AMRITA VISHWA VIDYAPEETHAM
DEEMED TO BE UNIVERSITY
School of Engineering

DEPARTMENT OF AEROSPACE ENGINEERING

B. Tech. in AEROSPACE ENGINEERING

CURRICULUM AND SYLLABI

2024

GENERAL INFORMATION

ABBREVIATIONS USED IN THE CURRICULUM

Cat	-	Category
L	-	Lecture
T	-	Tutorial
P	-	Practical
Cr	-	Credits
ENGG	-	Engineering Sciences (including General, Core and Electives)
HUM	-	Humanities (including Languages and others)
SCI	-	Basic Sciences (including Mathematics)
PRJ	-	Project Work (including Seminars)

AES	-	Aerospace Engineering
AIE	-	Computer Science and Engineering - Artificial Intelligence
BIO	-	Biology
CCE	-	Computer and Communication Engineering
CHE	-	Chemical Engineering
CHY	-	Chemistry
CSE	-	Computer Science and Engineering
CVL	-	Civil Engineering
CUL	-	Cultural Education
EAC	-	Electronics and Computer Engineering
ECE	-	Electronics and Communication Engineering
EEE	-	Electrical and Electronics Engineering
ELC	-	Electrical and Computer Engineering
HUM	-	Humanities
MAT	-	Mathematics
MEE	-	Mechanical Engineering
PHY	-	Physics

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

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

PROGRAM OUTCOMES FOR ENGINEERING

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze 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 modeling 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.

Program Specific Outcomes (PSO)

PSO 1: Students will learn governing differential principles in the fundamental disciplines of Aerospace Engineering (Covering aerodynamics, guidance & controls, propulsion and structures) along with their applications.

PSO 2: Students will be trained in the methodology and tools that are used in the fundamental design of aircrafts and rockets.

PSO 3: Students will have the ability to function in multidisciplinary teams in the aerospace engineering domains.

CURRICULUM

SEMESTER I

Cat.	Code	Title	L T P	Credit
HUM	23ENG101	Technical Communication	2 0 3	3
SCI	23MAT109	Calculus	3 0 0	3
ENGG	23CSE105	Algorithmic Thinking & 'C' Programming	2 0 3	3
SCI	23PHY106/23CHY108	Engineering Physics - B /Engineering Chemistry - A	2 1 0	3
SCI	23PHY186/23CHY188	Engineering Physics Lab - B / Engineering Chemistry Lab	0 0 3	1
ENGG	23EEE106	Electrical and Electronics Engineering -A	3 0 0	3
ENGG	23AEE101	Introduction to Aerospace Engineering & Technology	1 0 3	2
ENGG	23MEE102	Engineering Graphics and 3D Modelling	2 0 3	3
HUM	22ADM101	Foundations of Indian Heritage	2 0 1	2
		TOTAL	33	23

SEMESTER II

Cat.	Code	Title	L T P	Credit
SCI	23MAT119	Differential Equations & Transforms	3 1 0	4
SCI	23PHY106/23CHY108	Engineering Physics - B /Engineering Chemistry - A	2 1 0	3
SCI	23PHY186/23CHY188	Engineering Physics Lab - B / Engineering Chemistry Lab	0 0 3	1
ENGG	23CSE114	Introduction to Python Programming	1 0 3	2
ENGG	23AEE111	Engineering Mechanics for Aerospace	3 0 0	3
ENGG	23AEE112	Introduction to Aerospace Electronics	2 0 0	2
ENGG	23MEE182	Manufacturing Practice - B	0 0 3	1
ENGG	23EEE186	Electrical and Electronics Engineering Lab-A	0 0 3	1
HUM	22ADM111	Glimpses of Glorious India	2 0 1	2
HUM	22AVP103	Mastery Over Mind	1 0 2	2
		TOTAL	31	21

