dharampal. *Collected Works (Volumes IV & V)*.
6. Dharampal. *Archival Compilations (unpublished)*.
7. Bajaj, Jitendra & M. D. Srinivas. *Indian Economy and Polity*. Chennai: Centre for Policy Studies.
8. Bajaj, Jitendra & M. D. Srinivas. *Timeless India, Resurgent India*. Chennai: Centre for Policy Studies.
9. Joshi, Murli Manohar. *Science, Sustainability and Indian National Resurgence*. Chennai: Centre for Policy Studies, 2008.
10. Tripathi, Dwijendra. *The Oxford History of Indian Business*. New Delhi: Oxford University Press, 2004.
11. McGuire, John, et al, eds. *Evolution of World Economy, Precious Metals and India*. New Delhi: Oxford University Press, 2001.
12. Tripathi, Dwijendra and Jyoti Juman. *The Concise Oxford History of Indian Business*. New Delhi: Oxford University Press, 2007.
13. Kudaisya, Medha M. *The Life and Times of G. D. Birla*. New Delhi: Oxford University Press, 2003.
14. Raychaudhuri, Tapan and Irfan Haib, eds. *The Cambridge Economic History of India*. Volume 1. New Delhi: Orient Longman, 2004.
15. Kumar, Dharma, ed. *The Cambridge Economic History of India*. Volume 2. New Delhi: Orient Longman, 2005.
17. Sabavala, S. A. and R. M. Lala, eds. *J. R. D. Tata: Keynote*. New Delhi: Rupa & Co., 2004.
18. Mambro, Arvind ed. *J. R. D. Tata: Letters*. New Delhi: Rupa & Co., 2004.
19. Lala, R. M., *For the Love of India: The Life and Times of Jamsetji Tata*. New Delhi: Penguin, 2006.
20. Thapar, Romila. *The Penguin History of Early India: From the Origins to AD 1300*. New Delhi: Penguin, 2002.
21. Majumdar, R. C., et. al. *An Advanced History of India*. Macmillan.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

Syllabus Unit

1

Introduction to Health

Health is wealth; Role of lifestyle habits on health; Importance of adolescence; Stages, Characteristics and changes during adolescence; Nutritional needs during adolescence why healthy lifestyle is important for adolescence. Eating Habits – eating disorders, skipping breakfast, junk food consumption.

Practicals – Therapeutic Diets

Unit 2**Food and Nutritional Requirements during Adolescence**

Fluid intake; nutrition related problems; lifestyle related problems, Role of physical activity; resting pattern and postures, Personal habits – alcoholism, and other tobacco products, electronic addiction etc

Practicals – Ethnic Foods

Unit 3**Need for a Positive Life Style Change**

Peer pressure & procrastination, Stress, depression, suicidal tendency, Mini project review and viva, Whole portions revision.

TEXTBOOKS:

1. B. Srilakshmi, "Dietetics", New age international (P) ltd, publishers, 2010.
2. "Nutrient requirement and Recommended Dietary Allowances for Indians", published by Indian Council of Medical Research, ICMR, 2010.

REFERENCE BOOKS:

1. K Park "Textbook of preventive and social medicine", 2010.
2. WHO Report on Adolescent Health: 2010

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23HUM235**INDIAN CLASSICS FOR THE TWENTY-FIRST CENTURY****L-T-P-C: 2-0-0-****Syllabus****Unit 1**

Introductory study of the Bhagavad Gita and the Upanishads.

Unit 2

The relevance of these classics in a modern age.

Unit 3

Goals of human life – existential problems and their solutions in the light of these classics etc.

REFERENCE:

The Bhagavad Gita, Commentary by Swami Chinmayananda

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

PREAMBLE:

This paper will introduce the students to the multiple dimensions of the contribution of India to the fields of philosophy, art, literature, physical and social sciences. The paper intends to give an insight to the students about the far-reaching contributions of India to world culture and thought during the course of its long journey from the hoary antiquity to the present times. Every nation takes pride in its achievements and it is this sense of pride and reverence towards the achievements that lays the foundation for its all-round progress.

Syllabus Unit**1**

A brief outline of Indian history from prehistoric times to the present times.

Contributions of India to world culture and civilization: Indian Philosophy and Religion; Art and Literature; Physical and Social Sciences.

Unit 2

Modern India: Challenges and Possibilities.

Scientific and technological progress in post-independence era; Socio-cultural and political movements after independence; Challenges before the nation today – unemployment – corruption – degradation of cultural and moral values – creation of a new system of education; Creation of a modern and vibrant society rooted in traditional values.

Unit 3

Modern Indian Writing in English: Trends in Contemporary Indian Literature in English.

TEXTBOOK:

Amrita Vishwa Vidyapeetham.

BTC-AIE

B.Tech Curriculum June 2021

BACKGROUND LITERATURE:

1. *Selections from The Cultural Heritage of India, 6 volumes, Ramakrishna Mission Institute of Culture(Kolkata) publication.*
2. *Selections from the Complete Works of Swami Vivekananda, Advaita Ashrama publication.*
3. *Invitations to Indian Philosophy, T. M. P. Mahadevan, University of Madras, Chennai.*
4. *Outlines of Indian Philosophy, M. Hiriyanna, MLBD.*
5. *An Advanced History of India, R. C. Majumdar et al, Macmillan.*
6. *India Since 1526, V. D. Mahajan, S. Chand & Company*
7. *The Indian Renaissance, Sri Aurobindo.*
8. *India's Rebirth, Sri Aurobindo.*
9. *On Nationalism, Sri Aurobindo.*
10. *The Story of Civilization, Volume I: Our Oriental Heritage, Will Durant, Simonand Schuster, New York.*
11. *Eternal Values for a Changing Society, Swami Ranganathananda, Bharatiya Vidya Bhavan.*
12. *Universal Message of the Bhagavad Gita, Swami Ranganathananda, Advaita Ashrama.*
13. *Awaken Children: Conversations with Mata Amritanandamayi*
14. *Indian Aesthetics, V. S. Seturaman, Macmillan.*
15. *Indian Philosophy of Beauty, T. P. Ramachandran, University of Madras, Chennai.*
16. *Web of Indian Thought, Sister Nivedita*
17. *Essays on Indian Nationalism, Anand Kumaraswamy*
18. *Comparative Aesthetics, Volume 2, Kanti Chandra Pandey, Chowkhamba, Varanasi*
19. *The Invasion That Never Was, Michel Danino*
20. *Samskara, U. R. Ananthamurthy, OUP.*
21. *Hayavadana, Girish Karnard, OUP.*

22. *Naga-Mandala, Girish Karnard, OUP.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

OBJECTIVES:

To familiarize students with Sanskrit language; to introduce students to various knowledge traditions in Sanskrit; to help students appreciate and imbibe India's ancient culture and values.

