B.Tech in Artificial Intelligence and Data Science

(Quantum Technologies)

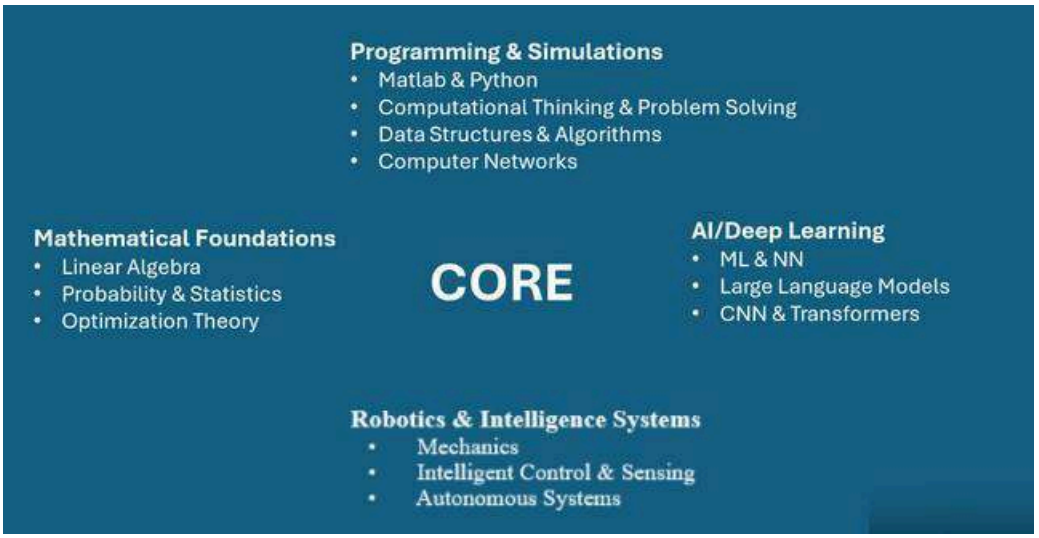
Curriculum and Syllabus

2025

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



B.Tech. Artificial Intelligence & Data Science (Quantum Technologies)

A 4-year professional degree conceived and designed for those who aspire to work with computers, robots, computational modelling and artificial intelligence, for solving real-world problems in Robotics.

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.

PROGRAMME SPECIFIC OUTCOMES

PSO1: Demonstrate proficiency in quantum algorithms, quantum-enhanced machine learning, and AI-driven solutions and solve real world challenges that include applying classical algorithms, and quantum sensing and computing to drug discovery, financial modeling, material science, cybersecurity, and optimization.

PSO2: Develop Secure Quantum Systems by gaining proficiency in quantum cryptography and secure communications to address emerging threats.

PSO3: Develop ethical and responsible Quantum Technology solutions by considering the ethical implications of quantum 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 using quantum technologies.

SEMESTER I

Cat.	Course Code	Title	L T P	Credit
SCI	25MAT106	Mathematics for Intelligent Systems 1	2 0 2	3
ENGG	25AID101	Computational Thinking, programming and Problem Solving	2 0 2	3
ENGG	25AIA102	Elements of Computing	2 0 2	3
ENGG	25EEE101	Foundations of Electrical and Electronics Engineering	2 0 2	3
SCI	25PHY105	Mechanics - Foundations for Robotics	2 0 2	3
HUM		Amrita Value Program I	1 0 0	1
HUM	22AVP103	Mastery Over Mind	1 0 2	2
HUM	23ENG101	Technical Communication	2 0 3	3
		Micro Credential Course Set 1		3
TOTAL				**24**

SEMESTER II

Cat.	Course Code	Title	L T P	Credit
SCI	25MAT116	Mathematics for Intelligent Systems 2	2 0 2	3
ENGG	25AID111	Introduction to data structures and algorithms	2 0 2	3
ENGG	25AIA112	Object Oriented Programming	2 0 2	3
ENGG	25AID113	Introduction to AI and Machine Learning	2 0 2	3
ENGG	25AIA114	Software-Defined Communications Systems	2 0 2	3
ENGG	25AIA115	Introduction to Robotics & Automation	2 0 2	3
HUM	25AID116	User Interface Design	1 0 2	2
HUM		Amrita Value Programme II	1 0 0	1
		Micro Credential Course Set 2		3
TOTAL				**24**

SEMESTER III

Cat	Course Code	Title	L T P	Cr
SCI	25MAT206	Mathematics for Intelligent Systems 3	2 0 2	3
ENGG	25AIA201	Deep Learning	2 0 2	3
ENGG	25AIA202	Introduction to Control System	2 0 2	3
ENGG	25AID202	Introduction to Computer Networks	2 0 2	3
ENGG	25AIA203	Introduction to ROS2 & Robot Simulation	2 0 2	3
HUM	22ADM101	Foundations of Indian Heritage	2 0 1	2
HUM	23LSE201	Life Skills for Engineers I	1 0 2	2
		Micro Credential Course Set 3		3
TOTAL				**22**

Cat	Course Code	Title	L T P	Cr
SCI	25MAT216	Mathematics for Intelligent Systems 4	2 0 2	3
ENGG	25AIA211	Dynamics of Robots	2 0 2	3
ENGG	25AIA212	Advanced Control systems	2 0 2	3
ENGG	25AIA213	Introduction to IoT	2 0 2	3
ENGG	25AID214	Operating Systems	2 0 2	3
ENGG	25AIA215	Computer Vision	2 0 2	3
HUM	22ADM111	Glimpses of Glorious India	2 0 1	2
HUM	23LSE211	Life Skills for Engineers II	1 0 2	2
		Micro Credential Course Set 4		3
TOTAL				**25**

SEMESTER IV

SEMESTER V

Cat	Course Code	Title	L T P	Cr
SCI	25MAT306	Mathematics for Intelligent Systems 5	2 0 2	3
ENGG	25AIA301	Natural Language Processing for Robotics	2 0 2	3
ENGG	25AIA302	Big Data Analytics	2 0 2	3
ENGG		Elective - 1	2 0 2	3
ENGG	25AIA303	Modelling, Simulation & Analysis	2 0 2	3
ENGG	25AIA304	Signal and image processing	2 0 2	3
HUM		Free Elective	2 0 1	2
HUM	23LSE301	Life Skills for Engineers III	1 0 2	2
		Micro Credential Course Set 5		3
TOTAL				**25**

SEMESTER VI

Cat	Course Code	Title	L T P	Cr
SCI	25MAT316	Mathematics for Intelligent Systems 6	2 0 2	3
ENGG	25AIA311	AI Agents	2 0 2	3
ENGG		Elective - 2	2 0 2	3
ENGG		Elective - 3	2 0 2	3
ENGG	25AID301	Reinforcement Learning	2 0 2	3
ENGG	25AIA312	Underactuated Robotics	2 0 2	3
HUM	23LSE311	Life Skills for Engineers IV	1 0 2	2
		Micro Credential Course Set 6		3
TOTAL				**23**

Cat	Course Code	Title	L T P	Cr
ENGG		Free Elective - 1	2 0 2	3
ENGG		Free Elective - 2	2 0 2	3
PRJ	25AIA498	Project Phase - 1		4
ENGG	23ENV300	Environmental Science		P/F
ENGG	23LAW300	Indian Constitution		P/F
		Total		**10**

Cat	Course Code	Title	L T P	Cr
PRJ	25AIA499	Project Phase - II		10
		Total		**10**

SEMESTER VII

SEMESTER VIII

Total Credits 163

***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
22ADM201	Strategic Lessons from Mahabharatha	1-0-0
22ADM211	Leadership from Ramayana	1-0-0
22AVP210	Kerala Mural Art and Painting	1-0-0
22AVP218	Yoga Therapy and Lessons	1-0-0
22AVP212	Introduction to Traditional Indian Systems of Medicine	1-0-0
22AVP201	Amma's Life and Message to the modern world	1-0-0
22AVP204	Lessons from the Upanishads	1-0-0
22AVP205	Message of the Bhagavad Gita	1-0-0
22AVP206	Life and Message of Swami Vivekananda	1-0-0
22AVP207	Life and Teachings of Spiritual Masters of India	1-0-0
22AVP208	Insights into Indian Arts and Literature	1-0-0
22AVP213	Traditional Fine Arts of India	1-0-0
22AVP214	Principles of Worship in India	1-0-0
22AVP215	Temple Mural Arts in Kerala	1-0-0
22AVP218	Insights into Indian Classical Music	1-0-0
22AVP219	Insights into Traditional Indian Painting	1-0-0
22AVP220	Insights into Indian Classical Dance	1-0-0
22AVP221	Indian Martial Arts and Self Defense	1-0-0
22AVP209	Yoga and Meditation	1-0-0

PROFESSIONAL ELECTIVES

Elective 1 Basket

Cat	Course Code	Title	L T P	Cr
ENGG	25AIA331	Mobile Robotics	2 0 2	3
ENGG	25AIA332	Probabilistic Robotics	2 0 2	3
ENGG	25AIA333	Advanced ROS2	2 0 2	3
ENGG	25AIA334	Design Thinking	2 0 2	3

Elective 2 Basket

Cat	Course Code	Title	L T P	Cr
ENGG	25AIA341	Data driven Control in Robotics	2 0 2	3
ENGG	25AIA342	Active Inference	2 0 2	3
ENGG	25AIA343	Human Computer Interface	2 0 2	3

Elective 2 Basket

Cat	Course Code	Title	L T P	Cr
ENGG	25AIA351	Swarm Robotics	2 0 2	3
ENGG	25AIA352	Soft Robotics	2 0 2	3
ENGG	25AIA353	Biomimetics	2 0 2	3
ENGG	25AIA354	Embedded systems	2 0 2	3

Evaluation Pattern

Assessment	Internal/External	Weightage (%)
Regular tests (minimum 5 to 10*)	Internal	50
Project Review 1 & 2 / Mid Semester Examination	Internal	20
Final Project Review/ End Semester Examination	External	30

*The minimum number of assessments for 50 percent weightage will be decided by each campus and may vary from 5 to 10.

Micro Credential Courses (1 credit each):

Course code	Course Name
25AID431	Introduction to Classical Computing
25AID432	Mathematical Postulates of Quantum Mechanics
25AID433	Elements of Quantum Computing
25AID434	Linear algebra and Quantum Gates
25AID435	Elements of Quantum Programming
25AID436	Quantum Programming Frameworks
25AID437	Conceptual ideas in Quantum mechanics
25AID438	Quantum Operator Mechanics
25AID439	Basic Laboratory Course for Quantum Technologies-1
25AID440	Quantum Machine Learning
25AID441	Basic Laboratory Course for Quantum Technologies-2
25AID442	Quantum Protocols and algorithms
25AID443	Basic Laboratory Course for Quantum Technologies-3
25AID444	Introduction to Quantum Communication
25AID445	Introduction to Quantum Sensing
25AID446	Introduction to Quantum Sensing -2
25AID447	Introduction to Quantum Materials -1
25AID448	Introduction to Quantum Materials-2
25AID449	Quantum Measurements and Classical limits
25AID450	Quantum States of light
25AID451	Quantum Enhanced sensing and Metrology
25AID452	Fundamentals of Photonics for Quantum Communication
25AID453	Foundations of Quantum Communication
25AID454	Advanced Concepts in Quantum Communication
25AID455	Foundations of Quantum Materials
25AID456	Collective Phenomenon in Quantum Materials
25AID457	Advanced Topics in Quantum Materials
25AID458	Foundations of Quantum Information

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

SEMESTER 1

25MAT106 Mathematics for Intelligent Systems 1 L-T-P-C: 2- 0- 2- 3

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 CO	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
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	-	-

Syllabu

s 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.

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).*

25AID101 Computational Thinking, Programming and Problem-Solving L-T-P-C: 2- 0- 2- 3

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

Syllabu

s 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.*

25AIA102 Elements of Computing L-T-P-C: 2- 0- 2- 3

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 CO	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
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

Syllabu

s 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.*

25EEE101 Foundations of Electrical and Electronics Engineering L-T-P-C: 2- 0- 2- 3

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 / CO	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
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

- *D. P. Kothari and J. Nagrath, Basic Electrical Engineering"(4th edition), McGraw Hill, 2019.*
- *James W. Nilsson and Susan Riedel, Electric Circuits, (11th edition), Pearson, 2018.*
- *Ogata, Modern Control Engineering (5th edition), Pearson, 2009.*
- *B.S. Manke, Khanna, Linear Control Systems with MATLAB Applications, 12th edition, 2016 .*

25PHY105 Mechanics – Foundations for Robotics L-T-P-C: 2- 0- 2- 3

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 CO	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
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

Syllabus

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

- *B. S. Choo and S. H. Han, Introduction to Computational Mechanics, 1st edition, 2005*
- *J.L. Meriam and L.G. Kraige, Engineering Mechanics: Dynamics, 8th edition, 2016*
- *Ferdinand P. Beer and E. Russell Johnston Jr., Vector Mechanics for Engineers: Statics and Dynamics, 11th edition, 2015*
- *James M. Gere and Barry J. Goodno, Mechanics of Materials, 9th edition, 2018*
- *David Morin, Introduction to Classical Mechanics: With Problems and Solutions, 1st edition, 2008*
- *Irving H. Shames, Engineering Mechanics: Statics and Dynamics, 4th edition, 2002*

22AVP103	Mastery Over Mind (MAOM) 1-0-2 2

1. Course Overview

Master Over the Mind (MAOM) is an Amrita initiative to implement schemes and organise university-wide programs to enhance health and wellbeing of all faculty, staff, and students (UN SDG -3). This program as part of our efforts for sustainable stress reduction gives an introduction to immediate and long-term benefits and equips every attendee to manage stressful emotions and anxiety facilitating inner peace and harmony.