SEMESTER III

Cat	Code	Title	L T P	Cr
SCI	23MAT208	Complex Analysis & Calculus of Variations	3 0 0	3
ENGG	23AEE201	Mechanics of Fluids	3 1 0	4
ENGG	23AEE202	Mechanics of Materials	2 1 0	3
ENGG	23AEE203	Materials for Aviation and Space	3 0 0	3
ENGG	23AEE204	Introduction to Thermodynamics	2 1 0	3
ENGG	23AEE205	Introduction to Control Theory	2 1 0	3
ENGG	23AEE281	Instrumentation and Control Lab	0 0 3	1
HUM		Amrita Value Program I	1 0 0	1
HUM	23LSE201	Life Skills for Engineers I	1 0 2	P/F
		Total	26	21

SEMESTER IV

Cat	Code	Title	L T P	Cr
SCI	23MAT212	Linear Algebra	3 0 0	3
ENGG	23AEE211	Aerodynamics I	3 0 0	3
ENGG	23AEE212	Compressible Fluid Flow	2 1 0	3
ENGG	23AEE213	Aerospace Structures I	3 0 0	3
ENGG	23AEE214	Avionics	3 0 0	3
ENGG	23AEE282	Mechanics of Fluids Lab.	0 0 3	1
ENGG	23AEE283	Materials Testing Lab[@]	0 0 3	1
HUM		Amrita Value Program II	1 0 0	1
HUM	23LSE211	Life Skills for Engineers II	1 0 2	2
HUM		Free Elective [**]	2 0 0	2
HUM	23ENV300	Environmental Science		P/F
		Total	29	22

SEMESTER V

Cat	Code	Title	L T P	Cr
SCI	23MAT304	Foundation of Data Science	3 0 0	3
ENGG	23AEE301	Aerodynamics II	2 1 0	3
ENGG	23AEE302	Aerospace Propulsion	2 1 0	3
ENGG	23AEE303	Aerospace Structures II	3 0 0	3
ENGG	23AEE304	Flight Mechanics	2 1 0	3
ENGG		Professional Elective I	3 0 0	3
ENGG	23AEE381	Aero-structures Lab@	0 0 3	1
ENGG	23AEE382	Avionics Lab@	0 0 3	1
HUM	23LSE301	Life Skills for Engineers III	1 0 2	2
ENGG	23LIV390	Live-in –Labs I		[3]
HUM	23LAW300	Indian Constitution		P/F
		Total	27	22 + [3]

SEMESTER VI

Cat	Code	Title	L T P	Cr
ENGG	23AEE311	Flight Dynamics & Control	3 0 0	3
ENGG	23AEE383	Aero Design Lab	2 0 3	3
ENGG		Professional Elective II	3 0 0	3
ENGG		Professional Elective III	3 0 0	3
ENGG	23AEE312	Machine Learning for Aerospace	1 0 3	2
ENGG	23AEE384	Propulsion Lab@	0 0 3	1
ENGG	23AEE385	Low-speed Aerodynamics Lab@	0 0 3	1
ENGG	23AEE386	Innovations Lab.	0 0 3	1
HUM	23LSE311	Life Skills for Engineers IV	1 0 2	2
ENGG	23LIV490*	Live-in –Labs II		[3]
		Total	31	19+3

SEMESTER VII

Cat	Code	Title	L T P	Cr
ENGG	23AEE401	Computational Fluid Dynamics for Aerospace	2 0 3	3
ENGG	23AEE402	Finite Element Methods for Aerospace	3 0 0	3
ENGG	23AEE403	Space Flight Mechanics	3 0 0	3
ENGG		Professional Elective IV	3 0 0	3
ENGG		Professional Elective V*	3 0 0	3
ENGG	23AEE481	UAV and Flight-testing lab.	1 0 3	2
PRJ	23AEE498	Project Phase 1	0 0 6	2
ENGG	232AEE497	Industrial Internship		P/F
		Total	29	19

SEMESTER VIII

Cat	Code	Title	L T P	Cr
ENGG		Professional Elective VI*	3 0 0	3
PRJ	23AEE499	Project Phase II	0 0 30	10
		Total	33	13

		Total Credits		160

@'Hands-on' Project-based Lab.
***Professional Elective - Electives categorised under Engineering, Science, Mathematics, 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.**