Syllabus Unit**1**

Sanskrit Language – Vakya Vyavahara (प्रथमादीक्षा) – Introduction to Sanskrit language – Devanagari script and Sanskrit alphabet – Vowels and Consonants – Pronunciation – Classification of Consonants – Samyukthakshara Words – Nouns and Verbs – Cases – Introduction to Numbers and Time – Verbs: Singular, Dual and Plural – SarvaNamas: First Person, Second Person, Third Person – Tenses: Past, Present and Future – Words for Communication – Selected Slokas – Moral Stories – Subhashithas – Riddles.

Unit 2

Language Studies – Role of Sanskrit in Indian & World Languages.

Unit 3

Introduction to Sanskrit Classical Literature – Kavya Tradition – Drama Tradition – Stotra Tradition – Panchatantra Stories.

Unit 4

Introduction to Sanskrit Technical Literature – Astronomy – Physics – Chemistry – Botany – Engineering – Aeronautics – Ayurveda – Mathematics – Medicine – Architecture – Tradition of Indian Art – Administration – Agriculture.

Unit 5

Indology Studies – Perspectives and Innovations.

1. *Vakya Vyavahara*– Prof. Vempaty Kutumba Sastri, Rashtriya Sanskrit Sansthan, New Delhi
2. *The Wonder that is Sanskrit* – Dr.Sampadananda Mishra, New Delhi
3. *Science in Sanskrit* – Samskritha Bharathi, NewDelhi

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Syllabus

Unit 1

Introduction to Basic Concepts of NSS: History, philosophy, aims and objectives of NSS, Emblem, flag, motto, song, badge etc., Organisational structure, roles and responsibilities of various NSS functionaries.

NSS Programmes and Activities: Concept of regular activities, special campaigning, Day Camps, Basis of adoption of village / slums, methodology of conducting survey, financial pattern of the scheme, other youth programme/schemes of GOI, Coordination with different agencies, Maintenance of the Diary.

Unit 2

Volunteerism and Shramdan: Indian Tradition of volunteerism, Needs and importance of volunteerism, Motivation and Constraints of volunteerism, Shramdan as part of volunteerism, Amalabharatam Campaign, Swatch Bharath.

Unit 3

Understanding youth: Definition, profile and categories of youth, Issues, challenges and opportunities for youth, Youth as an agent of social change.

Youth and Yoga: History, philosophy and concept of Yoga, Myths and misconceptions about Yoga, Different Yoga traditions and their impacts, Yoga as a preventive and curative method, Yoga as a tool for healthy life style

Unit 4

Youth Development Programmes in India: National Youth Policy, Youth development programmes at the national level, state level and voluntary sector, youth-focused and youth-led organizations.

Youth and Crime: Sociological and psychological factors influencing youth crime, Peer mentoring in preventing crimes, Awareness about Anti-Ragging, Cyber Crime and its prevention, Juvenile Justice.

Unit 5

Environmental Issues: Environment conservation, enrichment and sustainability, climate change, waste management, rain water harvesting, energy conservation, waste land development.

Project Work / Practical

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23HUM239**PSYCHOLOGY FOR EFFECTIVE LIVING****L-T-P-C: 2-0-0-****Course Objectives**

1. To help students acquire the basic knowledge of behavior and effective living
2. To create an awareness of the hazards of health compromising behaviours
3. To develop and strengthen the tools required to handle the adversities of life

Course Outcome

CO 1 : Understand the basic concepts of Behavioral

Psychology
CO 2: Demonstrate self reflective skills through activities

CO 3: Apply the knowledge of psychology to relieve stress

CO 4: Analyse the adverse effects of health compromising behaviours.

CO 5: Evaluate and use guided techniques to overcome and cope with stress related problems.

CO-PO Mapping

PO												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						1						1
CO2						2	3		3	3		
CO3						3	3	2	1		3	2
CO4						2	2	3				1
CO5						1	2				1	1
Amrita Vishwa Vidyapeetham						BTC-AIE		B.Tech Curriculum June 2021				

Syllabus Unit

1

Self-Awareness & Self-Motivation

Self analysis through SWOT, Johari Window, Maslow's hierarchy of motivation, importance of self esteem and enhancement of self esteem.

Unit 2

The Nature and Coping of Stress

Conflict, Relationship issues, PTSD. Stress – stressors – eustress – distress, coping with stress, stress management techniques.

Unit 3

Application of Health Psychology

Health compromising behaviours, substance abuse and addiction.

TEXTBOOKS:

1. *V. D. Swaminathan & K. V. Kaliappan "Psychology for effective living – An introduction to Health Psychology. 2nd edition Robert J. Gatchel, Andrew Baum & David S. Krantz, McGraw Hill.*
2. *Psychology. 2nd edition Robert J. Gatchel, Andrew Baum & David S. Krantz, McGraw Hill.*

REFERENCE BOOKS:

1. *S. Sunder, 'Textbook of Rehabilitation', 2nd edition, Jaypee Brothers, New Delhi. 2002.*
2. *Weiben & Lloyd, 'Psychology applied to Modern Life', Thompson Learning, Asia Ltd.2004.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Objectives:

1. To strengthen the fundamental knowledge of human behavior
2. To strengthen the ability to understand the basic nature and behavior of humans in organizations as a whole
3. To connect the concepts of psychology to personal and professional life

Course Outcome

CO 1: Understand the fundamental processes underlying human behavior such as learning, motivation, individual differences, intelligence and personality.

CO 2: Apply the principles of psychology in day-to-day life for a better understanding of oneself and others. CO 3: Apply the knowledge of Psychology to improve study skills and learning methods

CO 4: Apply the concepts of defense mechanisms to safeguard against abusive relationships and to nurture healthy relationships.