With a meditation technique offered by Amrita Chancellor and world-renowned humanitarian and spiritual leader, Sri Mata Amritanandamayi Devi (Amma), this course has been planned to be offered to all students of all campuses of AMRITA, starting off with all first years, wherein one hour per week is completely dedicated for guided practical meditation session and one hour on the theory aspects of MAOM. The theory section comprises lecture hours within a structured syllabus and will include invited guest lecture series from eminent personalities from diverse fields of excellence. This course will enhance the understanding of experiential learning based on university's mission: "Education for Life along with Education for Living", and is aimed to allow learners to realize and rediscover the infinite potential of one's true Being and the fulfilment of life's goals.

Course Syllabus

Unit 1

Causes of Stress: The problem of not being relaxed. Need for meditation -basics of stress management at home and workplace. Traditions and Culture. Principles of meditation– promote a sense of control and autonomy in the Universal Human Value System. Different stages of Meditation. Various Meditation Models. Various practices of Meditation techniques in different schools of philosophy and Indian Knowledge System.

Unit 2

Improving work and study performance. Meditation in daily life. Cultivating compassion and good mental health with an attitude of openness and acceptance. Research and Science of Meditation: Significance of practising meditation and perspectives from diverse fields like science, medicine, technology. philosophy, culture, arts, management, sports, economics, healthcare, environment etc. The role of meditation for stress and anxiety reduction in one's life with insights based on recent cutting-edge technology. The effect of practicing meditation for the wholesome wellbeing of an individual.

Unit 3

Communications: principles of conscious communication. Relationships and empathy: meditative approach in managing and maintaining better relationships in life during the interactions in the world, role of MAOM in developing compassion, empathy and responsibility, instilling interest, and orientation to humanitarian projects as a key to harness intelligence and compassion in youth. Methodologies to evaluate effective awareness and relaxation gained from meditation. Evaluating the global transformation through meditation by instilling human values which leads to service learning and compassion driven research.

TEXT BOOKS:

1. Mata Amritanandamayi Devi, "Cultivating Strength and vitality,"
published by Mata Amritanandamayi Math, Dec 2019
2. Swami Amritaswarupananda Puri ,"The Color of Rainbow " published by MAM, Amritapuri.

REFERENCES:

1.Craig Groeschel, "Winning the War in Your Mind: Change Your Thinking, Change Your Life"

Zondervan Publishers, February 2019
2. R Nagarathna et al, “New Perspectives in Stress Management “Swami Vivekananda Yoga Prakashana publications, Jan 1986
3. Swami Amritaswarupananda Puri “Awaken Children Vol 1, 5 and 7 - Dialogues with Amma on Meditation”, August 2019
4. Swami Amritaswarupananda Puri “From Amma’s Heart - Amma’s answer to questions raised during world tours” March 2018
5. Secret of Inner Peace- Swami Ramakrishnananda Puri, Amrita Books, Jan 2018.
6. Mata Amritanandamayi Devi “Compassion :The only way to Peace:Paris Speech”, MA Center, April 2016.
7. Mata Amritanandamayi Devi “Understanding and collaboration between Religions”, MA Center, April 2016.
8. Mata Amritanandamayi Devi “Awakening of Universal Motherhood: Geneva Speech” M A center, April 2016.

2. Evaluation and Grading

Internal			**External**	**Total**
Components	*Weightage*		Practical (attendance and class participation) 60%	100%
Quizzes(based on the reading material)	20%	40%		
Assignments (Based on webinars and lecture series)	20%			

3. Course Outcomes (CO)

CO1: Relate to the causes of stress in one’s life.
CO2: Experiment with a range of relaxation techniques CO3: Model a meditative approach to work, study, and life.
CO4: Develop appropriate practice of MA-OM technique that is effective in one’s life CO5: Inculcate a higher level of awareness and focus.
CO6: Evaluate the impact of a meditation technique

CO – PO Affinity Map

P O / C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2		-	2	3	-	3	-	3	-	-	-
CO2	3	3	3	2	2	_	2	3	3	3	-	3	-	-	-
CO3	3	3	2	2	2	2	2	3	3	3	-	3	-	-	-
CO4	3	3	3	2	-	2	3	3	3	3	-	3	-	-	-
CO5	3	2	2	2	-	2	-	3	2	2	-	2	-	-	-
CO6	3	2	2	2	3	2	_	3	2	2	-	2	-	-	-

23ENG101	Technical Communication	L-T-P-C: 2-0-3-3

Course Objective:

Learn the fundamentals of mechanics of writing
Acquire the ability to draft formal correspondence and various technical documents
Develop abilities in critical thinking and analysis
Acquire skills of scanning for specific information, comprehension, and organization of ideas
Enhance competency in technical presentation skills

Course Outcomes

CO1: Apply the mechanics of writing in formal correspondence

CO2: Write technical documents with appropriate form and content
CO3: Organize technical information or ideas in a logical and coherent manner
CO4: Compose grammatically and stylistically accurate project reports/ term papers
CO5: Make effective technical presentations

CO-PO Mapping

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

Syllabus

Unit 1
Error Analysis
Mechanics of Writing: Grammar rules -articles, tenses, auxiliary verbs (primary & modal) prepositions, subject-verb agreement, pronoun-antecedent agreement, discourse markers and sentence linkers, impersonal passive, modifiers, phrasal verbs
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/Emails
Punctuation
Scientific Reading & Listening Comprehension
Unit 3
Technical paper writing: Documentation style - Document editing – Proof reading - Organizing and Formatting
Tone and style
Graphical representation
Reading and listening comprehension of technical documents
Mini Technical project / Term paper (10 -12 pages)
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. EB. The Elements of Style New York. Alliyan & Bacon, 1999.
4. Riordan, G. Daniel and Pauley E. Steven. Technical Report Writing Today VIII Edition (Indian Adaptation). New Delhi: Biztantra, 2004.
5.Michael Swan. Practical English Usage Oxford University Press, 2000

Evaluation Pattern

Assessment	Internal	End Semester
Midterm Exam	30	
*Continuous Assessment (CA)	30	
End Semester/Project		40

*CA Theory/Lab – Quizzes, Assignments, User Manual, Abstract, Project Report, Presentation, etc.

SEMESTER 2

25MAT116 Mathematics for Intelligent Systems 2 L-T-P-C: 2- 0- 2- 3

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 / CO	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
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 – QR decomposition-Gram-Schmidt Orthogonalization- 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 e^{AT}- 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.

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).*

25AID111 Introduction to Data Structures & Algorithms L-T-P-C: 2- 0- 2- 3

Course Objectives

- This course aims to introduce the concept of data structures.
- 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 / CO	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
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. Augenstin 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*

25AIA112 Object Oriented Programming L-T-P-C: 2- 0- 2- 3

Course Objectives

- 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/ PSO CO	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
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*

25AID113 Introduction to AI and Machine Learning L-T-P-C: 2- 0- 2- 3

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 / CO	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
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.*

25AIA114 Software-Defined Communication Systems L-T-P-C: 2- 0- 2- 3

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 / CO	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
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	2	2	2	3	-	-	-	2	2	2	2	3	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.*

25AIA115 Introduction to Robotics and Automation L-T-P-C: 2 0 2 3

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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

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

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

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

Unit 4

Role of Robotics in Smart Manufacturing and Automation, Collaborative Robots (Cobots) and Human-Robot Interaction, Integration of Robotics with IoT and AI, Case Studies: Robotics in Autonomous Vehicles, Drones, and Smart Factories.

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*

25AID116 **User Interface Design** **L-T-P-C: 1 0 2 2**

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 / CO	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
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	-	-	-	-

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.*

SEMESTER 3

25MAT206 Mathematics for Intelligent Systems 3 L-T-P-C: 2- 0- 2- 3

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	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO 3
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).*

25AIA201 **Deep Learning** **L-T-P-C: 2- 0- 2- 3**

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/ 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	PSO3
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.*

25AIA202 **Introduction to Control System** **L-T-P-C: 2- 0- 2- 3**

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/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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. ISBN9780470048962.*
- *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.*

25AID202 **Introduction to Computer Networks** **L-T-P-C: 2- 0- 2- 3**

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	PSO1	PSO 2	PSO 3
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).*

25AIA203 Introduction to ROS2 &Robot Simulation L-T-P-C: 2- 0- 2- 3

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	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO 3
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.

Unit 2: Intermediate ROS2 Concepts & Robot Simulation

ROS2 middleware and communication mechanisms, ROS2 launch files and parameter management, ROS2 package dependencies and ROS2 ecosystem, Introduction to Rviz, TF & visualization in Rviz, URDF files for Robots, Introduction to Gazebo simulator.

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*

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

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
CO2	Understand the foundational concepts of Indian civilization like puruśārtha-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 / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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*

23LSE201 **Life Skills for Engineers I** **L-T-P-C: 1 0 2-2**

Course Objective

- 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

After completing this course, students will be able to

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 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/ PSO	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO3
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 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 mindset 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, Alligations, 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.

Text Books / References

- *Students" Career Planning Guide, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.*
- *Soft Skill Handbook, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham. Adair. J., (1986), "Effective Team Building: How to make * winning team", London, U.K Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
- *The hard truth about Soft Skills, by Amazon Publication. Verbal Skills Activity Book, CIR, AVVP*
- *English Grammar & Composition, Wren & Martin*
- *Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce Cracking the New GRE 2012*
- *Kaplan's – GRE Comprehensive Programme*
- *Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.*

- *Quantitative Aptitude for All Competitive Examinations, Abhijit Guha. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma. How to Prepare for Data Interpretation for the CAT, Arun Sharma.*

Evaluation Pattern

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

SEMESTER 4

25MAT216 Mathematics for Intelligent Systems 4 L-T-P-C: 2- 0- 2- 3

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

Syllabu

s Unit 1

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).*

25AIA211 **Dynamics of Robots** **L-T-P-C: 2- 0- 2- 3**

Course Objectives

- The course helps the student to have a deep understanding of the dynamics of robotic systems.
- The course will deliver clearly on how to apply Newton-Euler and Euler-Lagrange methods to multi-body robotic systems.
- The course will introduce advanced topics such as trajectory planning, control, and optimization in the context of robot dynamics.
- The introduce advanced topics such as trajectory planning, control, and optimization in the context of robot dynamics.

Course Outcomes (COs)

After completing this course, students will be able to:

CO1	Develop a basic understanding of the dynamics of robotic systems.
CO2	Apply Newton-Euler and Euler-Lagrange methods to multi-body robotic systems.
CO3	Analyse the dynamics of robotic manipulators, mobile robots, and other robotic systems.
CO4	Implement advanced topics such as trajectory planning, control, and optimization in the context of robot dynamics.

CO-PO Mapping

PO/ PSO CO	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
CO1	3	3	2	1	3	2	1	-	3	3	-	1	1	2	2
CO2	3	3	2	2	3	3	1	-	3	3	-	1	1	2	2
CO3	3	3	3	3	3	3	1	-	3	3	1	2	1	2	2
CO4	3	3	3	3	3	3	1	-	3	3	-	-	2	2	2

Syllabus

Unit 1: Foundations and Dynamics of Robotic Manipulators

Kinematics review, forward/inverse kinematics, Jacobian matrix, velocity/force analysis, Euler-Lagrange formulation, Newton-Euler formulation, Recursive Newton – Euler Dynamics, application to industrial robotic arms.

Unit 2: Dynamics of Mobile and Advanced Robotic Systems

Dynamics of wheeled mobile robots, non-holonomic constraints, motion planning, unmanned ground vehicles (UGVs), drones, parallel manipulators, Stewart platforms, flexible-link robots, underactuated systems, humanoid robots and other advanced robotic systems.

Unit 3: Trajectory Planning, Control, and Simulation

Trajectory planning, smooth motion, energy-efficient motion, computed torque control, feedback linearization, PID control, control based on dynamic models, numerical methods, modelling & simulation using simulation tools (MATLAB, Simulink, Python, ROS).

Textbooks/ Reference Books:

- *Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, Robot Dynamics and Control, 2nd edition, Wiley, 2020*
- *John J. Craig, Introduction to Robotics: Mechanics and Control, Pearson Education India, 2008*
- *Kevin M. Lynch and Frank C. Park, Modern Robotics: Mechanics, Planning, and Control, Cambridge English, 2017*

25AIA212 **Advanced Control systems** **L-T-P-C: 2- 0- 2- 3**

Course Objectives

- This course helps to gain an in-depth understanding of state-space analysis and modern control techniques.
- This course helps to analyse nonlinear control systems and stability using advanced methods.
- This course helps to design optimal and robust controllers for complex engineering systems.

Course Outcomes (COs)

After completing this course, students will be able to:

CO1	Formulate and analyze control systems using state-space representation.
CO2	Evaluate the stability and performance of nonlinear systems
CO3	Design optimal control strategies using Lyapunov and linear quadratic regulator (LQR) methods.
CO4	Implement robust and adaptive control techniques for real-world applications.

CO-PO Mapping

PO/ PSO / CO	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
CO1	3	3	2	2	3	1	-	-	-	-	-	1	3	2	-
CO2	3	3	3	3	2	-	-	-	-	-	1	2	3	3	-
CO3	3	3	3	3	3	2	1	1	1	2	2	2	3	3	2
CO4	3	3	3	3	3	2	1	1	2	2	2	3	3	3	3

Syllabus

Unit 1 State-Space Analysis and Modern Control System Design

State-space representation of dynamic systems, Solution of state equations and state transition matrix, Controllability and observability (Kalman's criteria), Canonical forms and pole placement techniques, State feedback control and full-order observers, Introduction to optimal state feedback.

Unit 2: Nonlinear Control Systems and Stability Analysis

Characteristics and classification of nonlinear systems, Phase plane analysis and describing function method, Lyapunov stability analysis and LaSalle's theorem, Input-output stability concepts, Popov's and Circle Criteria for stability, Nonlinear system examples in robotics and automation.