Professional Electives				
Professional Electives I				
ENGG	**23AEE331**	**Experimental Aerodynamics**	**3 0 0**	**3**
ENGG	**23AEE332**	**Structural Dynamics**	**3 0 0**	**3**
ENGG	**23AEE333**	**Fundamentals of Heat Transfer**	**3 0 0**	**3**
ENGG	**23AEE334**	**Advanced Avionics**	**3 0 0**	**3**

Professional Electives II				
ENGG	**23AEE341**	**Turbulent Flows**	**3 0 0**	**3**
ENGG	**23AEE342**	**Composite Materials and Mechanics**	**3 0 0**	**3**
ENGG	**23AEE343**	**Air Breathing Engines**	**3 0 0**	**3**
ENGG	**23AEE344**	**Aircraft Systems**	**3 0 0**	**3**

Professional Electives III				
ENGG	**23AEE351**	**Advanced Composite Structures**	**3 0 0**	**3**
ENGG	**23AEE352**	**Rocket and Spacecraft Propulsion**	**3 0 0**	**3**
ENGG	**23AEE353**	**Satellite Engineering**	**3 0 0**	**3**
ENGG	**23AEE354**	**Computational Methods for Engineers**	**3 0 0**	**3**

Professional Electives IV				
ENGG	23AEE431	Helicopter Theory	3 0 0	3
ENGG	23AEE432	Engineering Fracture Mechanics	3 0 0	3
ENGG	23AEE433	Hypersonic Flow Theory	3 0 0	3
ENGG	23AEE434	Manufacturing Engineering	3 0 0	3

Professional Electives V				
ENGG	23AEE441	Aero-Elasticity	3 0 0	3
ENGG	23AEE442	Atomization & Combustion	3 0 0	3
ENGG	23AEE443	State Space Techniques	3 0 0	3
ENGG	23AEE444	Multidisciplinary Design Optimization	3 0 0	3

Professional Electives VI				
ENGG	23AEE451	Advanced Computational Fluid Dynamics	3 0 0	3
ENGG	23AEE452	Surface Engineering, Coating and Joining Technologies	3 0 0	3
ENGG	23AEE453	Introduction to Airport Management	3 0 0	3

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

PROFESSIONAL ELECTIVES 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

SYLLABUS

SEMESTER I

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.

23MAT109	CALCULUS	L-T-P-C: 3-0-0-3

Course Objectives:

- Understand the various functions and their graphs.
- Understand the basic concept of continuous function and find the extreme values of the continuous functions.
- Understand the definite integral and various integration techniques.
- To understand parameterisation of curves and to find arc lengths.
- To familiarise with calculus of multiple variables.
- To use important theorems in vector calculus in practical problems.

Course Outcomes:

CO1: To understand the concepts of shifting, scaling of functions, limits, continuity, and differentiability.
CO2: To learn integration techniques and definite integral.
CO3: To learn the limits, continuity and partial derivatives of multivariable functions.
CO4: To learn the scalar and vector fields, gradient, divergence and curl of vector fields and their physical interpretations
CO5: To learn line integral, surface integral and volume integrals. To understand Greens Theorem, Divergence theorem and Stokes theorem

CO-PO Mapping

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

Syllabus

Unit-I:
Graphs: Functions and their Graphs. Shifting and Scaling of Graphs. (1.5)
Limit and Continuity: Limit (One Sided and Two Sided) of Functions. Continuous Functions, Discontinuities, Monotonic Functions, Infinite Limits and Limit at Infinity. (2.1, 2.6)
Graphing : Extreme Values of Functions, Concavity and Curve Sketching, (4.1, 4.4).
Integration: Definite Integrals, The Mean Value Theorem for definite integrals, Fundamental Theorem of Calculus, Integration Techniques. (5.2 - 5.3, 8.1 – 8.5)

Unit II:

Functions of severable variables: Functions, limit and continuity. Partial differentiations, total derivatives, differentiation of implicit functions and transformation of coordinates by Jacobian. Taylor's series for two variables.