CO-PO Mapping

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

Syllabus Unit

Psychology of Adolescents: Adolescence and its characteristics.

Unit 2

Learning, Memory & Study Skills: Definitions, types, principles of reinforcement, techniques for improving study skills, Mnemonics.

Unit 3

Attention & Perception: Definition, types of attention, perception.

TEXTBOOKS:

1. *S. K. Mangal, "General Psychology", Sterling Publishers Pvt. Ltd. 2007*
2. *Baron A. Robert, "Psychology", Prentice Hall of India. New Delhi 2001*

REFERENCE BOOKS:

1. *Elizabeth B. Hurlock, Developmental Psychology – A life span approach, 6th edition.*
2. *Feldman, Understanding Psychology, McGraw Hill, 2000.*
3. *Clifford Morgan, Richard King, John Scholper, "Introduction to Psychology", Tata McGraw Hill, Pvt Ltd 2004.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23HUM241

SCIENCE AND SOCIETY – AN INDIAN PERSPECTIVE

L-T-P-C: 2-0-0-

Syllabus

Unit 1

Introduction

Western and Indian views of science and technology

Introduction; Francis Bacon: the first philosopher of modern science; The Indian tradition in science and technology: an overview.

Unit 2

Indian sciences

Introduction; Ancient Indian medicine: towards an unbiased perspective; Indian approach to logic; The methodology of Indian mathematics; Revision of the traditional Indian planetary model by Nilakantha Somasutvan in circa 1500 AD

Science and technology under the British rule

Introduction; Indian agriculture before modernization; The story of modern forestry in India; The building of New Delhi

Unit 3

Science and technology in Independent India

Introduction; An assessment of traditional and modern energy resources; Green revolution: a historical perspective; Impact of modernisation on milk and oilseeds economy; Planning without the spirit and the determination.

Building upon the Indian tradition

Introduction; Regeneration of Indian national resources; Annamahatmyam and Annam Bahu Kurvita: recollecting the classical Indian discipline of growing and sharing food in plenty and regeneration

of Indian agriculture to ensure food for all in plenty.

Conclusion

REFERENCES:

1. Joseph, George Gheverghese. *The Crest of the Peacock: Non-European Roots of Mathematics*. London: Penguin (UK), 2003.
2. Iyengar, C. N. Srinivasa. *History of Hindu Mathematics*. Lahore: 1935, 1938 (2 Parts).
3. Amma, T. A. Saraswati. *Geometry in Ancient and Medieval India*. Varanasi: Motilal Banarsidass, 1979.
4. Bag, A. K. *Mathematics in Ancient and Medieval India*. Varanasi: Motilal Banarsidass, 1979.
5. Sarma K. V. & B. V. Subbarayappa. *Indian Astronomy: A Source-Book*. Bombay: Nehru Centre, 1985.
6. Sriram, M. S. et. al. eds. *500 Years of Tantrasangraha: A Landmark in the History of Astronomy*. Shimla: Indian Institute of Advanced Study, 2002.
7. Bajaj, Jitendra & M. D. Srinivas. *Restoring the Abundance: Regeneration of Indian Agriculture to Ensure Food for All in Plenty*. Shimla: Indian Institute of Advanced Study, 2001.
8. Bajaj, Jitendra ed. *Report of the Seminar on Food for All: The Classical Indian Discipline of Growing and Sharing Food in Plenty*. Chennai: Centre for Policy Studies, 2001.
9. Bajaj, Jitendra & M. D. Srinivas. *Annam Bahu Kurvita: Recollecting the Indian Discipline of Growing and Sharing Food in Plenty*. Madras: Centre for Policy Studies, 1996.
10. Parameswaran, S. *The Golden Age of Indian Mathematics*. Kochi: Swadeshi Science Movement.
11. Somayaji, D. A. *A Critical Study of Ancient Hindu Astronomy*. Dharwar: 1972.
12. Sen, S. N. & K. V. Sarma eds. *A History of Indian Astronomy*. New Delhi, 1985.
13. Rao, S. Balachandra. *Indian Astronomy: An Introduction*. Hyderabad: Universities Press, 2000.
14. Bose, D. M. et. al. *A Concise History of Science in India*. New Delhi: 1971.
15. Bajaj, Jitendra & M. D. Srinivas. *Indian Economy and Polity*. Chennai: Centre for Policy Studies.

16. *Bajaj, Jitendra & M. D. Srinivas. Timeless India, Resurgent India. Chennai: Centre for Policy Studies.*
17. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre for Policy Studies, 2008.*
18. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*

** The syllabus and the study material in use herein has been developed out of a 'summer programme' offered by the Centre for Policy Studies (CPS), Chennai at the Indian Institute of Advanced Study (IIAS), Rashtrapati Nivas, Shimla, sometime ago. The same has been very kindly made available to us by Professors Dr M.D. Srinivas (Chairman) and Dr J.K. Bajaj (Director) of the CPS.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Syllabus

Unit 1

Introduction: Relevance of Bhagavad Gita today – Background of Mahabharatha.

ArjunaVishada Yoga: Arjuna's Anguish and Confusion – Symbolism of Arjuna's

Chariot.

Sankhya Yoga: Importance of Self-knowledge – Deathlessness: Indestructibility of Consciousness – Being Established in Wisdom – Qualities of a Sthita-prajna.

Unit 2

Karma Yoga: Yoga of Action – Living in the Present – Dedicated Action without Anxiety over Results – Concept of Swadharma.

Dhyana Yoga: Tuning the Mind – Quantity, Quality and Direction of Thoughts – Reaching Inner Silence.

Unit 3

Bhakti Yoga: Yoga of Devotion – Form and Formless Aspects of the Divine – Inner Qualities of a True Devotee.

GunatrayaVibhaga Yoga: Dynamics of the Three Gunas: Tamas, Rajas, Sattva – Going Beyond the Three Gunas – Description of a Gunatheetha.

TEXTBOOKS / REFERENCES:

1. Swami Chinmayananda, "The Holy Geeta", Central Chinmaya Mission Trust, 2002.
2. Swami Chinmayananda, "A Manual of Self Unfoldment", Central Chinmaya Mission Trust, 2001.

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

OBJECTIVES:

To give students an introduction to the basic ideas contained in the Upanishads; and explores how their message can be applied in daily life for achieving excellence.