Unit 3: Optimal and Robust Control Techniques

Introduction to optimal control and performance index, Linear Quadratic Regulator (LQR) and Linear Quadratic Gaussian (LQG) control, Robust control concepts: H∞ control and model uncertainty, Adaptive control: Model Reference Adaptive Control (MRAC) and Self-tuning regulators, Practical implementation and case studies in robotics and automation.

Textbooks/ Reference Books:

- *Katsuhiko Ogata, Modern Control Engineering, 5th Edition, Pearson, 2010.*
- *M. Gopal, Digital Control and State Variable Methods, 4th Edition, McGraw-Hill, 2012.*
- *Jean-Jacques Slotine and Weiping Li, Applied Nonlinear Control, Pearson, 1991.*
- *Brian D. O. Anderson and John B. Moore, Optimal Control: Linear Quadratic Methods, Dover Publications, 2007.*
- *John Doyle, Bruce Francis, Allen Tannenbaum, Feedback Control Theory, Dover, 2009.*
- *Hassan Khalil, Nonlinear Systems, 3rd Edition, Pearson, 2002.*

25AIA213 **Introduction to IoT** **L-T-P-C: 2- 0- 2 -3**

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.
-

Course outcomes

After completing this 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 / CO	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
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 – Actuations-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:

- *Pethuru Raj and Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press, 2017*
- *Singh, R., Gehlot, A., Gupta, L. R., Singh, B., & Swain, M, Internet of things with Raspberry Pi and Arduino, CRC Press, 2019*
- *Strickland, James R. "Raspberry Pi for Arduino Users, Raspberry Pi for Arduino Users - Building IoT and Network Applications and Devices, CRC Pres, 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.*

25AID214 **Operating Systems** **L-T-P-C: 2 0 2 3**

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 / CO	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
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

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*

25AIA215 **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 / CO	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
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

Unit 3

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

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

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 / CO	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
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

- *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.

CIR Course - BTech

Sem: 4	Life Skills for Engineers II	23LSE211	L-T-P-C: 1-0-2-2

Pre-requisite: An inquisitive mind, 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
- 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.

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. 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

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

25MAT306 Mathematics for Intelligent Systems 5 L-T-P-C: 2- 0- 2- 3

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	Apply graphical models to real-world problems such as image recognition, natural language processing, and recommendation systems.
CO4	Develop directed and undirected graphical models.

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
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 I

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

Unit II

Markov Networks, Independencies in Markov Networks, Hidden Markov Models

Unit III

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 edi- tion), 2010.*
- *'Machine Learning: A Probabilistic Perspective', Kevin Murphy and Francis Bach, Penguin Publishers, 2012*
- *Probabilistic graphical models: principles and techniques. Koller, Daphne, and Nir Friedman. MIT press, 2009.*

25AIA301 Natural Language Processing for Robotics L-T-P-C: 2- 0- 2- 3

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

On successful completion of the 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
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	2
CO4	3	3	3	3	3	2	1	2	3	3	2	3	2	2	1

Syllabus

Unit I

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

Unit II

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

Unit III

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

25AIA302 **Big Data Analytics** **L-T-P-C:2-0-2-3**

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	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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	-	-	-

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 Recurrsion, 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 evolutions 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, Pat- rick Wendell and MateiZaharia, O'Reilly; 1st edition , 2015*
- *'Programming in Scala: A Comprehensive Step-by-Step Guide', Martin Odersky,Lex Spoon andBill 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*

25AIA303 Modelling, Simulation & Analysis L-T-P-C: 2- 0- 2-3

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 simula- tion 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 com- puter-based modeling for engineering applications.
CO2	Analyze different system models, including basic ones such as mechanical, electri- cal, 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 estima- tion 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
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

Syllabu

s 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 sys- tems, 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 mecha- nisms, and wheeled mobile robots, Validation and verification of simulation models, Parameter es- timation methods, Parameter estimation examples, System identification, Introduction to optimi- zation, 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).*

25AIA304 **Signal and Image Processing** **L-T-P-C: 2- 0- 2-3**

Course Objectives

- To provide students information about advanced signal processing techniques.
- To afford the ability to implement and apply techniques for signal processing and analysis.
- To impart the basics of digital image processing techniques.
- To impart an understanding on the application of digital image processing techniques.
- To enable the students to implement and apply image processing techniques for image quality improvement and analysis of real-world images.

Course Outcomes

After completing this course, students will be able to

CO1	Analyze time and frequency properties of signals using Fourier and Wavelet transforms.
CO2	Design filters for processing of signals
CO3	Perform data driven representation of signals using PCA and ICA
CO4	Carry out digital image processing, in various stages (sampling, segmentation, clas- sification)
CO5	Demonstrate competence in image compression and feature extraction

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
CO1	2	-	-	-	-	-		2	2	2	-	2	3	1	1
CO2	2	3	-	-	-	-	-	-	2	2	-	2	2	1	1
CO3	2	3	-	-	-	-	-	-	2	2	-	2	2	1	1
CO4	2	3	-	-	-	-	-	-	2	2	-	2	1	1	1
CO5	2	2	-	-	-	-	-	-	2	2	-	2	1	1	1

Syllabus

Unit-1: Introduction to signals and its characteristics, Noises, Filters- IIR and FIR filters, Spectrum – power spectral density function, cross-spectral density and coherence function, cestrum and homomorphic filtering.

Unit-2: Time-Frequency Analysis – Fourier transform, wavelet transform, applications of wavelets, Multivariate analysis- PCA and ICA in biomedical signal analysis.

Unit-3: Fundamentals of Digital Image Processing Components of an image processing system, Digital image representation, Digital images, Image sampling and quantization, Image Enhancement and Segmentation- Segmentation based on dissimilarities (point, line and edges),

region-based segmentation (thresholding, region growing, splitting and merging, active contours, clustering, Applications in medical image segmentation, performance evaluation of segmentation algorithms. Feature Extraction and Classification of Medical Images Boundary preprocessing and features, region-based features, texture analysis, principal components, pattern classification and performance evaluation.

Unit-4: Image Compression Coding Redundancy, Spatial and Temporal Redundancy, Irrelevant Information, Measuring Image Information, Shannon's First Theorem, Fidelity Criteria, Image Compression Models, The Encoding or Compression Process, lossy and lossless image compression techniques.

Text Books / References

- *'Digital Image Processing using MATLAB', Rafael C. Gonzalez, Richard E. Woods and Steven Eddins, Pearson Education Inc., 2011.*
- *'Digital Image Processing', William K. Pratt, John Wiley, New York, 2002.*
- *'Digital Signal and Image Processing The Sparse Way', K.P.Soman and R. Ramanathan,Cengage Learning Pvt. Ltd, 2016.*
- *Cohen, A. (1986). Biomedical Signal Processing: Volume 1 and 2. CRC Press.*
- *Rangayyan, R. M. (2015). Biomedical Signal Analysis. Germany: Wiley.*
- *Tompkins, W. J. (1993). Biomedical Digital Signal Processing. United Kingdom: Prentice Hall.*
- *Rao, R. M. (1998). Wavelet Transforms: Introduction to Theory and Applications. India: Pearson Education.*
- *Jain, A. K. (1989). Fundamentals of Digital Image Processing. India: Prentice Hall.*

CIR Course - BTech

Sem: 5	Life Skills for Engineers III	23LSE301	L-T-P-C: 1-0-2-2

Pre-requisite: 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.
Logical Reasoning: Blood Relations, Direction Test, Syllogisms, Series, Odd man out, Coding \& Decoding, Cryptarithmetic 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.

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. 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

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

25MAT316 Mathematics for Intelligent Systems 6 L-T-P-C:2-0-2-3

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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.

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.*

25AIA311 **AI Agents** **L-T-P-C: 1 0 2-2**

Course Objective

- Learn core AI agent concepts, including reflex-based, goal-based, utility-based, and learning agents.
- Develop skills in crafting effective prompts, controlling responses, and implementing ReAct (Reasoning + Acting) agents.
- Gain hands-on experience in deploying AI agents using OpenAI Functions, LangChain, and function-calling frameworks.
- Apply AI agents in automation, decision-making, and interactive business solutions.

Course Outcomes

After completing this course, students will be able to

CO1	Develop AI agents using ReAct prompting, OpenAI Functions, and various function-calling frameworks.
CO2	Improve response accuracy, loop logic, and function execution for efficient automation.
CO3	Deploy AI-driven solutions in business automation, decision-making, and user interactions.
CO4	Utilize hierarchical agents, SWARM-based function calling, and lightweight AI models (SmolAgents).

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
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 I: Foundations of AI Agents

AI Agent Introduction- Prompt Engineering-Control Response Formats-Zooming Out-Agent Setup

Unit II: ReAct and OpenAI Functions Agents

Introduction to ReAct Prompting-Building Action Functions-ReAct Agent Development (Planning, Prompting, Loop Logic, Code Setup, Response Parsing, Function Calling, and Housekeeping)- OpenAI Functions Agent (Intro, Demo, Tools, Loop Logic, Setup Challenge, Tool Calls, Message Handling, Argument Handling, and Automatic Function Calls)-Adding UI to Agents

Unit III: Advanced AI Agent Architectures and Applications

Model-Based Reflex Agents, Goal-Based Agents, Utility-Based Agents, Learning Agents, and Hierarchical Agents-LaVague and GPT Auto Trainer-LLM Function Calls and Frameworks, Business Implications of AI Automation-AI for RFP Automation-Introduction to Vectors and

SWARM-Based Function Calling-SmolAgents and Future Trends in AI Agents

Text Books / References

- *Russell, Stuart Jonathan, Norvig, Peter, Davis, Ernest. Artificial Intelligence: A Modern Approach. United Kingdom: Pearson, 2010.*
- *Sutton, Richard S., Barto, Andrew G. Reinforcement Learning: An Introduction. United States: MIT Press, 2018.*
- *Géron, Aurélien. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow. United States: O'Reilly Media, 2019.*
- *Howard, Jeremy, Gugger, Sylvain. Deep Learning for Coders with fastai and PyTorch. United States: O'Reilly Media, 2020.*
- *Chase, Harrison. LangChain for Developers. United States: Independently Published, 2023.*

25AID301 **Reinforcement Learning** **L-T-P-C: 2- 0- 2- 3**

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

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
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*

25AIA312 **Under-actuated Robotics** **L-T-P-C: 2- 0- 2- 3**

Course Objectives:

- To enable learners to apply mathematics in the design of under-actuated robotic systems with a primary emphasis on linear quadratic regulator based predictive control and state estimation
- To train the students in applying the idea of optimal control to the design of under-actuated robotic control

Course Outcomes:

After completing this course, students will be able to:

CO1	Analyze nonlinear under-actuated systems
CO2	Demonstrate simple robot models for walking and running
CO3	Simulate the dynamics and control of highly articulated robots
CO4	Perform nonlinear planning and control of simple robot 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
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 – I

Fully actuated vs Under-actuated Systems

Motivation and Definition of under-actuated control problem-Input and output state constraints-Non holonomic Constraints-Case studies examples- simple pendulum-Humanoid robot, UAV and wheeled robots- Introduction to optimal control-Double-integrator examples

UNIT – II

Model Based Control

Pendulum case study-Nonlinear dynamics with constant torque-Equations of motion-Linearizing the manipulator equations-Controllability Factor- Linear Quadratic regulator (Hamilton-Jacobi-Bellman (HJB) sufficiency), Pontryagin's min-time control

UNIT – III

Nonlinear Planning & Control-1

Formulating control design as an optimization-Continuous dynamic programming-HJB equation-Solving for minimizing control-Stabilization of nonlinear systems- Finite horizon control -Linear quadratic optimal tracking-LQR with input and output constraints- LQR as a convex optimization problem- LQG-Case studies- Pendulum

UNIT – IV

Nonlinear Planning & Control-2

Lyapunov functions-Relationships to HJB equations-Lyapunov analysis for linear and polynomial systems Trajectory optimization problem- Feedback motion planning-Linear Quadratic Gaussian approach- Model predictive control approach

Text Books / References

- Brian D. O. Anderson and John B. Moore. Optimal Control: Linear Quadratic Methods. Dover Publications, 1st Edition, 2007.
- Bertsekas, Dimitri P. Dynamic Programming and Optimal Control. 3rd ed. Vols. I and II. Nashua, NH: Athena Scientific, 2007. ISBN: 9781886529083 (set).
- Donald.E.Kirk. Optimal Control Theory, Dover Publications, 2004
- Fantoni, Isabelle, and Rogelio Lozano. Non-linear Control for Under-actuated Mechanical Systems. New York, NY: Springer-Verlag, 2002. ISBN: 9781852334239.
- Strogatz, Steven H. Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering. Boulder, CO: Westview Press, 2001. ISBN: 9780738204536.
- Slotine, Jean-Jacques E., and Weiping Li. Applied Nonlinear Control. Upper Saddle River, NJ: Prentice Hall, 1991. ISBN: 9780130408907
- MIT open course ware: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6 832-underactuated-robotics-spring-2009/index.html

CIR Course - BTech

Sem: 6	Life Skills for Engineers IV	23LSE311	L-T-P-C: 1-0-2-2

Pre-requisite: 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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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

Team Work: 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

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 7

23ENV300 ENVIRONMENTAL SCIENCE P/F

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

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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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.

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

Reference(s)
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	End Semester
Midterm Exam	30	
*Continuous Assessment (CA)	30	
End Semester/Projects		40

23LAW300 INDIAN CONSTITUTION L-T-P-C: P/F

Course Objectives

- To know about Indian constitution

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

Course Outcomes

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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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 Book(s)
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.

Reference(s)
Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi.