Vector Differentiation: Vector and Scalar Functions, Derivatives, Curves, Tangents, Arc Length, Curves in Mechanics, Velocity and Acceleration, Gradient of a Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field. (Sections: 9.4, 9.5, 9.6, 9.9, 9.10, 9.11)

Unit III: Vector Integration: Line Integral, Line Integrals Independent of Path. (Sections : 10.1, 10.2)

Green's Theorem in the Plane, Surfaces for Surface Integrals, Surface Integrals, Triple Integrals – Gauss Divergence Theorem, Stoke's Theorem. (Sections : 10.4, 10.5, 10.6, 10.7, 10.9)

Text Book

1. 'Calculus', G.B. Thomas Pearson Education, 2009, Eleventh Edition.

Reference

1. 'Calculus', Monty J. Strauss, Gerald J. Bradley and Karl J. Smith, 3rd Edition, 2002.
2. Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2018.
3. Advanced Engineering Mathematics by Dennis G. Zill and Michael R.Cullen, second edition, CBS Publishers, 2012.

Evaluation Pattern

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

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

23CSE105	**Algorithmic Thinking & C Programming**	**L-T-P-C: 2-0-3-3**

Course Objective:
To provide the foundations of algorithmic thinking and problem solving.
To provide the foundations of programming using C language.

Course Outcomes

CO1: Apply algorithmic thinking to define problems and design solutions.

CO2: Understand an algorithm or a C program by tracing its computational states, identifying bugs and correcting them.

CO3: Apply the basic programming constructs for problem solving.

CO4: Develop computer programs that implement suitable algorithms for real-world scenarios.

CO-PO Mapping

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

Syllabus

Unit I
Problem Solving and Algorithmic Thinking Overview – problem definition, logical reasoning; Algorithm – What is an algorithm, practical examples, properties, representation, algorithms vs programs.

Unit II
Introduction to C – Basic units of a C Program – identifiers, data types, operators, constants, variables, name binding, expressions, logic. I/O Statements. Control Structures in C – Sequence, Selection and Repetition.

Unit III
Problem solving – Data organization: Arrays, introduction to Structures. Searching and Sorting, Modularization, Introduction to recursion.

Textbooks
Paolo Ferragina and Fabrizio Luccio, "Computational Thinking: First Algorithms, Then Code", Springer, 2018.
Byron Gottfried. Programming With C. Fourth Edition, McGrawHill,; 2018.

References:
Forouzan Bhrouz A, Hassan Afyouni. Computer Science: A structured programming approach in C. Fourth Edition, Cengage Learning; 2023.
Jeri Hanly and Elliot Koffman. Problem Solving and Program Design in C. Fifth Edition, Addison Wesley (Pearson); 2007.
Karl Beecher, "Computational Thinking: A beginner's guide to problem-solving and programming", BCS, The Chartered Institute for IT, 2017.

Paul Curzon and Peter William Mcowan, "The Power of Computational Thinking: Games, Magic And Puzzles To Help You Become A Computational Thinker", WSPC (EUROPE), 2017.

David Riley and Kenny A. Hunt, "Computational Thinking for the Modern Problem Solver", Chapman and Hall/CRC, 2014.

Evaluation Pattern

Assessment	Internal	End Semester

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

*CA – Can be Quizzes, Assignments, Projects, and Reports

23PHY106	**Engineering Physics - B**	**L-T-P-C: 2-1-0-3**

Course Objective:
To expose the essentials of Newtonian mechanics, Wave optics and elemental Quantum Mechanics to the Engineering students to enable them to apply in their engineering applications.