Syllabus Unit**1**

An Introduction to the Principal Upanishads and the Bhagavad Gita – Inquiry into the mystery of nature – Sruti versus Smriti – Sanatana Dharma: its uniqueness – The Upanishads and Indian Culture – Upanishads and Modern Science.

Unit 2

The challenge of human experience & problems discussed in the Upanishads – the True nature of Man – the Moving power of the Spirit – The Message of Fearlessness – Universal Man – The central problems of the Upanishads – Ultimate reality – the nature of Atman – the different manifestations of consciousness.

Unit 3

Upanishad Personalities – episodes from their lives and essential teachings: Yajnavalkya, Aruni, Uddalaka, Pippalada, Satyakama Jabala, Svetaketu, Nachiketas, Upakosala, Chakrayana Ushasti, Raikva, Kapila and Janaka. Important verses from Upanishads – Discussion of Sage Pippalada's answers to the six questions in Prasnopanishad.

REFERENCES:

1. *The Message of the Upanishads by Swami Ranganathananda, Bharatiya Vidya Bhavan*
2. *Eight Upanishads with the commentary of Sankaracharya, Advaita Ashrama*
3. *Indian Philosophy by Dr. S. Radhakrishnan, Oxford University Press*
4. *Essentials of Upanishads by R L Kashyap, SAKSI, Bangalore*
5. *Upanishads in Daily Life, Sri Ramakrishna Math, Mylapore.*
6. *Eternal stories of the Upanishads by Thomas Egenes and Kumuda Reddy*
7. *Upanishad Ganga series – Chinmaya Creations*

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Objectives:

- To introduce the significance of food, nutrients, locally available food re-sources, synergic food combinations, good cooking methods and importance of diversity in foods
- To understand nutritional imbalances and chronic diseases associated with the quality of food.
- To gain awareness about the quality of food – Organic food, genetically modified food, adulterated food, allergic food, , food poisoning and food safety.
- To understand food preservation processing, packaging and the use of additives.

Course Outcome:

CO1: Acquire knowledge about the various food and food groups

CO2: Understand nutritional imbalances and chronic diseases prevailing among different age groups. CO3: Understand the significance of safe food and apply the food safety standards

CO4: Demonstrate skills of food processing, preservation and packaging methods with or without additives CO5: Evaluate the quality of food based on the theoretical knowledge of Food and Nutrition

CO-PO Mapping:

PO												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1		1	1			1	2	1	1	1	1	3
CO 2		1	1			1	1	1	1	1	1	3
CO 3		1	1			1	1	1	1	1	1	3
CO 4		1	1			1	1	1	1	1	1	3
CO 5			1			1	1	1	2	1	1	3

Syllabus Unit

1

Food and Food Groups

Introduction to foods, food groups, locally available foods, Nutrients, Cooking methods, Synergy between foods, Science behind foods, Food allergies, food poisoning, food safety standards.

Cookery Practicals – Balanced Diet

Unit 2

Nutrients and Nutrition

Nutrition through life cycle, RDA, Nutrition in disease, Adulteration of foods & Food additives, Packaging and labeling of foods.

Practicals – Traditional Foods

Unit 3

Introduction to Food Biotechnology

Future foods – Organic foods and genetically modified foods, Fortification of foods value addition of foods, functional foods, Nutraceuticals, supplementary foods, Processing and preservation of foods, applications of food

technology in daily life, and your prospects associated with food industry – Nanoparticles, biosensors, advanced research.

Practicals – Value added foods

TEXTBOOKS:

1. *N. Shakuntalamanay, M. Shadaksharaswamy, "Food Facts and principles", New age international (P)ltd, publishers, 2005.*
2. *B. Srilakshmi, "Dietetics", New age international (P) ltd, publishers, 2010.*

REFERENCE BOOKS:

1. *B. Srilakshmi, "Food Science", New age international (P) ltd, publishers, 2008.*
2. *"Nutrient requirement and Recommended Dietary Allowances for Indians", published by Indian Council of Medical Research, ICMR, 2010.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Syllabus

This paper will introduce the basics of Japanese language. Students will be taught the language through various activities like writing, reading, singing songs, showing Japanese movies etc. Moreover this paper intends to give a thorough knowledge on Japanese scripts that is Hiragana and Katakana. Classes will be conducted throughout in Japanese class only. Students will be able to make conversations with each other in Japanese. Students can make self-introduction and will be able to write letters in Japanese. All the students will be given a text on Japanese verbs and tenses.

Students can know about the Japanese culture and the lifestyle. Calligraphy is also a part of this paper. Informal sessions will be conducted occasionally, in which students can sing Japanese songs, watch Japanese movies, do Origami – pattern making using paper.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Syllabus

Students will be taught the third and the most commonly used Japanese script, Kanji. Students will be taught to write as well as speak.

Students will be given detailed lectures on Calligraphy.

This version of the course includes a new project where the students should make a short movie in Japanese language selecting their own topics.

By the end of the semester they the students will master the subject in all means. They will be able to speak Japanese as fluently as they speak English. Students will be encouraged to write stories and songs in Japanese language themselves.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23KAN230

KANNADA I

L-T-P-C: 2-0-0-

OBJECTIVES:

To enable the students to acquire basic skills in functional language; to develop independent reading skills and reading for appreciating literary works; to analyse language in context to gain an understanding of vocabulary, spelling, punctuation and speech.

Syllabus Unit

1

Adalitha Kannada: bhashe, swaroopa, belavanigeya kiru parichaya Paaribhaashika padagalu

Vocabulary Building

Unit 2

Prabhandha – Vyaaghra Geethe – A. N. Murthy Rao

Prabhandha – Baredidi...baredidi, Baduku mugiyuvudilla allige...– Nemi Chandra Paragraph writing – Development: comparison, definition, cause & effect Essay – Descriptive & Narrative

Unit 3

Mochi – Bharateepriya

Mosarina Mangamma – Maasti Venkatesh Iyengar Kamalaapurada Hotelnalli – Panje Mangesh Rao Kaanike – B.

M. Shree

Geleyanobbanige bareda Kaagada – Dr. G. S. Shivarudrappa Moodala Mane – Da. Ra.