Evaluation Pattern

Assessment	Internal	End Semester
Midterm Exam	20	
*Continuous Assessment (CA)	40	
End Semester/Projects		40

•CA – Can be Quizzes, Assignment, Projects, and Reports

25AIA498 **Project Phase – 1** **L-T-P-C: 0- 0- 8- 4**

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 / CO	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
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

SEMESTER 8

25AIA499 **Project Phase – II** **L-T-P-C: 0- 0- 20- 10**

Course Objectives

- Project Phase – 2 aims at helping students to solve the identified research problem
- 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	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 / CO	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
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

Micro Credential courses for Quantum

Technologies (each of 1 credit)

25AID431 Introduction to Classical Computing

Bits , Logic Gates, Adders and Verilog , Circuit Simplification and Boolean Algebra , Reversible Logic Gates, Introductory idea about Error Correction, Computational Complexity, Turing Machines.

Reference

1. **Thomas G Wong : Introduction to Classical and Quantum Computing, Chapter 1.**

2. Ciaran Hughes et.el: Quantum Computing for the Quantum Curious

3. Yuly Billing : Quantum computing for High School Students

https://legacy.cs.indiana.edu/~dgerman/2020/boot-camp/qc-high-2e-with-cover.pdf

25AID432 Mathematical Postulates of Quantum Mechanics

Complex Numbers: What is a complex number, Doing math with complex numbers, Euler's formula and the polar form

Linear algebra: Vectors, Matrices, Inner Product and norms, Inner product as projection, Special matrices

Elementary Quantum Mechanics: Mathematical postulates of quantum mechanics, New notation: the 'braket' notation, Single quantum state and the qubit, Quantum measurement, Quantum operations, Multiple quantum states, Observables,

Reference

4. **Matin Laforest, The mathematics of quantum mechanics. (Main Reference) http://www.stat.ucla.edu/~ywu/linear.pdf**

5. Ciaran Hughes et al.: Quantum Computing for the QuantumCurious

6. **Yuly Billing : Quantum computing for High School Students**

https://legacy.cs.indiana.edu/~dgerman/2020/boot-camp/qc-high-2e-with-cover.pd

f

25AID433 Elements of Quantum Computing

Introduction to Superposition, Qubit, Creating superpositions, Quantum Cryptography, Quantum Gates, Entanglement, Quantum Teleportation, Quantum Algorithms

Reference

7. **Anastasia Perry et.al: Quantum Computing as a High School Module (Main Reference) https://arxiv.org/pdf/1905.00282**

8. Ciaran Hughes et.al: Quantum Computing for the Quantum Curious

9. Yuly Billing : Quantum computing for High School Students

https://legacy.cs.indiana.edu/~dgerman/2020/boot-camp/qc-high-2e-with-cover.pd

f

25AID434 Linear algebra and Quantum Gates

Superposition, Measurement, Bloch Sphere Mapping, Physical Qubits, Quantum Gates, Quantum circuits, Linear Algebra and Quantum Gate Representation: Vectors, Inner products, Quantum Gates as matrices, Outer Products, Multiple Quantum bits, Quantum Address and Universal Quantum Gates, Quantum Error Correction

References

10. Thomas G Wong : Introduction to Classical and Quantum Computing, Chapter 2,3,4.

11. Ciaran Hughes et.al Quantum Computing for the Quantum Curious

12. Yuly Billing : Quantum computing for High School Students

https://legacy.cs.indiana.edu/~dgerman/2020/boot-camp/qc-high-2e-with-cover.pd

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25AID435 Elements of Quantum Programming

IBM Quantum: Services, Quantum Composer Quantum Processor , Simulator

Quantum Assembly Language: OpenQASM , Quantum Adder

Qiskit: Quantum Composer, Quantum Lab, simulator, Quantum Processor

IBM Quantum: Services, Quantum Composer , Quantum Processor , Simulator

Quantum Assembly Language: OpenQASM , Quantum Adder

Qiskit: Quantum Composer, Quantum Lab, simulator, Quantum Processor

Reference

References

13. Andrew Cross et.al , Open Quantum Assembly Language

https://assets.amazon.science/2f/11/b60fba45406fb41d2b2af9aa43a8/open-quantum-assembly-language.pdf

14. Janche Sang et.al. Hands-on Quantum Programming Labs for EECS Students, https://arxiv.org/pdf/2308.14002

15. Qiskit SummerSchool Video

https://www.youtube.com/playlist?list=PLOFEBzvs-Vvr-GzDWlZpAcDpki5jUqYJu

16. Abhijit J. Quantum Algorithm Implementations for Beginners https://arxiv.org/pdf/1804.03719

17. Learn Quantum Computing using Qiskit, https://arxiv.org/pdf/2308.14002

18. Janche Sang et.al Hands-on Quantum Programming Labs for EECS Students https://arxiv.org/pdf/2308.14002

25AID436 Quantum Programming Frameworks

Use of 'struct' for Data structures in Matlab and Python, basics of object oriented programming .

QCLab in Matlab, Python framework for quantum programming-Pennylane.ai

Applications in Quantum Machine learning and Quantum Chemistry

References

19. QCLAB: A Matlab Toolbox for Quantum Computing ; https://arxiv.org/abs/2503.03016 https://github.com/QuantumComputingLab

20. QCLAB++: Simulating quantum circuits on GPUs; https://github.com/QuantumComputingLab

21. Pennylane.ai

https://pennylane.ai/codebook/pennylane-fundamentals/circuits-and-qnodes

https://pennylane.ai/faq

22. Janche Sang et.al Hands-on Quantum Programming Labs for EECS Students https://arxiv.org/pdf/2308.14002

25AID437 Conceptual ideas in Quantum mechanics.

Introduction to the quantum world.-: Advanced quantum mechanics of spin.- Quantum mechanics of light.-Advanced quantum mechanics with light. (all from reference -1)

Computational experiments with wavefunction , Schrodinger Equation, The time-independent Schrodinger equation, Quantum particles with several particles and spin (all from reference -2)

Reference

23. James K. Freericks, Quantum Mechanics done right, Vol 1 and 2

24. A computational Introduction to Quantum Physics

https://github.com/CambridgeUniversityPress/A-Computational-Introduction-to-Quantum-Physics

25AID438 Quantum Operator Mechanics.

Linear Algebra Math interlude. Spin one-half and polarization.- The simple harmonic oscillator.- Summary of the fundamental operator identities.- Angular momentum and spin.- The Ising and XY models of interacting spins.- The nonrelativistic Hydrogen atom.- Particles in boxes.

Time dependence.-Heisenberg model.- Relativistic Hydrogen atom.- Bosons and Fermions.- Hubbard model.

Computational experiments: Quantum Physics with Explicit time dependence, Quantum Technology and applications (Reference 2)

Reference

25. James K. Freericks, Quantum Mechanics done r ight, Vol 1 and 2

26. A computational Introduction to Quantum Physics

https://github.com/CambridgeUniversityPress/A-Computational-Introduction-to-Quantum-Physics

25AID439 Basic Laboratory Course for Quantum Technologies-1

Optics : Interferometry - wavelength measurements, intensity measurements , Diffraction – single slit, grating Microscopy – magnification, aberration , Polarization optics – PBS, HWP, QWP

RLC circuits - Series and parallel RLC circuits – Verifying the quality factor formulae - Extracting intrinsic losses

Digital circuits : Adder, Multiplier , Encoder, Decoder , D flipflop, shift registers , How to use common Integrated Circuit chips

25AID440 Quantum Machine Learning

Revision of Classical ML with Pseudo inverse, Kernel Methods and Neural Networks

Basics of Quantum Computing , Quantum Linear Algebra, Quantum Kernel Methods

Quantum Neural Networks, Quantum Transformer

Reference

27. Quantum Machine Learning A Hands-on Tutorial for Machine Learning Practitioners and Researchers

https://arxiv.org/pdf/2502.01146

25AID443 Basic Laboratory Course for Quantum Technologies-2

Using Oscilloscope : Ring-up and ring-down time measurements of RLC circuits : Measurements of different pulse-shapes generated by a function generator

Using Vector Network Analyser : Transmission and reflection measurements of coaxial cable in open, short and matched termination , Voltage standing wave ratio measurement , Amplitude and Phase quadrature, In-phase and Out-of-phase quadrature plots and Quality factor measurement of RLC circuits , Characterising S-parameters, ABCD and Z matrices of common 2 port networks – coaxial cable, attenuator, low pass high pass bandpass filters etc. , Characterising 3 port networks – directional couplers, circulators, isolators

Using a spectrum analyser : Noise from a resistor at different temperatures . Interfacing instruments with a computer , Data acquisition ○ Signal demodulation – heterodyne vs Homodyne, Mixing of signals

Sampling: digitisation using ADCs – under-sampling and aliasing, oversampling and noise

25AID442 Quantum Protocols and algorithms

Entanglement, Measurements, Bell Inequalities, Monogamy of entanglement, super dense coding, Reversible computation .

Quantum Algorithms : Deutsch algorithm , Deutsch Josza algorithm , Bernstein - Vazirani algorithm Simon's algorithm

Database search , Grover's algorithm , Quantum Fourier Transform and prime factorization , Shor's Algorithm.

Additional Topics in Quantum Algorithms : Variational Quantum Eigensolver (VQE) , HHL , QAOA

25AID443 Basic Laboratory Course for Quantum Technologies-3

Interfacing instruments with a computer , Data acquisition ○ Signal demodulation – heterodyne vs Homodyne, Mixing of signals ○ Sampling, digitisation using ADCs – under-sampling and aliasing, oversampling and noise , Averaging and interpolation techniques

Quantum Simulators : Running quantum protocols in a quantum simulator

Implementing simple quantum algorithms on cloud-based quantum computers (depending on availability of time on such machines)

Running simple algorithms on cloud-based quantum processors (optional)

25AID444 Introduction to Quantum Communication

Basics of Polarization optics, Basics of linear and square-law detectors

Digital communication – information theory (basics) ,No cloning theorem

Quantum Memories , Quantum repeaters , Entanglement and Bell Theorems

Bell Measurements and Tests , Quantum Teleportation protocol

Quantum Dense coding, Quantum Key Distribution protocols

Quantum Networks and Quantum Internet , Survey of Hardware implementations

References

1. Quantum computation and quantum information – Nielsen and Chuang Cambridge University Press, Cambridge (2010)

2. A Pathak, Elements of Quantum Computation and Quantum Communication, Boca Raton, CRC Press (2015)

25AID445 Introduction to Quantum Sensing

Classical sensing: Photo detection Classical noise: Johnson Noise, Telegraph noise, flicker or 1/f noise

Sensitivity of classical measurements : Classical Fisher information, Cramer - Rao bounds

Quantum measurements : projective/orthogonal measurements , Approximate/non-orthogonal measurements

Weak continuous measurements , Error-disturbance relations , Standard quantum limits

Quantum non-demolition measurements

States of light : Fock states, Coherent states, Squeezed states , Tomography

Wigner quasi-probability distribution, P-distribution , Husimi Q function Course

References:

1. Quantum Measurement and Control, Howard Wiseman and David Milburn, Cambridge University Press

2. Quantum Measurement, Vladimir Braginsky and Farid Ya Khalili, Cambridge University Press (1995)

3. Quantum Information Science – Manenti R., Motta M., 1st Edition, Oxford University Press (2023)

25AID446 Introduction to Quantum Sensing -2

Quantum photo detection: Square-law detectors, Intensity measurements and Photo-detection

Linear Detectors and Quadrature Measurements, Quantum Cramer-Rao bounds

Single photon-based sensing applications, Entanglement based sensing applications Atomic state-based sensing, solid-state spin-based sensing applications (gravimetry, magnetometry

References:

4. Quantum Measurement and Control, Howard Wiseman and David Milburn, Cambridge University Press

5. Quantum Measurement, Vladimir Braginsky and Farid Ya Khalili, Cambridge University Press (1995)

6. Quantum Information Science – Manenti R., Motta M., 1st Edition, Oxford University Press (2023)

25AID447 Introduction to Quantum Materials -1

Band theory basics , Correlated systems , Magnetism, Superconductivity, 2D materials

References

1. Condensed Matter Physics, M P Marder, 2nd Edition, John Wiley and Sons, 2010

2. Introduction to Superconductivity, Michael Tinkham, standard ed., Medtech (2017)

25AID448 Introduction to Quantum Materials-2

Topological Phases of matter: Basics of Topology , Geometric phases - Berry Phase

Aharonov Bohm effect , Topological phases of matter

Survey of material growth techniques: Molecular beam epitaxy , Chemical vapor deposition, MOVPE

Pulsed laser deposition, etc. Crystal growth techniques

References

1. Condensed Matter Physics, M P Marder, 2nd Edition, John Wiley and Sons, 2010

2. Introduction to Superconductivity, Michael Tinkham, standard ed., Medtech (2017)

3. Quantum Dynamics Simulation of the Advection-Diffusion Equation

25AID449 Quantum Measurement and Classical Limits

Prerequisite: Undergraduate-level quantum mechanics or "Introduction to Quantum Mechanics for Engineers"

Course Content: Classical vs. Quantum Sensing: Limits of classical measurements (Johnson noise, shot noise) - Cramer-Rao bounds and precision limits - Quantum Measurement Principles (Part 1): Projective (von Neumann) measurements - Weak measurements - Photodetection and Classical Noise Sources: Photo detection theory - Classical noise models and their effect on measurement

Learning Outcomes:

1. Compare classical and quantum sensing paradigms
2. Understand fundamental noise limitations in measurement systems
3. Describe and apply basic quantum measurement principles

References:

- Wiseman, H., & Milburn, D., *Quantum Measurement and Control*
- Braginsky, V., & Khalili, F.Y., *Quantum Measurement*

25AID450 Quantum States of Light

Course Content: Quantum Measurement Principles (Part 2): Quantum non-demolition (QND) measurements – Error disturbance relations (Heisenberg-type inequalities) - Quantum States of Light: Coherent states, Fock states - Squeezed states and their generation - Phase-Space Representations: Wigner function - P and Q quasi-probability distributions

Learning Outcomes:

- Identify and describe different quantum states of light
- Analyze phase-space representations for optical states
- Understand the role of nonclassical states in sensing

References:

- Wiseman, H., & Milburn, D., *Quantum Measurement and Control*
- Braginsky, V., & Khalili, F.Y., *Quantum Measurement*

25AID451 Quantum Enhanced Sensing and Metrology

Course Content: Quantum Enhanced Sensing Techniques: Single-photon-based sensing - Entanglement-enhanced metrology – Applications: Gravimetry, Magnetometry - Atomic clocks and time standards -Quantum Fisher Information and Limits: Quantum Cramer-Rao bound - Parameter estimation in quantum systems

Learning Outcomes:

- Apply entanglement and quantum resources to sensing tasks
- Evaluate the quantum limits to measurement precision
- Analyze real-world applications of quantum metrology

References :

- Wiseman, H., & Milburn, D., *Quantum Measurement and Control*
- Braginsky, V., & Khalili, F.Y., *Quantum Measurement*

25AID452 Fundamentals of Photonics for Quantum Communication

Course Content: Intersection of photonics and quantum computing landscapes - Overview of light as an electromagnetic wave – Polarizing Beam Splitters (PBS) - Wave Plates (Retarders) - Applications in quantum optics - Photoelectric effect and photon detection basics - Photomultiplier Tubes (PMT) and Photodiodes (APD) - Comparison of PMTs and APDs for Quantum Communication - Sensitivity, speed, and noise considerations

Learning Outcomes:

4. Understand the fundamentals of photonics and quantum optics
5. Analyse photon detection technologies
6. Apply concepts to quantum communication

Suggested Reading:

- *Fundamentals of Photonics by Bahaa E. A. Saleh and Malvin Carl Teich*
- *Introduction to Quantum Optics by Gilbert Grynberg, Claude Fabre, Alain Aspect*
- *Pathak, A., Elements of Quantum Computation and Quantum Communication*
- *Nielsen, M.A., & Chuang, I.L., Quantum Computation and Quantum Information*

25 Foundations of Quantum Communication

Course Content: Classical vs. Quantum Information - Basics of Quantum Information: Qubits and Superposition - Quantum Entanglement and Non-Locality - Bell's Inequality - Shannon entropy, quantum entropy - noise and quantum channels- No-Cloning Theorem and Its Security Implications - Quantum Key Distribution (QKD) - Practical Challenges in QKD

Learning Outcomes:

7. Differentiate between classical and quantum information
8. Analyse information measures and quantum communication
9. Evaluate security and practical aspects of quantum communication

Suggested Reading:

- Quantum computation and quantum information – Nielsen and Chuang Cambridge University Press, Cambridge, 2010
- "From Classical to Quantum Shannon Theory", M. M. Wilde, CUP; http://arxiv.org/abs/1106.1445.
- J. Preskill, Chapter 5 of his lecture notes: Lecture notes on Quantum Information Theory http://www.theory.caltech.edu/~preskill/ph229/#lecture

25AID454 Advanced concepts in Quantum Communication

Course Content: QKD Protocols: BB84, E91, BBM92, B92, DPS, COW – Long distance and distributed quantum computing: Quantum memory, repeater chains - Survey of Hardware implementations: Free space communications - Satellite based communications - Fibre optics-based communications – Real world quantum networks

Learning Outcomes:

10. Gain insights into QKD Protocols
11. Understand long-distance quantum networking
12. Evaluate real-world quantum communication systems

Suggested Reading:

- Quantum Computing and Techniques – Rajiv Chopra, Khanna Publishing House, 2024.
- A Pathak, Elements of Quantum Computation and Quantum Communication, Boca Raton, CRC Press, 2015
- "Towards real-world quantum networks: a review." Wei, Shi-Hai, et al. , Laser & Photonics Reviews 16.3 (2022): 2100219.

25AID455 Foundations of Quantum Materials

Course Content: Review of Basic Concepts**:** Crystal lattices, reciprocal space, phonons (briefly) - Electronic Structure of Solids **-** Free electron model (Drude, Sommerfeld - brief review) - Electrons in a periodic potential: Bloch's theorem - Band theory: Formation of energy bands and gaps - Classification: Metals, semiconductors, insulators based on band structure - Crystal structures and Brillouin zones (Examples: simple cubic, FCC, BCC, graphene lattice).

Learning Outcomes:

- Describe basic crystal structures and their reciprocal lattices.
- Explain the origin of electronic band structures in solids using Bloch's theorem.
- Classify materials as metals, semiconductors, or insulators based on their electronic band structure.

- Calculate or sketch simple Brillouin zones.

Suggested Books and Literature:

Primary Textbooks:

13. *Kittel, C. Introduction to Solid State Physics.* (Wiley) - The classic undergraduate text, covers crystal structure, reciprocal lattice, and band theory extensively.
14. *Ashcroft, N. W., & Mermin, N. D. Solid State Physics.* (Cengage) - A more advanced, comprehensive graduate-level text, excellent for rigorous treatment of fundamentals.
15. *Simon, S. H. The Oxford Solid State Basics.* (Oxford University Press) - A modern, concise, and conceptually clear introduction.

Supplementary Reading:

1. *Singleton, J. Band Theory and Electronic Properties of Solids.* (Oxford University Press) - Focuses specifically on electronic structure.
2. *Hook, J. R., & Hall, H. E. Solid State Physics.* (Wiley) - Another good undergraduate-level text.

25AID456 Collective Phenomena in Quantum Materials

Prerequisites (Recommended): Foundations of Quantum Materials (or equivalent solid-state physics background).

Course Content: Magnetism in Solids: Origin of magnetic moments (spin and orbital) - Types of magnetism: Diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism, ferrimagnetism (basic models like Curie, Curie-Weiss laws, Mean Field Theory) - Transport effects related to magnetism: Hall effect (classical and anomalous), magnetoresistance (GMR/TMR mentioned briefly) - Magnetic characterization overview: Kerr effect (briefly) - Superconductivity**:** Phenomenology: Zero resistance, Meissner effect, critical fields/currents - Theoretical framework: Cooper pairs, BCS theory (overview), energy gap - Macroscopic quantum phenomena: Josephson effect (DC and AC), Flux quantization - Ginzburg-Landau theory (phenomenological description) - Applications overview: Superconducting magnets, SQUIDs, quantum bits (briefly).

Learning Outcomes:

- Differentiate between various types of magnetic order in materials.
- Explain the physical principles behind key magnetic phenomena and related transport effects.
- Describe the defining characteristics of the superconducting state.
- Understand the basic concepts of BCS theory, the Josephson effect, and their implications for devices.

Suggested Books and Literature:

Primary Textbooks (covering both topics):

16. *Kittel, C. Introduction to Solid State Physics.* (Wiley) - Has chapters on both magnetism and superconductivity suitable for an introductory level.
17. *Ashcroft, N. W., & Mermin, N. D. Solid State Physics.* (Cengage) - Provides more detailed treatments of both phenomena.

Specialized Books (for deeper dives):

1. *Blundell, S. Magnetism in Condensed Matter.* (Oxford University Press) - Excellent, dedicated text on magnetism.
2. *Tinkham, M. Introduction to Superconductivity.* (Dover/McGraw Hill) - The classic graduate-level text on superconductivity. (May be too advanced for primary reading but good for reference).
3. *Annett, J. F. Superconductivity, Superfluids and Condensates.* (Oxford University Press) - Modern treatment linking these related phenomena.

Review Articles / Specific Topics:

1. For GMR/TMR: Look for review articles on Spintronics (e.g., in *Reviews of Modern Physics* or *Nature Materials*). Seminal papers by Fert and Grünberg.
2. For Josephson effect applications: Review articles on SQUIDs or superconducting qubits.

25AID457 Advanced Topics in Quantum Materials

Prerequisites (Recommended): Foundations of Quantum Materials, Collective Phenomena in Quantum Materials (or equivalent background).

Course Content: Low-Dimensional Materials: Graphene: Crystal structure, unique Dirac electronic band structure, optical properties - Transition Metal Dichalcogenides (TMDCs): Structure, semiconducting nature, excitons, valleytronics concept - (Optional/Briefly: Other 2D materials like h-BN, phosphorene) - Mention of growth techniques (CVD, MBE) as relevant context - Topological Phases of Matter: **-** Quantum Hall Effect (Integer and Fractional - overview) - Geometric Phases: Berry phase, Aharonov-Bohm effect - Topological Insulators: Concept of bulk insulator with conducting edge/surface states, Z2 invariants (overview) -(Optional/Briefly: Weyl and Dirac semimetals).

Learning Outcomes:

- Describe the unique electronic and optical properties of graphene and TMDCs.
- Explain the concepts of Berry phase and the Aharonov-Bohm effect.
- Understand the defining characteristics of topological insulators.
- Analyze how dimensionality and topology influence material properties.

Suggested Books and Literature:

Primary Textbooks (often need combining/supplementing):

18. Standard texts (Kittel, Ashcroft/Mermin) provide background but may lack depth on newest topics.
19. *Dresselhaus, M. S., Dresselhaus, G., & Avouris, P. (Eds.). Carbon Nanotubes: Synthesis, Structure, Properties, and Applications.* (Springer) - While focused on nanotubes, contains relevant physics for graphene. (Somewhat dated but foundational).
20. *Vanderbilt, D. Berry Phases in Electronic Structure Theory: Electric Polarization, Orbital Magnetization and Topological Insulators.* (Cambridge University Press) - Advanced monograph focused on Berry phase and topology.

Specialized Books / Chapters:

1. *Bernevig, B. A., & Hughes, T. L. Topological Insulators and Topological Superconductors.* (Princeton University Press) - Key text for topological phases. (Graduate level).
2. Chapters in advanced condensed matter textbooks (e.g., *Altland, A., & Simons, B. D. Condensed Matter Field Theory.* Cambridge University Press) might cover some of these topics.

Key Review Articles / Seminal Papers (Crucial for this rapidly evolving field):

1. **Graphene:** *Castro Neto, A. H., et al. (2009). The electronic properties of graphene. Reviews of Modern Physics, 81(2), 109.* Seminal papers by Geim & Novoselov.
2. **TMDCs:** Search for review articles in journals like *Nature Nanotechnology, Nature Materials, Chemical Society Reviews, ACS Nano*. Look for authors like Kis, Wang, Heinz, Urbaszek.
3. **Topological Insulators:** *Hasan, M. Z., & Kane, C. L. (2010). Colloquium: Topological insulators. Reviews of Modern Physics, 82(4), 3045.* & *Qi, X. L., & Zhang, S. C. (2011). Topological insulators and superconductors. Reviews of Modern Physics, 83(4), 1057.*
4. **Berry Phase:** Original papers by M. Berry. Sakurai's *Modern Quantum Mechanics* has a good chapter.

25AID458 Foundations of Quantum information

Prerequisite: Undergraduate-level quantum mechanics or "Introduction to Quantum Mechanics for Engineers.

Course Content: Understanding Qbits, Introduction to different types of Qbits: Superconducting Qubits, Trapped Ion Qubits, Photonic Qubits, Spin Qubits and Topological Qubits, Difference between the Qbits and classical bits; Classical logic: AND (Conjunction), NOT (Negation), OR (Disjunction), XOR (Exclusive OR) and NAND and NOR; Introduction to Quantum Gates, Solovay-Kitaev Theorem for gate construction, Single and two-Qbits gates. Universal gates, Understanding quantum circuit and its representation.

Learning Outcomes:

- Understanding Qbits and its classification and applications.
- Understanding the concept of classical logic
- Concept of Quantum gates and Circuit

Suggested Books and Literature:

21. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information", Cambridge University press, 2010
22. Eleanor G. Rieffel and Wolfgang H. Polak, Quantum Computing: A Gentle Introduction"
23. Mikio Nakahara and Tetsuo Ohmi, Quantum Computing: From Linear Algebra to Physical Realizations".

ELECTIVES 1

25AIA331 Mobile Robotics L-T-P-C: 2-0- 2-3

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 (COs)

On successful completion of the 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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1	3	3	3	2	3	2	2	2	3	3		2	1	1	-
CO2	3	3	3	2	3	2	2	2	3	3		2	2	2	2

CO 3	3	3	3	3	3	2	2	2	3	3		2	2	2	2
CO 4	3	3	3	3	3	3	2	3	3	3		2	2	1	3

Syllabus

Unit 1

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

Unit 3

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.*

25AIA332 **Probabilistic Robotics** **L-T-P-C: 2- 0- 2-3**

Course Objectives

- The course aims at statistical techniques for representing information and making decisions in robotics.
- The course helps to quantify and counter the uncertainty that arises in most contemporary robotics applications.

Course Outcomes (COs)

On successful completion of the course, students will be able to:

CO1	Enumerate the fundamental aspects concerning mobile robotics.
CO2	Apply State estimation techniques and observability filters to mobile robots.
CO3	Apply Simultaneous localization and mapping and its variations for mobile robot path planning.
CO4	Mathematically define the decision-making process for mobile robots.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction C Robot Paradigms, State Estimation, Gaussian Filters - Kalman Filter - Extended Kalman Filters C Geometric Approach, Nonparametric Filters - Discrete and Particle Filters.

Unit 2

Wheeled Locomotion C Robot Motion Models, Sensors C Robot Perception Models, Mapping with known poses, SLAM - The FastSLAM Algorithm - GraphSLAM - Self SLAM, Exploration and 3D Mapping.

Unit 3

Uncertain knowledge and reasoning - Probabilistic Reasoning - Probabilistic Reasoning over Time - Making Simple Decisions - Making Complex Decisions -Multiagent Decision Making.