Course Outcomes

CO1: To apply the principles of Newtonian mechanics to engineering problems
CO2: To understand the fundamentals of wave optics and it's applications in engineering
CO3: To understand the essentials of Quantum mechanics and apply it to simple applications

CO-PO Mapping

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

Syllabus

Classical Mechanics: Review of Newton's third law and Free Body diagrams. Rigid body dynamics: Centre of mass. Moment of inertia. Torque, angular momentum, and angular acceleration. Work, power, and energy. Conservation of

momentum. Conservation of energy. Elastic and inelastic collisions. Circular motion: Radial and tangential forces. Centripetal acceleration and centripetal force. (15 Lectures)

Fundamentals of Wave optics: Theory of superposition -Qualitative: Superposition of two and many Wave trains of the Same Frequency and random phase, Vector addition of amplitudes, Fresnel and Fraunhofer Diffraction - Diffraction by a single and double Slit, intensity variation in single and double slit interference, Effect of increasing the number of Slits(Grating), Intensity distribution from an Ideal grating. Resolving power of grating and grating spectra. Principles of interferometry- Theory of Michelson's Interferometer and its applications.(15 Lectures)

Quantum mechanics: Wave function, Probability density, expectation values - Schrodinger equation – time dependent and independent, Linearity and superposition, expectation values, operators, Eigen functions and Eigen values. Application of 1D Schrodinger Wave equation: Free particle, Particle in a box, Finite potential well- Essentials of semiconducting materials (15 Lectures)

References:

1. Richard Wolfson, "Essential University Physics", Vols. 1 and 2. Pearson Education, Singapore, 2011.
2. Halliday D., Resnick R. and Walker J., "Fundamentals of Physics", Wiley Publications, 2008.
3. Francis A. Jenkins, Harvey E.White, "FUNDAMENTALS OF OPTICS" Forth edition- McGraw-Hill Publications.
4. Beiser A., "Concepts of modern physics", McGraw-Hill India, 2006.

Evaluation Pattern

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

*CA – Can be Quizzes, Assignments, Projects, and Reports

23CHY108	Engineering Chemistry - A	L-T-P-C: 2-1-0-3

Course Objective:

The objective of the course is to impart knowledge on the concepts of chemistry involved in the application of engineering materials that are used in the industry/day-to day life.

Course Outcomes:

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

CO1: analyze the solids using X-ray diffraction technique and analyse the materials using computational tools.

CO2: apply the fundamental principles of electrochemistry to illustrate the functioning of electrochemical energy systems.

CO3: apply the knowledge of chemistry to predict the type of corrosion in engineering materials and suggest suitable prevention methods.

CO-PO Mapping

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

Syllabus

Solid state

Crystalline and amorphous solids, isotropy and anisotropy, - Miller indices, space lattice and unit cell, Bravais lattices, the seven crystal systems and their Bravais lattices, X-ray diffraction - Bragg's equation and experimental methods (powder method and rotating crystal technique), types of crystals - molecular, covalent, metallic and ionic crystals - close packing of spheres – hexagonal, cubic and body centred cubic packing, elements of symmetry in crystal systems, defects in crystals – stoichiometric, non-stoichiometric, extrinsic and intrinsic defects. Vesta – for visualization of crystal structures.

Electrochemical energy system

Faradays laws, origin of potential, electrochemical series, reference electrodes, Nernst equation, introduction to batteries - classification - primary, secondary and reserve (thermal) batteries. Characteristics - cell potential, current, capacity and storage density, energy efficiency. Construction, working and application of Leclanche cell-Duracell, Li-MnO_2 cell, lead acid batteries. Ni-Cd battery, Lithium ion batteries. Fuel cell - construction and working of PEMFC.

Corrosion control and metal finishing

Introduction, causes and different types of corrosion and effects of corrosion, theories of corrosion - chemical corrosion, Pilling Bed-worth ratio, electrochemical corrosion and its mechanism, factors affecting corrosion - galvanic series. Over potential and Tafel polarization. Corrosion control methods - cathodic protection, sacrificial anode, impressed current cathode. Surface coatings - galvanizing, tinning, electroplating of Ni and Cr. Anodising of aluminium.

References:

Patrick M. Woodward, Pavel Karen, John S. O. Evans, Solid State Materials Chemistry, Cambridge University Press, 2021

Vladimir S. Bagotsky, Alexander M. Skundin, Yurij M. Volfkovich, Electrochemical Power Sources Batteries, Fuel Cells, and Supercapacitors, John Wiley and Sons, 2015

Sanjay K Sharma, Green corrosion chemistry, John Wiley and Sons, 2012

Philip A. Schweitzer, P.E, Fundamentals of Corrosion Mechanisms, Causes, and Preventative Methods, CRC Press, 2009.