Bendre Swathantryada Hanate – K. S. Nissaar Ahmed

Unit 4

Letter Writing – Personal: Congratulation, thanks giving, invitation, condolence

Unit 5

Reading Comprehension; nudigattu, gaadegalu Speaking Skills: Prepared speech, pick and speak

REFERENCES:

1. *H. S. Krishna Swami Iyengar – Adalitha Kannada – Chetana Publication, Mysuru*
2. *N. Murthy Rao – Aleyuva Mana – Kuvempu Kannada Adyayana Samste*
3. *Nemi Chandra – Badhuku Badalisabahudu – Navakarnataka Publication*
4. *Sanna Kathegalu – Prasaraanga, Mysuru University , Mysuru*
5. *B. M. Shree – Kannadada Bavuta – Kannada Sahitya Parishattu*
6. *K. S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna Book House (P) Ltd.*
7. *Dr. G. S. Shivarudrappa – Samagra Kavya – Kamadhenu Pustaka Bhavana*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23KAN231

KANNADA II

L-T-P-C: 2-0-0-2

OBJECTIVES:

To enable the students to acquire basic skills in functional language; to develop independent reading skills and reading for appreciating literary works; to develop functional and creative skills in language; to enable the students to plan, draft, edit & present a piece of writing.

Syllabus Unit

1

Official Correspondence: Adhikrutha patra, prakatane, manavi patra, vanijya patra

Unit 2

Nanna Hanate – Dr. G. S. Shivarudrappa

Mankuthimmana Kaggada Ayda bhagagalu – D. V. Gundappa (Padya Sankhye 5, 20, 22, 23, 25, 44, 344, 345, 346, 601)

Ella Marethiruvaga – K. S. Nissar Ahmed Saviraru Nadigalu – S Siddalingayya

Unit 3

Sayo Aata – Da. Ra. Bendre

Unit 4

Sarva Sollegala turtu Maha Samelana – Beechi Swarthakkaagi Tyaga – Beechi

Unit 5

Essay writing: Argumentative & Analytical Précis writing

REFERENCES:

1. *H. S. Krishnaswami Iyengar – Adalitha Kannada – Chetan Publication, Mysuru*
2. *Dr. G. S. Shivarudrappa – Samagra Kavya. – Kamadhenu Pustaka Bhavana*
3. *Shrikanth – Mankuthimmana Kaggā – Taatparya – Sri Ranga Printers & Binders*
4. *K. S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna book house*
5. *Dr. Da. Ra. Bendre – Saayo Aata – Shri Maata Publication*
6. *Beechi – Sahukara Subbamma – Sahitya Prakashana*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23MAL230**MALAYALAM I****L-T-P-C: 2-0-0-****Course Objectives:**

To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother tongue; to learn our culture & values; to equip students read & write correct Malayalam; to correct the mistakes in pronunciation; to create awareness that good language is the sign of complete personality

Course Outcome:

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

CO1: Understand and inculcate philosophical thoughts and practices
CO2: Understand and appreciate the post modern trends of literature.

CO3: Analyse the literary texts and comprehend the cultural diversity of Kerala
CO4: Distinguish the different genres in Malayalam literature

CO5: Demonstrate the ability to effectively communicate in Malayalam

CO-PO Mapping:

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

CO4	-	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	1	1	-	-

Syllabus Unit

1

Ancient poet trio: Adhyatmaramayanam,

Lakshmana Swanthanam (valsa soumitre... mungikidakayal), Ezhuthachan – Medieval period classics
–Jnanappana (kalaminnu... vilasangalingane), Poonthanam

Unit 2

Modern Poet trio: Ente Gurunathan, Vallathol Narayana Menon – Critical analysis of the poem.

Unit 3

Short stories from period 1 / 2 / 3, Poovanpazham – Vaikaom Muhammed Basheer – Literary & Cultural figures of Kerala and about their literary contributions.

Unit 4

Literary Criticism: Ithihasa studies – Bharatha Paryadanam – Vyasante Chiri – Kuttikrishna Mararu
– Outline of literary Criticism in Malayalam Literature – Introduction to Kutti Krishna Mararu & his outlook towards literature & life.

Unit 5

Error-free Malayalam: 1. Language; 2. Clarity of expression; 3. Punctuation – Thettillatha Malayalam

Writing – a. Expansion of ideas; b .Precis Writing; c. Essay Writing; d. Letter writing; e. Radio Speech; f. Script / Feature / Script Writing; g. News Editing; h. Advertising; i. Editing; j. Editorial Writing; k. Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

1. *P. K. Balakrishnanan, Thunjan padhanangal, D. C. Books, 2007.*
2. *G. Balakrishnan Nair, Jnanappanayum Harinama Keerthanavum, N. B. S, 2005.*
3. *M. N. Karasseri, Basheerinte Poonkavanam, D. C. Books, 2008.*
4. *4 M. N. Vijayan, Marubhoomikal Pookkumbol, D. C. Books, 2010.*
5. *M. Thomas Mathew, Lavanyanubhavathinte Yukthisasthram, National Book Stall, 2009.*
6. *M. Leelavathy, Kavitha Sahityacharitram, National Book Stall, 1998.*
7. *Thayattu Sankaran, Vallathol Kavithapadhanam, D. C. Books, 2004.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23MAL231**MALAYALAM II****L-T-P-C: 2-0-0-****OBJECTIVES:**

To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother-tongue; to learn our culture & values; to equip students read & write correct Malayalam; to correct the mistakes in pronunciation; to create awareness that good language is the sign of complete personality.

Course Outcome:

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

CO1: Understand the different cultural influences in linguistic translation
CO2: Identify and appreciate the Romantic elements of modern literature
CO3: Analyze the genre of autobiographical writing

CO4: Critically evaluate the significance of historical, political and socio cultural aspects in literature
CO5: Demonstrate good writing skills in Malayalam

CO-PO Mapping:

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

Syllabus Unit

1

Ancient poet trio: Kalayanasougandhikam, (kallum marangalun... namukkennarika vrikodara) Kunjan Nambiar – Critical analysis of his poetry – Ancient Drama: Kerala Sakunthalam (Act 1), Kalidasan (Translated by Attor Krishna Pisharody).

Unit 2

Modern / romantic / contemporary poetry: Manaswini, Changampuzha Krishna Pillai – Romanticism – modernism.