Text Books / References

- *Sebastian Thrun, Wolfram Burgard and Dieter Fox, Probabilistic Robotics, The MIT Press, 2005. ISBN: 9780262201629, 3rd edition.*
- *Stuart Russell and Peter Norvig 'Artificial Intelligence - A Modern Approach' 3rd edition. Machine Learning: a Probabilistic Perspective, Kevin Patrick Murphy. MIT Press, 2012.*

25AIA333 **Advanced ROS2** **L-T-P-C: 2- 0- 2- 3**

Course Objectives

- This course deepen understanding of ROS2 architecture, middleware, and advanced features such as lifecycle nodes, QoS settings, and component-based design.
- This course enable students to develop, simulate, and control complex robotic systems using ROS2 and Gazebo.
- This course introduces explore advanced topics such as multi-robot systems, real-time performance, and ROS2 security for practical applications.

Course Outcomes

After completing this course, students will be able to

CO1	Implement custom ROS2 nodes, services, actions, and interfaces for complex robotic applications.
CO2	Demonstrate proficiency in simulating and controlling robots using ROS2, Gazebo, and ROS2 control frameworks.
CO3	Apply advanced ROS2 features such as Nav2, MoveIt SLAM, and behavior trees to solve real-world robotics problems.
CO4	Develop ROS2-based systems for multi-robot coordination, real-time performance, and secure deployments.

CO-PO Mapping

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

CO 3	3	3	3	2	3	2	1	1	3	3	-	3	2	2	2
CO 4	3	2	2	3	3	2	1	1	3	3	-	3	2	2	2

Syllabus

Unit 1

Review of basic ROS2 C Robotic Simulation concepts- nodes, publishers, subscribers, services, launch files, Actions based on python and C++ - Client C Server, Goal state machines, Goal policies, QoS settings, Life cycle nodes, executers.

Unit 2

ROS2 control, navigation stack (Nav2), Moveit2, SLAM, behavior trees, multi-robot systems, ROS2 bridges (ROS1/ROS2), real-time systems.

Unit 3

ROS2 security, performance optimization, debugging tools (rqt, ros2cli), cloud robotics, ROS2 on embedded systems, case studies (autonomous robots, drones, industrial automation).

Text Books / References

- *Rico, F. M. A Concise Introduction to Robot Programming with ROS2. CRC Press; 2023.*
- *Edouard Renard, ROS 2 from Scratch, Packt Publishing, 2024*
- *Ros2 Humble Tutorial: https://docs.ros.org/en/humble/Tutorials.html*
- *Lentin Joseph, Mastering ROS for Robotics Programming, Packt Pub Ltd, 2015*

25AIA334 **Design Thinking** **L-T-P-C: 2- 0- 2- 3**

Course Objectives

- Understand the fundamental principles and process of Design Thinking.
- Develop problem-solving and creative thinking skills for user-centered design.
- Apply Design Thinking frameworks to real-world problems through prototyping and testing.

Course Outcomes (COs)

On successful completion of the course, students will be able to:

CO1	Explain the principles and phases of Design Thinking in problem-solving
CO2	Analyze user needs and define design challenges using empathy and ideation techniques.
CO3	Develop and prototype innovative solutions for real-world problems.
CO4	Evaluate and refine prototypes through user feedback and iterative testing.

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO 3
CO1	3	3	2	2	3	2	2	2	3	3	2	2	3	2	1
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2
CO3	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3

Syllabus

Unit 1

Introduction to Design Thinking and User-Centered Approach: Definition and importance of Design Thinking, Key principles and phases of Design Thinking, Human-centered design approach and empathy in problem-solving, Understanding user needs, user personas, and journey mapping, Case studies of successful Design Thinking applications

Unit 2

Ideation, Prototyping, and Creativity Techniques: Problem framing and defining design challenges, Brainstorming, mind mapping, and SCAMPER techniques, Low-fidelity vs. high-fidelity prototyping, Storyboarding and wireframing for concept visualization, Role of collaboration and multidisciplinary teams in design.

Unit 3

Testing, Iteration, and Implementation: Usability testing and gathering user feedback, Iterative design and refinement processes, Business and feasibility aspects of design solutions, Implementing and scaling innovative solutions, Ethics and sustainability in Design Thinking.

Textbooks/ Reference Books:

- *Tim Brown, Change by Design: How Design Thinking Creates New Alternatives for Business and Society, Harper Business, 2009.*
- *Jeanne Liedtka and Tim Ogilvie, Designing for Growth: A Design Thinking Toolkit for Managers, Columbia Business School Publishing, 2011.*
- *Tom Kelley and David Kelley, Creative Confidence: Unleashing the Creative Potential Within Us All, Crown Business, 2013.*
- *Donald A. Norman, The Design of Everyday Things, Basic Books, 2013.*
- *IDEO, The Field Guide to Human-Centered Design, Design Kit, 2015.*
- *Roger L. Martin, The Design of Business: Why Design Thinking Creates Competitive Advantage, Harvard Business Press, 2009.*

ELECTIVES 2

25AIA341 Data Driven Control in Robotics L-T-P-C: 2- 0- 2-3

Course Objectives

- The course aims to review the basic modelling and control aspects of robotic systems.
- The course then directs to data-based methods for better control of robotic systems.
- The course also covers the computer vision part essential for data-based control of robotics.
- The course also imparts knowledge about learning based control systems.

Course Outcomes (COs)

On successful completion of the course, students will be able to:

CO1	Explain computer vision and machine learning applied to robotic control
CO2	Model dynamic systems, measuring and controlling their behavior, and making decisions about future courses of action
CO3	Use machine learning techniques to derive more effective sensory abilities, controllers, and decision-making strategies for robotic systems
CO4	Use neural networks to do overall control of mobile robots.

CO-PO Mapping

PO/PSO / CO	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
CO1	3	2	1	-	3	-	-	-	3	3	-	3	3	-	-
CO2	3	3	3	3	3	-	2	1	3	3	-	3	3	3	1
CO3	3	3	3	3	3	2	2	1	3	3	-	3	3	3	1
CO4	3	3	3	3	3	2	2	1	3	3	-	3	3	3	1

Syllabus

Unit 1

System Modeling - Control System Principles - Computing, Measurement, State, and Parameter Estimation - Decision-Making and Machine Learning - Numerical Methods for Evaluation and Search - Expert Systems - Neural Networks for Classification and Control.

Unit 2

Vision for Robots: Mid-Level Visual State Estimation, Direct Perception, Active and Interactive Perception, Self-Supervised Image Representations: Unstructured Full-Scene Representations, Object and Key point - Structured Representations.

Unit 3

Learning - Based Control: Predictive Models and Forward Dynamics Models, Model-Based Reinforcement Learning and Visual Servoing, Model-Free Reinforcement Learning and Sim-to-Real Transfer, Imitation learning and Learning from Demonstrations.

Text Books / References

- *H. Asada and J.-J. Slotine, Robot Analysis and Control, J. Wiley & Sons, 1S8c.*
- *M. Brady, J. Hollerbach, T. Johnson, T. Lozano-Perez, and M. Mason, Robot Motion: Planning and Control, MIT Press, 1S84.*
- *P. Corke, Robotics, Vision, and Control, Springer, 2011.*
- *A. Staugaard, Jr., Robotics and AI: An Introduction to Applied Machine Intelligence, Prentice-Hall, 1S87.*
- *P. Antsaklis and K. Passino, An Introduction to Intelligent and Autonomous Control, Kluwer, 1SS3.*

25AIA342 **Active Inference** **L-T-P-C: 2- 0- 2-3**

Course Objectives

- The course aims to introduce the principles of active inference and the free energy principle in the context of robotics.
- The course aims to explore Bayesian inference, generative models, and variational methods for perception, decision-making, and action in robots.
- The course enable students to implement active inference algorithms for robotic tasks such as navigation, manipulation, and human-robot interaction.
- The course encourages students to apply active inference frameworks to real-world robotics problems, emphasizing adaptive and goal-directed behaviour.

Course Outcomes (COs)

On successful completion of the course, students will be able to:

CO1	Explain the theoretical foundations of active inference and its application to robotics
CO2	Implement generative models and Bayesian inference algorithms for robot perception and decision-making
CO3	Apply active inference to solve robotics tasks such as navigation, manipulation, and exploration-exploitation trade-offs
CO4	Demonstrate active inference-based solutions for adaptive and goal-directed robotic behaviour.

CO-PO Mapping

PO/PSO / CO	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
CO1	3	2	3	2	2	1	2	1	3	3	-	3	3	2	-
CO2	3	3	3	3	3	-	-	1	3	3	-	3	3	3	2
CO3	3	3	3	3	3	2	2	1	3	3	-	3	3	3	1
CO4	3	3	3	3	3	2	2	2	3	3	-	3	3	3	1

Syllabus

Unit 1

Active inference, free energy principle, Bayesian inference, predictive coding, perception-action loop, generative models, variational methods, Markov decision processes (MDPs), partially observable Markov decision processes (POMDPs)

Unit 2

Belief updating, surprise minimization, goal-directed behavior, exploration-exploitation trade-off, sensorimotor control, embodied cognition, robot perception, decision-making, planning, hierarchical models, computational neuroscience..

Unit 3

Robotics applications (navigation, manipulation, human-robot interaction), simulation tools (Python, ROS2, Pyro), case studies.

Text Books / References

- *Thomas Parr, Giovanni Pezzulo and Karl J. Friston, Active Inference: The Free Energy Principle in Mind, Brain, and Behavior, MIT Press, 2022.*
- *Le´o Pio-Lopez, Ange Nizard, Karl Friston and Giovanni Pezzulo, Active inference and robot control: A case study,* *https://discovery.ucl.ac.uk/id/eprint/1520078/1/201c0c1c.full.pdf*
- *Charel van Hoof, Free Energy Principle tutorial without a PhD, Notebook series in Kaggle,* *https://www.kaggle.com/code/charel/how-the-brain-might-function* .

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25AIA343 Human Computer Interface L-T-P-C: 2- 0- 2-3

Course Objectives

The course will help student:

- Understand the fundamental principles and concepts of Human-Computer Interaction (HCI).
- Analyze user experience (UX) design principles and interaction techniques.
- Apply HCI methodologies to design user-friendly and accessible interfaces.

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Course Outcomes (COs)

On successful completion of the course, students will be able to:

CO1	Explain the principles, models, and theories of Human-Computer Interaction
CO2	Evaluate usability and user experience through design methodologies
CO3	Develop interactive prototypes with a focus on accessibility and user-centered design.
CO4	Analyze emerging trends in HCI, such as AI-driven interfaces and virtual reality.

CO-PO Mapping

PO/ PSO CO	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
CO1	3	3	2	2	3	2	2	2	3	3	2	2	1	2	1
CO2	3	3	3	-	-	3	2	1	1	3	3	3	1	-	2
CO3	3	3	3	3	3	2	2	2	1	-	-	1	3	3	-
CO4	3	3	3	3	3	-	-	2	1	1	3	3	3	3	3

Syllabus

Unit 1

Introduction to Human-Computer Interaction: Definition and importance of HCI, Principles of user-centered design, Cognitive psychology and human perception in interface design, Interaction paradigms: Command-line, graphical, touch-based, and voice interfaces, Usability principles and guidelines

Unit 2

Design and Evaluation of User Interfaces: User experience (UX) and usability engineering, Prototyping and wireframing tools, Heuristic evaluation and cognitive walkthroughs, Interaction design models: Norman's model, Fitts' Law, and Hick's Law, Accessibility considerations in interface design

Unit 3

Advanced Topics and Emerging Trends in HCI: Artificial Intelligence in user interfaces (chatbots, voice assistants), Augmented Reality (AR), Virtual Reality (VR), and Brain-Computer Interfaces (BCI), Adaptive and context-aware interfaces, Ethics and social impact of HCI, Future trends in Human- Computer Interaction.

Text Books / References

- *Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, Human-Computer Interaction, Pearson, 4th Edition, 2004.*
- *Ben Shneiderman, Designing the User Interface: Strategies for Effective Human-Computer Interaction, Pearson, 6th Edition, 2016.*
- *Donald A. Norman, The Design of Everyday Things, Basic Books, 2013.*
- *Jeff Johnson, Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Guidelines, Morgan Kaufmann, 2014.*
- *Steve Krug, Don't Make Me Think: A Common Sense Approach to Web Usability, New Riders, 2013.*
- *Bill Moggridge, Designing Interactions, MIT Press, 2007.*

ELECTIVES 3

25AIA351 Swarm Robotics L-T-P-C: 2- 0- 2-3

Course Objectives

- The course introduces the principles of swarm intelligence, decentralized control, and self- organization in robotic systems.
- The course encourages the students to explore bio-inspired algorithms and communication strategies for coordinating large-scale robot swarms.
- The course enables students to design, simulate, and implement swarm robotics systems using tools like ROS2, Gazebo, and ARGoS.
- The course also imparts knowledge to apply swarm robotics concepts to real-world applications such as search and rescue, agriculture, and surveillance.

Course Outcomes (COs)

On successful completion of the course, students will be able to:

CO1	Explain the principles of swarm intelligence and decentralized control in multi-robot systems.
CO2	Implement bio-inspired algorithms for collective behavior, task allocation, and navigation in swarms
CO3	Analyse swarm robotics systems using tools like ROS2, Gazebo, and ARGoS
CO4	Demonstrate swarm robotics solutions for real-world applications, emphasizing scalability, robustness, and fault tolerance.

CO-PO Mapping

PO/ PSO CO	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
CO1	3	2	1	-	3	-	-	-	3	3	-	3	1	2	-
CO2	3	3	3	3	3	-	-	-	3	3	-	3	3	2	1
CO3	3	3	3	3	3	1	-	-	3	3	-	3	2	3	1

CO4	3	3	3	3	3	1	-	1	3	3	-	3	3	3	2

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Unit

1

- Swarm intelligence, decentralized control, self-organization, collective behavior, bio- inspired algorithms like ant colony, whale and particle swarm optimization, , ROS2 for swarm robotics.

Unit 2

- Communication protocols, local sensing, global coordination, task allocation, swarm navigation, obstacle avoidance, flocking, foraging, pattern formation, multi-agent systems.