Chemistry: A Molecular Approach, 4th Edition Nivaldo J. Tro, Santa Barbara City College

Jain and Jain, "Engineering Chemistry", Dhanpat Rai Publishing company, 2015

Evaluation Pattern

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

*CA – Can be Quizzes, Assignments, Projects, and Reports

23PHY186	Engineering Physics Lab - B	L-T-P-C: 0-0-3-1

Course Objectives

To introduce experiments for testing the understanding of physics concepts in the areas of mechanics, optics, solid state physics, quantum mechanics and electricity and magnetism.
To make the student to acquire practical skills in finding properties of mater, optical properties, electrical characteristics of semiconductor materials and quantum behaviour of materials

Course Outcomes

CO1: Be able to perform experiment to study elastic properties of materials Evaluate
CO2: Be able to design, perform experiments on dispersion, interference and diffraction. Evaluate
CO3: Be able to design; perform experiments to measure semiconducting properties. Evaluate
CO4: Perform experiment to study atomic spectrum of H2 atom and quantum nature of light.

CO-PO Mapping

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

Syllabus

- To determine the Young's modulus of the given material using non-uniform bending.
- Determination of Rigidity modulus of the given wire using torsional oscillation method.
- To find the dispersive power of the material of the prism.
- Determination of the wavelength of diode laser using diffraction grating and to find the mean size of Lycopodium particles.
- To find the radius of curvature of given convex lens by Newton's rings method
- To determine the efficiency and fill factor of the given solar cell and to study its characteristics.
- Determination of band gap of a semiconductor.
- Determination of Planck's constant and work function of the given metal using photoelectric effect.
- Experiment to verify the quantum nature of the hydrogen atom by measuring the wavelengths of spectral lines in the Balmer series.

Evaluation Pattern

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

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

23CHY188	Engineering Chemistry Lab	L-T-P-C: 0-0-3-1

Course Objectives

Using instrumental techniques to analyze the ions present in water.
To understand the kinetics of chemical reactions and adsorption principles.
To determine the rate of corrosion and its control.
To synthesis nanoparticles and determine the surface charge of oxide particles.
To estimate the amount of given substances using electrochemical methods.

Course Outcomes

CO1: Analyze the ions present in the given sample water
CO2: Analyze the adsorption isotherm and determine the rate constant of a reaction
CO3: Apply the solid state chemistry principles for preparing nanoparticles and determining the surface charge on oxides.
CO4: Apply the fundamental principles of electrochemistry for the analysis of given substance and understand the corrosion kinetics

CO-PO Mapping

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

Syllabus

Chemical Kinetics and surface chemistry – understanding the principle of adsorption, determining the rate constant of a reaction.
Electrochemistry – Evaluating the dissociation constant of acids, estimation of acid and ferrous ion present in water.
Corrosion and control – anodization and Tafel plot
Instrumentation techniques – Estimations of ions in water using flame photometer and UV-Visible spectrophotometer.
Solid state - Determination of point of zero charge of metal oxide.

Evaluation Pattern

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

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

23EEE106 ELECTRICAL AND ELECTRONICS ENGINEERING-A L-T-P-C: 3-0-0-3

[#]Offered to Aerospace Engineering and Chemical Engineering.

Course Objectives

- To impart basic knowledge of electrical quantities and provide working knowledge for the analysis of DC and AC circuits.
- To understand the construction and working principle of DC and AC machines.
- To facilitate understanding of basic electronics and operational amplifier circuits.

Course Outcomes

CO 1: Understand the basic electric and magnetic circuits.
CO 2: Analyse DC and AC circuits.
CO 3: Interpret the construction and working of different types of electrical machines.
CO 4: Analyse basic electronic components and circuits.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction to Electrical Engineering, Current and Voltage sources, Resistance, Inductance and Capacitance; Ohm's law, Kirchhoff's law, Energy and Power – Series parallel combination of R, L, C components, Voltage Divider and Current Divider Rules – Super position Theorem, Network Analysis – Mesh and Node methods- Faraday's Laws of Electro-magnetic Induction, Magnetic Circuits, Self and Mutual Inductance, Generation of sinusoidal voltage, Instantaneous, Average and effective values of periodic functions, Phasor representation. Introduction to 3-phase systems, Introduction to electric grids.