Unit 3

Anthology of short stories from period 3/4/5: Ninte Ormmayku, M. T. Vasudevan Nair – literary contributions of his time

Unit 4

Part of an autobiography / travelogue: Kannerum Kinavum, V. T. Bhattathirippadu – Socio-cultural literature – historical importance.

Unit 5

Error-free Malayalam – 1. Language; 2. Clarity of expression; 3. Punctuation – Thettillatha Malayalam

Writing – a. Expansion of ideas; b. Précis Writing ; c. Essay Writing; d. Letter writing; e. Radio Speech; f. Script / Feature / Script Writing; g. News Editing; h. Advertising; i. Editing; j. Editorial Writing; k. Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

1. *Narayana Pillai. P. K, Sahitya Panchanan. Vimarsanathrayam, Kerala Sahitya Academy, 2000*
2. *Sankunni Nair. M. P, Chathravum Chamaravum, D. C. Books, 2010.*
3. *Gupthan Nair. S, Asthiyude Pookkal, D. C Books. 2005*
4. *Panmana Ramachandran Nair, Thettillatha Malayalam, Saryum thettum etc., D. C. Book, 2006.*
5. *M. Achuthan, Cherukatha-Innale, innu, National Book Stall, 1998.*
6. *N. Krishna Pillai, Kairaliyude Katha, National Book Stall, 2001.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

OBJECTIVES:

To familiarize students with Sanskrit language and literature; to enable them to read and understand Sanskrit verses and sentences; to help them acquire expertise for self-study of Sanskrit texts and communication in Sanskrit; to help the students imbibe values of life and Indian culture as propounded in scriptures.

Syllabus Unit**1**

Introduction to Sanskrit language, Devanagari script – Vowels and consonants, pronunciation, classification of consonants, conjunct consonants, words – nouns and verbs, cases – introduction, numbers, Pronouns, communicating time in Sanskrit. Practical classes in spoken Sanskrit

Unit 2

Verbs– Singular, Dual and plural – First person, Second person, Third person. Tenses – Past, Present and Future – Atmanepadi and Parasmaipadi–kārthariprayoga

Unit 3

Words for communication, slokas, moral stories, subhashithas, riddles (from the books prescribed)

Unit 4

Selected slokas from Valmiki Ramayana, Kalidasa's works and Bhagavad Gita. Ramayana – chapter VIII – verse 5, Mahabharata – chapter 174, verse – 16, Bhagavad Gita – chapter – IV verse 8, Kalidasa's Sakuntalam Act IV – verse 4

Unit 5

Translation of simple sentences from Sanskrit to English and vice versa.

ESSENTIAL READING:

1. *Praveshaha*; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore – 560085
2. *Sanskrit Reader I, II and III*, R. S. Vadhyar and Sons, Kalpathi, Palakkad
3. *Prakriya Bhashyam* written and published by Fr. John Kunnappally
4. *Sanskrit Primer* by Edward Delavan Perry, published by Ginn and Company Boston
5. *Sabdamanjari*, R. S. Vadyar and Sons, Kalpathi, Palakkad
6. *Namalinganusasanam* by Amarasimha published by Travancore Sanskrit series
7. *Subhashita Ratna Bhandakara* by Kashinath Sharma, published by Nirnayasagar press

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

23SAN231

SANSKRIT II

L-T-P-C: 2-0-0-

OBJECTIVES:

To familiarize students with Sanskrit language and literature; to enable them to read and understand Sanskrit verses and sentences; to help them acquire expertise for self- study of Sanskrit texts and communication in Sanskrit; to help the students imbibe values of life and Indian culture as propounded in scriptures.

Syllabus Unit

1

Seven cases, indeclinables, sentence making with indeclinables, Saptha karakas.

Unit 2

Ktavatu Pratyaya, Upasargas, Ktvanta, Tumunnanta, Lyabanta. Three Lakaras – brief introduction, Lot lakara.

Unit 3

Words and sentences for advanced communication. Slokas, moral stories (Pancatantra) Subhashitas, riddles.

Unit 4

Introduction to classical literature, classification of Kavyas, classification of Dramas – The five Mahakavyas, selected slokas from devotional kavyas– Bhagavad Gita – chapter – II verse 47, chapter – IV verse 7, chapter – VI verse 5, chapter – VIII verse 6, chapter – XVI verse 21, Kalidasa's Sakuntala act IV – verse 4, Isavasyopanishat 1st Mantra, Mahabharata chapter 149 verses 14 – 120, Neetisara chapter – III

Unit 5

Translation of paragraphs from Sanskrit to English and vice versa.

ESSENTIAL READING:

Amrita Vishwa Vidyapeetham.

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1. *Praveshaha*; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar,

Bangalore –560085

2. *Sanskrit Reader I, II and III, R.S. Vadhyar and Sons, Kalpathi, Palakkad*
3. *Prakriya Bhashyam written and published by Fr. John Kunnappally*
4. *Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston*
5. *Sabdamanjari, R. S. Vadyar and Sons, Kalpathi, Palakkad*
6. *Namalinganusasanam by Amarasimha published by Travancore Sanskrit series*
7. *Subhashita Ratna Bhandakara by Kashinath Sharma, published by Nirnayasagar Press.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Syllabus

Unit 1

Understanding CSR – Evolution, importance, relevance and justification. CSR in the Indian context, corporate strategy. CSR and Indian corporate. Structure of CSR – In the Companies Act 2013 (Section 135); Rules under Section 13; CSR activities, CSR committees, CSR policy, CSR expenditure CSR reporting.

Unit 2

CSR Practices & Policies – CSR practices in domestic and international area; Role and contributions of voluntary organizations to CSR initiatives. Policies; Preparation of CSR policy and process of policy formulation; Government expectations, roles and responsibilities. Role of implementation agency in Section 135 of the Companies Act, 2013. Effective CSR implementation.

Unit 3

Project Management in CSR initiatives – Project and programme; Monitoring and evaluation of CSR Interventions. Reporting – CSR Documentation and report writing. Reporting framework, format and procedure.