Unit 3

Simulation tools like Gazebo and ARGoS, swarm robotics applications (search and rescue, agriculture, surveillance), scalability, robustness, fault tolerance, case studies.

Text Books / References

Heiko Hamann, Swarm Robotics: A Formal Approach, SpringerNature, 2018

Dario Floreano and Claudio Mattiussi Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies, MIT Press, 2008.

Sebastian Thrun, Wolfram Burgard and Dieter Fox, Probabilistic Robotics, The MIT Press, 2005. ISBN: S7802c2201c2S, 3rd edition.

Molecular swarm robots: recent progress and future challenges, https://www.tandfonline.com/doi/full/10.1080/14c8cSSc.2020.17c17c1#abstract

25AIA352 **Soft Robotics** **L-T-P-C: 2- 0- 2-3**

Course Objectives (COBs)

By the end of this course, students will:

1. Understand the theoretical foundations, material selection, and bioinspired approaches in soft robotics.
2. Develop skills in the mathematical modeling, simulation, and control of soft robotic systems.
3. Learn advanced fabrication techniques and apply them to real-world robotic designs.

Course Outcomes

After completing this course, students will be able to

CO1	Explain the fundamental concepts of soft robotics, including materials and actuation mechanisms.
CO2	Model and analyze the mechanics, control, and behavior of soft robotic systems.
CO3	Design and fabricate soft robots for biomedical, industrial, and exploratory applications.
CO4	Assess the challenges, ethical concerns, and future trends in soft robotics.

CO-PO Mapping

PO/ PSO CO	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
CO1	3	3	2	2	3	2	2	2	3	3	2	2	3	2	1
CO2	3	3	1	3	3	3	3	3	3	3	3	1	-	1	2
CO3	2	3	3	3	3	2	2	2	1	2	3	3	-	-	3
CO4	3	3	3	1	1	1	2	2	1	3	3	3	3	3	3

Syllabus

Unit 1

Soft robotics principles and differences from rigid robotics. Material selection: elastomers, shape-memory alloys, hydrogels, and electroactive polymers. Bioinspiration: Soft robots modeled after biological

organisms such as octopuses, worms, and jellyfish. Actuation techniques: Pneumatic, hydraulic, dielectric elastomers, and shape-memory materials. Compliance and adaptability in robotic design.

Unit 2

Kinematics and dynamics of soft robotic structures. Continuum mechanics and finite element modeling (FEM) for soft robots. Machine learning and AI-based control strategies for adaptive soft robotic systems. Fabrication techniques: 3D printing, molding, soft lithography, and stretchable electronics. Embedded sensing technologies: Proprioceptive, tactile, and pressure sensors.

Unit 3

Soft robotics in biomedical applications: Prosthetics, rehabilitation, surgical robots, and drug delivery. Industrial applications: Soft grippers, human-robot interaction, and flexible automation. Exploration and environmental applications: Underwater soft robots and planetary exploration. Ethical considerations, power limitations, and self-healing materials in soft robotics. Future trends in AI-driven soft robotic systems and biohybrid robots.

Textbooks/ Reference Books

Cecilia Laschi, Matteo Cianchetti, Soft Robotics: Trends, Applications, and Challenges, Springer, 2017.

C. Majidi, Soft Robotics: Principles, Materials, and Applications, Wiley, 2023.

Luca Della Santina, Cosimo Della Santina, Modelling and Control of Soft Robotic Systems, Springer, 2021.

Fumiya Iida, Rolf Pfeifer, Morphological Computation and Soft Robotics, Springer, 2014.

Helmut Hauser, Adam Spiers, Soft Robotics: The Future of Intelligent Machines, MIT Press, 2022.

25AIA353 **Biomimetics** **L-T-P-C: 2- 0- 2-3**

Course Objectives (COBs)

By the end of this course, students will:

- Understand the fundamental principles of biomimetics and its role in engineering and design.
- Analyze biological systems and extract key principles for developing bio-inspired materials, structures, and robotic systems.
- Design and implement biomimetic solutions in robotics, materials, and medical applications.

Course Outcomes

After completing this course, students will be able to

CO1	Explain biomimetic principles and their relevance in engineering and technology
CO2	Identify and analyze biological strategies for adaptation, locomotion, sensing, and material development.
CO3	Apply biomimetic concepts to develop innovative designs in robotics, materials, and sustainable engineering
CO4	Evaluate and optimize biomimetic solutions for real-world applications, considering environmental, ethical, and technological constraints.

CO-PO Mapping

PO/ PSO CO	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
CO1	3	3	2	2	3	2	3	2	3	3	2	2	3	2	1
CO2	3	2	2	1	2	2	3	3	1	1	3	3	3	3	2
CO3	3	3	3	3	3	2	3	2	3	1	2	2	3	3	3
CO4	3	3	3	3	3	2	3	2	3	2	1	3	3	3	3

Syllabus

Unit 1: Fundamentals of Biomimetics and Biological Inspiration

Introduction to biomimetics: Definitions, scope, and importance. Evolutionary design principles in nature: Adaptation, resilience, and multifunctionality. Case studies: Lotus effect (self-cleaning surfaces), gecko

adhesion, shark skin hydrodynamics. Bioinspired materials: Superhydrophobicity, anti-fouling surfaces, self-healing materials, and structural color.

Unit 2: Biomimetic Structures, Mechanisms, and Robotics

Bioinspired locomotion: Walking, swimming, and flying mechanisms in nature. Biomimetic robotics: Soft robotics, snake-like robots, quadrupeds, and drone flight inspired by birds and insects. Energy-efficient biological strategies: Swarming behavior, collective intelligence, and decentralized control. Material and structural biomimicry: Bone-mimicking composites, nacre-inspired tough materials, and bioinspired lightweight structures.

Unit 3: Applications, Challenges, and Future Directions

Biomedical applications: Prosthetics, biohybrid systems, tissue engineering, and artificial organs. Sustainable engineering: Biomimetic architecture, water collection from desert beetles, and bioinspired urban design. Ethical and sustainability concerns: Bioethics, responsible biomimetic design, and long-term implications. Future trends: AI-driven biomimetics, genetic algorithms, and synthetic biology.

Textbooks /Reference Books

Janine M. Benyus, Biomimicry: Innovation Inspired by Nature, Harper Perennial,

2002. Julian F. Vincent, Structural Biomaterials, Princeton University Press, 2012.

Steven Vogel, Comparative Biomechanics: Life's Physical World, Princeton University Press, 2013.

Yohann Forterre, Peter Fratzl, Biomimetic Actuators and Materials, Springer, 201S.

S. N. Gorb, Functional Surfaces in Biology: Adhesion and Locomotion, Springer, 200S.

25AIA354 **Embedded Systems** **L-T-P-C: 2- 0- 2- 3**

By the end of this course, students will:

- Understand the basics of embedded systems.
- Understand the basics of general-purpose processors.
- Analyze different communication interfaces.
- Implement Embedded / RTOS concepts and different design technologies

Course Outcomes

After completing this course, students will be able to

CO1	Understand the overview and characteristics of embedded systems
CO2	Analyze the requirements and design challenges associated with embedded systems
CO3	Gain insights into the design technology for embedded systems.
CO4	Explore general-purpose processors, their benefits, basic architecture, and operations

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

Syllabus

Unit 1: Embedded Systems Overview; Characteristics; Components; Categorization; Requirements; Design challenges; Processor technology; IC technology; Design Technology; Processors (RT- level): custom single purpose processor design, combinational logic, sequential logic.

Unit 2: General Purpose Processors Introduction; Benefits; Basic architecture; Operations: Instruction execution, Pipelining; Programmer's view; development environment; Selecting a microprocessor.

Unit 3: Communication Interface Need for communication interfaces, RS232/ RS432 / UART, RS422 / RS485, USB, Infrared, IEEE 1394 Firewire, Ethernet, IEEE 802.11 wireless LAN, Bluetooth.

Unit 4: Embedded / RTOS Concepts and Digital Technology Architecture of the Kernel, Tasks and Task scheduler, Interrupt service routines, Semaphores, Mutex, Timers, Priority inversion problem. Logic synthesis, Behavioral synthesis, System synthesis, Hardware/Software co-design, Hardware/Software co-simulation, Reuse of intellectual property codes.

Text Books / References

- Givargis, T., Vahid, F. (2003). Embedded System Design: A Unified Hardware/Software Introduction. United States: John Wiley C Sons, Incorporated.
- Fan, X. (2015). Real-Time Embedded Systems: Design Principles and Engineering Practices. Netherlands: Elsevier Science.
- Kamal, R. (2011). Embedded Systems: Architecture, Programming and Design. India: Tata McGraw Hill Education Private
- Valvano, J. W. (2011). Embedded Microcomputer Systems: Real Time Interfacing. United States: Cengage Learning.
- An Embedded Software Primer (With Cd). (1999). India: Pearson Education.
- IEEE Embedded Systems Letters (ISSN-1943-0663) Journal, Elsevier.

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 Paramahamsa, 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.

22AVP219 Insights into Traditional Indian Painting

The course introduces traditional Indian paintings in the light of ancient Indian wisdom in the fields of aesthetics, the Shadanga (Sixs 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, Cheriyal, 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, Mohiniyatton, Kuchipudi, Odissy, 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

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:

1. *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.*
2. *Donald W Rogers, "Computational Chemistry Using PC", Wiley, (2003).*
3. *Alan Hinchliffe, "Chemical Modeling from atoms to liquids", Wiley, (2005).*

REFERENCES:

1. *James B Forseman 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.

23CHY241	ELECTROCHEMICAL ENERGY SYSTEMS AND PROCESSES	L-T-P-C: 3-0-0-3

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.

23CHY242	FUELS AND COMBUSTION	L-T-P-C: 3-0-0-3

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.

Flue gas analysis by chromatography and sensor techniques.

Unit 3

Combustion: Stochiometry, 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, theatrical 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, Biobliolife 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.

23CHY243	GREEN CHEMISTRY AND TECHNOLOGY	L-T-P-C: 3-0-0-3

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 Macquarrie; Blakwell Publishing.*
2. *Anastas, P. T., Warner, J. C. Green Chemistry: Theory and Practice, Oxford University Press Inc., New York, 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.

23CHY244	INSTRUMENTAL METHODS OF ANALYSIS	L-T-P-C: 3-0-0-3

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 out line 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 spetrophotometry - 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: 3-0-0-3

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.

23CHY246 CORROSION SCIENCE L-T-P-C: 3-0-0-3

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 - stray current 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 maneouvering 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.

23PHY241	ELECTRICAL ENGINEERING MATERIALS	L-T-P-C: 3-0-0-3

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 it's 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 it's 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, N J 1957.*
2. *C Kittel, "Introduction to solid state Physics", Wieley, 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.

23PHY242	PHYSICS OF LASERS AND APPLICATIONS	L-T-P-C: 3-0-0-3

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 semi conductor 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.

23PHY243	CONCEPTS OF NANOPHYSICS AND NANOTECHNOLOGY	L-T-P-C: 3-0-0-3

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.

Concept of quantum confinement and phonon confinement

Basic concepts – excitons, effective mass, free electron theory and its features, band structure of solids. Bulk to nano transition – 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.

23PHY244	PHYSICS OF SEMICONDUCTOR DEVICES	L-T-P-C: 3-0-0-3

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.

Theory of p-n junctions – diode and transistor:p-n junction under thermal equilibrium, forward bias, reverse bias, carrier density, current, electric field, barrier potential. V-I characteristics, 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.

23PHY245	ASTROPHYSICS	L-T-P-C: 3-0-0-3

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: Comic principles, big bang and big crunch – cosmic background radiation - Nucleo-synthesis - plank length 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.

23MAT241 INTRODUCTION TO GAME THEORY L-T-P-C: 3-0-0-3

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 Gmes, 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.

23MAT242	NUMERICAL METHODS AND OPTIMIZATION	L-T-P-C: 3-0-0-3

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

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.

FREE ELECTIVES OFFERED UNDER MANAGEMENT STREAM COMMON TO ALL PROGRAMS

23MNG331 FINANCIAL MANAGEMENT L-T-P-C: 3-0-0-3

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

23MNG332 SUPPLY CHAIN MANAGEMENTL-T-P-C: 3-0-0-3

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		

Syllabus Unit 1

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-bullwhip effect-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: Strtegies 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: 3-0-0-3

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, businessbuyingbehaviour. 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 Inida-1997.*
3. *Kotler, P. and Armstrong, G., 'Principles of Marketing' Prentice Hall of India, 2000.*
4. *Skinner, S.J., 'Marketing', All India Publishers and Distributes 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: 3-0-0-3

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 Klastrorin - '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

23MNG335 ENTERPRISE MANAGEMENT L-T-P-C: 3-0-0-3

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

Syllabus Unit 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' McGraw Hill 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.

23MNG336	OPERATIONS RESEARCH	L-T-P-C: 3-0-0-3

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 x n and m x 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 HalI, 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: 3-0-0-3

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: 3-0-0-3

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
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, Kolmogrov – 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

23MEE323 TOTAL QUALITY MANAGEMENT L-T-P-C: 3-0-0-3

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

Customer satisfaction – Customer retention - Employee involvement - Performance appraisal - 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

Besterfiled D. H. - 'Total Quality Management' - Pearson Education Asia – 2015-4th Edition

REFERENCE BOOKS

1. *Evans J. R, and Lidsay W. M. - 'The Management and Control of Quality' - Southwestern (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

23MEE324	LEAN MANUFACTURING	L-T-P-C: 3-0-0-3

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 systems.
Ford production systems – FPS gear model

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

23CSE321	SOFTWARE PROJECT MANAGEMENT L-T-P-C: 3-0-0-3

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

Syllabus Unit 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 Practioner'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.