REFERENCES:

1. *Corporate Governance, Ethics and Social Responsibility*, V Bala Chandran and V Chandrasekaran, PHI Learning Private Limited, New Delhi 2011.
2. *White H. (2005) Challenges in evaluating development effectiveness: Working paper 242, Institute of Development Studies, Brighton.*
3. *UNDP (nd) Governance indicators: A users guide. Oslo: UNDP*
4. *Rao, Subbha (1996) Essentials of Human Resource Management and Industrial Relations, Mumbai, Himalaya*
5. *Rao, V. S. L. (2009) Human Resource Management, New Delhi, Excel Books,*

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Syllabus

Unit 1

Mental Health – concepts, definition, Bio-psycho-social model of mental health. Mental health and mental illness, characteristics of a mentally healthy individual, Signs and symptoms of mental health issues, presentation of a mentally ill person. Work place – definition, concept, prevalence of mental health issues in the work place, why invest in workplace mental health, relationship between mental health and productivity, organizational culture and mental health. Case Study, Activity.

Unit 2

Mental Health Issues in the Workplace: Emotions, Common emotions at the workplace, Mental Health issues – Anger, Anxiety, Stress & Burnout, Depression, Addictions – Substance and Behavioural, Psychotic Disorders – Schizophrenia, Bipolar Disorder, Personality disorders. Crisis Situations – Suicidal behavior, panic attacks, reactions to traumatic events. Stigma and exclusion of affected employees. Other issues –work-life balance, Presenteeism, Harassment, Bullying, Mobbing. Mental Health First Aid – Meaning. Case Study, Activity.

Unit 3

Strategies of Help and Care: Positive impact of work on health, Characteristics of mentally healthy workplace, Employee and employer obligations, Promoting mental health and well being – corporate social responsibility (CSR), an inclusive work environment, Training and awareness raising, managing performance, inclusive recruitment, Supporting individuals –talking about mental health, making reasonable adjustments, Resources and support for employees – Employee Assistance Programme / Provider (EAP), in house counsellor, medical practitioners, online resources and telephone support, 24 hour crisis support, assistance for colleagues and care givers, Legislations. Case Study, Activity.

REFERENCES:

1. American Psychiatric Association. "Diagnostic and statistical manual of mental disorders: DSM-IV 4th ed." www.terapiacognitiva.eu/dwl/dsm5/DSM-IV.pdf
2. American Psychiatric Association. (2000) www.ccsa.ca/Eng/KnowledgeCentre/OurDatabases/Glossary/Pages/index.aspx.
3. Canadian Mental Health Association, Ontario "Workplace mental health promotion, A how to guide" wmhp.cmhaontario.ca/

Tips for employees and managers together. Calgary: Alberta Health Services. <http://www.mentalhealthpromotion.net/resources/minding-the-workplace-tips-for-employees-and-managers-together.pdf>

5. *Government of Western Australia, Mental Health Commission. (2014) "Supporting good mental health in the work place." http://www.mentalhealth.wa.gov.au/Libraries/pdf_docs/supporting_good_mental_health_in_the_workplace_1.sflb.ashx*
6. *Mental Health Act 1987 (India) www.tnhealth.org/mha.htm*
7. *Persons with disabilities Act 1995 (India) socialjustice.nic.in*
8. *The Factories Act 1948 (India) www.caaa.in/Image/19ulabourlawshb.pdf*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Objectives:

- To introduce the students to different literature– Sangam literature, Epics, Bhakthi literature and modern literature.
- To improve their ability to communicate with creative concepts, and also to introduce them to the usefulness of basic grammatical components in Tamil.

Course Outcomes

CO 1: To understand the Sangam

literature CO 2: To understand the creative literature

CO 3: To understand the literary work on religious

scriptures CO 4: To improve the communication and memory skills

CO 5: To understand the basic grammar components of Tamil language and their usage and applications. CO 6: Understand creative writing aspects and apply them.

CO-PO Mapping

PO/PSO												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			-	-	-	-	-	-	2	2	-	-
CO2			-	-	-	-	-	-	2	2	-	-
CO3			-	-	-	-	-	-	2	2	-	-
CO4			-	-	-	-	-	-	2	2	-	-
CO5			-	-	-	-	-	-	2	2	-	-
CO6			-	-	-	-	-	-	2	2	-	-

Syllabus**Unit 1**

The history of Tamil literature: Nāṭ ṭ upur ap pāṭ alkaḷ , kataikkaḷ , paḷ amoḷ ikaḷ – ciṟ ukataikaḷ tōṟ ṟ amum vaḷ arcciyum, ciṟ ṟ ilakkiyaṅ kaḷ : Kalin kattup paraṅ i (pōrpāṭ iyatu) – mukkūṭ ar paḷ ḷ u 35.

Kāppiyaṅ kaḷ : Cilappatikāram – maṅ imēkalai naṭ aiyiyal āyvu maṟ ṟ um aimperum – aiñciṟ uṅ kāppiyaṅ kaḷ toṭ arpaṅ a ceytikaḷ .

Unit 2

Amrita Vishwa Vidyapeetham, BTC-AIE B.Tech Curriculum June 2021
tiṅ ai ilakkiyamum nīṭiyilakkiyamum – patiṅ eṅ kiḷ kkaṅ akku nūlkaḷ toṭ arpaṅ a piṟ a ceytikaḷ –

tirukkuṛ al (aṇ pu, paṇ pu, kalvi, oḷ ukkam, naṭ pu, vāymai, kēḷ vi, ceynaṇ ṛ i, periyāraittuṇ akkōṭ al, viḷ ippuṇ arvu pēṇ ṛ a atikārattil uḷ ḷ a ceytikaḷ .

Aṛ anūlkaḷ : Ulakanīti (1-5) – ēlāti (1,3,6). – Cittarkaḷ : Kaṭ uveḷ i cittar pāṭ alkaḷ (āṇ antak kaḷ ippu -1, 4, 6, 7, 8), maṛ ṛ um akappēy cittar pāṭ alkaḷ (1-5).

Unit 3

tamiḷ ilakkaṇ am: Vākkiya vakaikaḷ – taṇ viṇ ai piṛ aviṇ ai – nērkkuṛ ṛ u ayaṛ kūṛ ṛ u

Unit 4

tamiḷ aka aṛ iṇarkaḷ iṇ tamiḷ toṇ ṭ um camutāya toṇ ṭ um: Pāratiyār, pāratitācaṇ , paṭ ṭ ukkōṭ ṭ ai kalyāṇ acuntaram, curatā, cujātā, ciṛ pi, mēttā, aptul rakumāṇ , na.Piccaimūrtti, akilaṇ , kalki, jī.Yū.Pōp, vīramāmuṇ ivar, aṇ ṇ ā, paritimār kalaiṇar, maṛ aimalaiyaṭ ikaḷ .