23CSE322	FINANCIAL ENGINEERING	L-T-P-C: 3-0-0-3

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

Syllabus Unit 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.
2. Perry H. Beaumont. Financial Engineering Principles. John Wiley and Sons Inc, New Jersey; 2004.

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.

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 CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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.

23CSE324	INFORMATION SYSTEMS	L-T-P-C: 3-0-0-3

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 CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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 acivities –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. Enterprice Business Systems CRM, ERP, SCM , Case Studies

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: 2-0-0-2

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;

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 Advaitha Ashram, Kolkatta.*
7. *Art of Man Making - Swami Chinmayananda published by Chinmaya Mission, Bombay*
8. *Will Power and its Development- Swami Budhananda published by Advaitha 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 Advaitha 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: 2-0-0-2

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. Promote subject enhance excellence.
3. To work towards excellence, one must know where he is. Our present state... An introspective analysis. Our faculties within.

Unit 2

4. The play of the mind. Emotions – convert weakness into strength.
5. The indispensible 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

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

23CUL232	EXPLORING SCIENCE AND TECHNOLOGY IN ANCIENT INDIA	L-T-P-C: 2-0-0-2

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 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:

IFIH's interactive multimedia DVD on Science & Technology in Ancient 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.

23CUL233	YOGA PSYCHOLOGY	L-T-P-C: 2-0-0-2

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: 1-0-3-2

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			

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 / McGraw Hill.*
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.

23ENG231	INDIAN THOUGHT THROUGH ENGLISH	L-T-P-C: 2-0-0-2

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.

23ENG232	INSIGHTS INTO LIFE THROUGH ENGLISH LITERATURE	L-T-P-C: 2-0-0-2

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 LittleBlack 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.

23ENG233	TECHNICAL COMMUNICATION	L-T-P-C: 2-0-0-2

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 CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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. Alliyan & 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: 2-0-0-2

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.

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.

23FRE230	PROFICIENCY IN FRENCH LANGUAGE (LOWER)	L-T-P-C: 2-0-0-2

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

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.

23FRE231	PROFICIENCY IN FRENCH LANGUAGE (HIGHER)	L-T-P-C: 2-0-0-2

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:
Metro St Michel - Publisher: CLE International

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: 2-0-0-2

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: 2-0-0-2

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: Model 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 GERMANLANGUAGE (LOWER)	L-T-P-C: 2-0-0-2

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

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

23GER233	PROFICIENCY IN GERMAN LANGUAGE (HIGHER)	L-T-P-C: 2-0-0-2

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: 2-0-0-2

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										3				
CO5									2					

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 - Sangya ke 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, Juloos.

BOOKS:

1. *Prem Chand Ki Srvashrestha Kahaniyam: Prem Chand; Diamond Pub Ltd. New Delhi*
2. *Vyavaharik Hindi Vyakaran ,Anuvad thaha Rachana : Dr. H. Parameswaran, Radhakrishna publishing House, 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: 2-0-0-2

OBJECTIVES:

Appreciation and assimilation of Hindi Literature both drisya & shravya using the best specimens provided as 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**				
CO3									**1**	**2**				
CO4										**3**				
CO5									**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. News reading 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. Niranjan, Jawahar Pusthakalay, 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: 2-0-0-2

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	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.

23HUM231	GLIMPSES INTO THE INDAN 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 a chronological 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 a chronological 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.

23HUM232 GLIMPSES OF ETERNAL INDIA L-T-P-C: 2-0-0-2

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 Arthasastra – 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.

Unit 3

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 Arthasastra 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. *Hiriyanna, 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. Arthasastra.*
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

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

23HUM233 GLIMPSES OF INDIAN ECONOMY AND POLITY L-T-P-C: 2-0-0-2

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 purusarthas; 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) – Yudhisthira'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: 600B.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 Arthasastra; 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. Arthasastra.

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 Jumani. 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*
15. *New Delhi: Orient Longman, 2004.*
16. *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

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

23HUM234	HEALTH AND LIFESTYLE	L-T-P-C: 2-0-0-2

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.

Practical - Cooking without Fire or Wire-healthy Snacks

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: 2-0-0-2

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.

23HUM236	INTRODUCTION TO INDIA STUDIES	L-T-P-C: 2-0-0-2

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:
Material given by the Faculty

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.

23HUM237	INTRODUCTION TO SANSKRIT LANGUAGE AND LITERATURE L-T-P-C: 2-0-0-2

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 - 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 – MoralStories – Subhashithas – Riddles.

Unit 2

Language Studies - Role of Sanskrit in Indian & World Languages.

Unit 3

Introduction to Sanskrit Classical Literature – KavyaTradition – 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.

TEXTBOOKS AND REFERENCE BOOKS:

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.

23HUM238	NATIONAL SERVICE SCHEME	L-T-P-C: 2-0-0-2

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: 2-0-0-2

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

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*
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.

23HUM240 PSYCHOLOGY FOR ENGINEERS L-T-P-C: 2-0-0-2

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 1
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: 2-0-0-2

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.

23HUM242	THE MESSAGE OF BHAGWAD GITA	L-T-P-C: 2-0-0-2

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.*

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.

23HUM243	THE MESSAGE OF THE UPANISHADS	L-T-P-C: 2-0-0-2

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 Smrti - 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*

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.

23HUM244	UNDERSTANDING SCIENCE OF FOOD AND NUTRITION	L-T-P-C: 2-0-0-2

Course Objectives:

- To introduce the significance of food, nutrients, locally available food resources, 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	2	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 foodsvalue 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.

23JAP230	PROFICIENCY IN JAPANESE LANGUAGE (LOWER)	L-T-P-C: 2-0-0-2

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.

23JAP231	PROFICIENCY IN JAPANESE LANGUAGE (HIGHER)	L-T-P-C: 2-0-0-2

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: 2-0-0-2

OBJECTIVES:

To enable the students to acquire basic skills in functional language; to develop independent reading skills and reading for appreciating literary works; to 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 W riting - 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 Iyangar – 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 - Prasaranga, 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. Nissaar 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 Iyangar – Adalitha Kannada – Chetan Publication, Mysuru*
2. *Dr. G. S. Shivarudrappa – Samagra Kavya. - Kamadhenu Pustaka Bhavana*
3. *Shrikanth - Mankuthimmana Kagga – 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: 2-0-0-2

Course Objectives:

To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother0-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	-	-	-	-	-	-	-	-	-	**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: 2-0-0-2

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

W riting - 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, Sariyum 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.

23SAN230	SANSKRIT I	L-T-P-C: 2-0-0-2

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-kartharipprayoga

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 - 560 085*
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: 2-0-0-2

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

W ords 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:

1. *Praveshaha; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560 085*
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.

23SWK230	CORPORATE SOCIAL RESPONSIBILITY	L-T-P-C: 2-0-0-2

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,*

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.

23SWK231	WORKPLACE MENTAL HEALTH	L-T-P-C: 2-0-0-2

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/*
4. *Alberta Health Services Mental Health Promotion. (2012). Minding the Workplace: 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.

23TAM230	TAMIL I	L-T-P-C: 2-0-0-2

Course Objectives:

- To introduce the students to different literature- Sangam literature, Epics, Bhakthi literatureandmodern literature.
- To improve their ability tocommunicate with creative concepts, and also to introduce them to the usefulness of basicgrammaticalcomponents 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 Unit1

The history ofTamilliterature: Nāṭṭupuṟap pāṭalkaḷ, kataikkaḷ, paḻamoḻikaḷ - ciṟukataikaḷ tōṟṟamum vaḷarcciyum, ciṟṟilakkiyaṅkaḷ: Kaliṅkattup paraṇi (pōrpāṭiyatu) - mukkūṭaṟ paḷḷu 35.
Kāppiyaṅkaḷ: Cilappatikāram – maṇimēkalai naṭaiyiyal āyvu maṟṟum aimperum – aiñciṟuṅ kāppiyaṅkaḷ toṭarpāṉa ceytikaḷ.

Unit 2

tiṇai ilakkiyamum nītiyilakkiyamum - patiṉeṇkīḻkkaṇakku nūlkaḷ toṭarpāṉa piṟa ceytikaḷ - tirukkuṟaḷ (aṉpu, paṇpu, kalvi, oḻukkam, naṭpu, vāymai, kēḷvi, ceynaṉṟi, periyāraittuṇakkōṭal, viḻippuṇarvu pēṉṟa atikārattil uḷḷa ceytikaḷ.
Aṟanūlkaḷ: Ulakanīti (1-5) – ēlāti (1,3,6). - Cittarkaḷ: Kaṭuveḷi cittar pāṭalkaḷ (āṉantak kaḷippu –1, 4, 6, 7, 8), maṟṟum akappēy cittar pāṭalkaḷ (1-5).

Unit 3

tamiḻ ilakkaṇam: Vākkiya vakaikaḷ – taṉviṉai piṟaviṉai – nērkkūṟṟu ayaṟkūṟṟu

Unit 4

tamiḻaka aṟiñarkaḷiṉ tamiḻ toṇṭum camutāya toṇṭum: Pāratiyār, pāratitācaṉ, paṭṭukkōṭṭai kalyāṇacuntaram, curatā, cujātā, ciṟpi, mēttā, aptul rakumāṉ, na.Piccaimūrtti, akilaṉ, kalki, jī.Yū.Pōp, vīramāmuṉivar, aṇṇā, paritimāṟ kalaiñar, maṟaimalaiyaṭikaḷ.

Unit 5

tamiḻ moḻi āyvil kaṇiṉi payaṉpāṭu. - Karuttu parimāṟṟam - viḷampara moḻiyamaippu – pēccu - nāṭakam paṭaippu - ciṟukatai, katai, putiṉam paṭaippu.

Textbooks:

1. http:/Www.tamilvu.trg/libirary/libindex.htm.
2. http:/Www.tunathamizh.tom/2013/07/blog0post_24.html
3. Mu.Varatarācaṉ “tamiḻ ilakkiya varalāṟu” cāhitya akaṭemi papḷikēṣaṉs, 2012
4. nā.Vāṉamāmalai “paḻaṅkataikaḷum, paḻamoḻikaḷum” niyū ceñcuri puttaka veḷiyīṭṭakam, 5. 1980,2008
6. nā.Vāṉamāmalai, “tamiḻar nāṭṭuppāṭalkaḷ” niyū ceñcuri puttaka veḷiyīṭṭakam 1964,2006
7. poṉ maṇimāṟaṉ “aṭōṉ tamiḻ ilakkaṇam “aṭōṉ papḷiṣiṅ kurūp, vañciyūr,
8. tiruvaṉantapuram, 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.

23TAM231	TAMIL II	L-T-P-C: 2-0-0-2

Course Objectives

- To learn the history ofTamilliterature.
- To analyze different styles of Tamil Language.
- To strengthen thecreativity in communication, Tamilbasicgrammar 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 ofTamilliterature: Nāṭṭupuṟap pāṭalkaḷ, kataikkaḷ, paḻamoḻikaḷ - ciṟukataikaḷ tōṟṟamum vaḷarcciyum, ciṟṟilakkiyaṅkaḷ: Kaliṅkattup paraṇi (pōrpāṭiyatu) - mukkūṭaṟ paḷḷu 35.
Kāppiyaṅkaḷ: Cilappatikāram – maṇimēkalai naṭaiyiyal āyvu maṟṟum aimperum – aiñciṟuṅ kāppiyaṅkaḷ toṭarpāṉa ceytikaḷ.

Unit 2
tiṇai ilakkiyamum nītiyilakkiyamum - patiṉeṇkīḻkkaṇakku nūlkaḷ toṭarpāṉa piṟa ceytikaḷ - tirukkuṟaḷ (aṉpu, paṇpu, kalvi, oḻukkam, naṭpu, vāymai, kēḷvi, ceynaṉṟi, periyāraittuṇakkōṭal, viḻippuṇarvu pēṉṟa atikārattil uḷḷa ceytikaḷ.
Aṟanūlkaḷ: Ulakanīti (1-5) – ēlāti (1,3,6). - Cittarkaḷ: Kaṭuveḷi cittar pāṭalkaḷ (āṉantak kaḷippu –1, 4, 6, 7, 8), maṟṟum akappēy cittar pāṭalkaḷ (1-5).

Unit 3
tamiḻ ilakkaṇam: Vākkiya vakaikaḷ – taṉviṉai piṟaviṉai – nērkkūṟṟu ayaṟkūṟṟu

Unit 4
tamiḻaka aṟiñarkaḷiṉ tamiḻ toṇṭum camutāya toṇṭum: Pāratiyār, pāratitācaṉ, paṭṭukkōṭṭai kalyāṇacuntaram, curatā, cujātā, ciṟpi, mēttā, aptul rakumāṉ, na.Piccaimūrtti, akilaṉ, kalki, jī.Yū.Pōp, vīramāmuṉivar, aṇṇā, paritimāṟ kalaiñar, maṟaimalaiyaṭikaḷ.

Unit 5
tamiḻ moḻi āyvil kaṇiṇi payaṉpāṭu. - Karuttu parimārṟam - viḷampara moḻiyamaippu – pēccu - nāṭakam paṭaippu - ciṟukatai, katai, putiṉam paṭaippu.

Text Books / References
http:/Www.tamilvu.trg/libirary/libindex.htm. http:/Www.tunathamizh.tom/2013/07/blog0post_24.html Mu.Varatarācaṉ "tamiḻ ilakkiya varalāṟu" cāhitya akaṭemi papḷikēṣaṉs, 2012
nā.Vāṉamāmalai "paḻaṅkataikaḷum, paḻamoḻikaḷum" niyū ceñcuri puttaka veḷiyīṭṭakam, 1980,2008
nā.Vāṉamāmalai, "tamiḻar nāṭṭuppāṭalkaḷ" niyū ceñcuri puttaka veḷiyīṭṭakam 1964,2006 poṉ maṇimāṟaṉ "aṭōṉ tamiḻ ilakkaṇam "aṭōṉ papḷiṣiṅ 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.