Unit 5

tamiḷ moḷ i āyvil kaṇ iṇ i payaṇ pāṭ u. – Karuttu parimār ṛ am – viḷ ampara moḷ iyamaippu – pēccu – nāṭ akam paṭ aippu – ciṛ ukatai, katai, putiṇ am paṭ aippu.

Textbooks:

1. <http://Www.tamilvu.trg/libirary/libindex.htm>.
2. http://Www.tunathamizh.tom/2013/07/blog0post_24.html
3. Mu.Varatarācaṇ “tamiḷ ilakkiya varalār u” cāhitya akaṭ emi papḷ ikēṣ aṇ s, 2012
4. nā.Vāṇ amāmalai “paḷ aṇ kataikaḷ um, paḷ amoḷ ikaḷ um” niyū ceṇcuri puttaka veḷ iṇ ṭ akam, 5. 1980,2008
6. nā.Vāṇ amāmalai, “tamiḷ ar nāṭ ṭ uppāṭ alkaḷ ” niyū ceṇcuri puttaka veḷ iṇ ṭ akam 1964,2006
7. poṇ maṇ imār aṇ “aṭ ṭ tamiḷ ilakkaṇ am “aṭ ṭ paḷ iṣ iṇ kurūp, vañciyūr,
8. tiruvaṇ antapuram, 2007.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Course Objectives

- To learn the history of Tamil literature.
- To analyze different styles of Tamil Language.
- To strengthen the creativity in communication, Tamil basic grammar and use of computer on Tamil Language.

Course Outcomes

CO 1: Understand the history of Tamil literature.

CO 2: Apply practical and comparative analyses on literature.

CO 3: Understand thinai literature, literature on justice, Pathinenkeelkanaku literature. CO 4: Understand the tamil scholars' service to Tamil language and society.

CO 5: Understand components of Tamil grammar and its usage CO 6: Understand creative writing aspects and apply them

CO-PO Mapping

PO/ PSO													
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1			-	-	-	-	-	-	2	2	-	-	
CO2			-	-	-	-	-	-	2	2	-	-	
CO3			-	-	-	-	-	-	2	2	-	-	
CO4			-	-	-	-	-	-	2	2	-	-	
CO5			-	-	-	-	-	-	2	2	-	-	
CO6			-	-	-	-	-	-	2	2	-	-	

Syllabus**Unit 1**

The history of Tamil literature: Nāṭ ṭ upur ap pāṭ alkaḷ , kataikkaḷ , paḷ amoḷ ikaḷ - ciṟ ukataikaḷ tōṟ ṟ amum vaḷ arcciyum, ciṟ ṟ ilakkiyaṅ kaḷ : Kaliṅ kattup paraṅ i (pōrpāṭ iyatu) – mukkuṭ ar paḷ i u 35.

Kāppiyaṅ kaḷ : Cilappatikāram – maṇ imēkalai naṭ aiyiyal āyvu maṟ ṟ um aimperum – aiñciṟ uṅ kāppiyaṅ kaḷ toṭ arpaṅ a ceytikaḷ .

Unit 2

tiṇ ai ilakkiyamum nītiyilakkiyamum – patiṇ eṇ kīl kkaṇ akku nūlkaḷ toṭ arpāṇ a piṇ a ceytikaḷ – tirukkuṇ aḷ (aṇ pu, paṇ pu, kalvi, oḷ ukkam, naṭ pu, vāymai, kēḷ vi, ceynaṇ ṇ i, periyāraittuṇ akkōṭ al, viḷ ippuṇ arvu pēṇ ṇ a atikārattil uḷ ḷ a ceytikaḷ .

Aṇ anūlkaḷ : Ulakanīti (1–5) – ēlāti (1,3,6). – Cittarkaḷ : Kaṭ uveḷ i cittar pāṭ alkaḷ (āṇ antak kaḷ ippu – 1, 4, 6, 7,

8), maṇ ṇ um akappēy cittar pāṭ alkaḷ (1–5).

Unit 3

tamiḷ ilakkaṇ am: Vākkiya vakaikaḷ – taṇ viṇ ai piṇ aviṇ ai – nērkūṇ ṇ u ayaṇ kūṇ ṇ u

Unit 4

tamiḷ aka aṇ iṇarkaḷ iṇ tamiḷ toṇ ṭ um camutāya toṇ ṭ um: Pāratiyār, pāratitācaṇ , paṭ ṭ ukkōṭ ṭ ai kalyāṇ acuntaram, curatā, cujātā, ciṇ pi, mēttā, aptul rakumāṇ , na.Piccaimūrtti, akilaṇ , kalki, jī.Yū.Pōp, vīramāmuṇ ivar, aṇ ṇ ā, paritimāṇ kalaiṇar, maṇ aimalaiyaṭ ikaḷ .

Unit 5

tamiḷ moḷ i āyvil kaṇ iṇ i payaṇ pāṭ u. – Karuttu parimāṇ ṇ am – viḷ ampara moḷ iyamaippu – pēccu – nāṭ akam paṭ aippu – ciṇ ukatai, katai, putiṇ am paṭ aippu.

Text Books / References

<http://Www.tamilvu.trg/libirary/libindex.htm>.

http://Www.tunathamizh.tom/2013/07/blog0post_24.html Mu.Varatarācaṇ “tamiḷ ilakkiya varalār u” cāhitya akaṭ emi paḷ ikeṣ aṇ s, 2012

nā.Vāṇ amāmalai “paḷ aṇ kataikaḷ um, paḷ amoḷ ikaḷ um” niyū ceṇcuri puttaka veḷ iyīṭ ṭ akam, 1980,2008 nā.Vāṇ amāmalai, “tamiḷ ar nāṭ ṭ uppāṭ alkaḷ ” niyū ceṇcuri puttaka veḷ iyīṭ ṭ akam 1964,2006 poṇ maṇ imāṇ aṇ “aṭ ṭ tamiḷ ilakkaṇ am “aṭ ṭ paḷ iṣ iṇ kurūp, vañciyū

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.