Unit 2

Electrical Machines: DC Motor: Construction, principle of operation, Different types of DC motors, Voltage equation of a motor, significance of back emf, Speed, Torque, Torque-Speed characteristics, Output Power, Efficiency and applications. Single Phase Transformer: Construction, principle of operation, EMF Equation. Regulation and Efficiency of a Transformer. Induction Machine: Three Phase Induction Motor: Construction and Principle of Operation, Slip and Torque, Speed Characteristics. Stepper motor: Construction, principle and mode of operation.

Unit 3

PN Junction diodes, VI Characteristics, Rectifiers: Half wave, Full wave, Bridge. Zener Diode- characteristics, Optoelectronic devices. BJT – characteristics and configurations, Transistor as a Switch. Junction Field Effect Transistors - operation and characteristics, Thyristor – Operation and characteristics. Fundamentals of DIAC and TRIAC. 555 Timer, Integrated circuits. Operational Amplifiers – Inverting and Non-inverting amplifier – Instrumentation amplifiers.

Textbooks

1. *Edward Hughes. "Electrical and Electronic Technology", 10th Edition, Pearson Education Asia, 2019.*
2. *D. P. Kothari, I J Nagrath, "Electric Machines", 5th Edition, Tata McGraw Hill, 2017.*
3. *A. P. Malvino, "Electronic Principles", 7th Edition, Tata McGraw Hill, 2007.*

References

1. *S. K. Bhattcharya, "Basic Electrical and Electronics Engineering", Pearson, 2012.*
2. *Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall of India Private Limited, 2nd Edition, 2003.*
3. *David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.*
4. *Michael Tooley B. A., "Electronic circuits: Fundamentals and Applications", 3rd Edition, Elsevier Limited, 2006.*

Evaluation Pattern

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

*CA – Can be Quizzes, Assignment, and Tutorials.

23AEE101 INTRODUCTION TO AEROSPACE ENGINEERING AND TECHNOLOGY L-T-P-C: -1-0-3-2

Course Objectives

To introduce the students to the interesting branches of aerospace engineering through a hands-on approach.

Course Outcomes

CO 1: Identify the Atmosphere and its levels; Examine effects of the weather on flight.
CO 2: Remember the historic attempts at flying; major components of flying machines and aerial Navigation: Recognize MAVs and the principles of Stealth technology.
CO 3: Understand Newton's equations of motion of flying vehicles; define various terms: Lift, Drag, Moments, airfoil, monocoque and semi-monocoque structures.
CO 4: Categorize and subsume thrust production in various types of engines for flight.
CO 5: Apply laws of planetary motion and recognize various orbits.
CO 6: Hands-on exposure to various aircraft components and other equipment through simple experiments.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	3	3	-	-	1	-	3	-	-	-
CO2	2	-	-	-	-	2	-	2	2	2	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	2	-	-	3	3	3
CO4	3	2	-		-	2	3	-	-	3	-	3	3	3	3
CO5	3	3	-	-	-	1	-	-	-	2	-	2	1	-	-
CO6	3	2	-	-	2	-	-	-	-	2	-	3	3	3	3

Syllabus

Unit 1
Visual Content (video) about Atmospheric Dynamics and its Influence on Flying Machines - History of Aviation (visual content) – Types of Flying Machines, Major Components of an Aircraft, and their Functions (visual content) – Aircraft vs Rotorcraft (visual content) – Basic Instruments for Flying (visual content) – Physical Properties and Structure of the Atmosphere: Temperature, Pressure and Altitude Relationships.

Lab Component:
Wind Tunnel
Essential parts of the wind tunnel: honey-comb; turbulence damping screens; the converging section; test- section; mounting and traversing mechanism; suction duct and fan.

Unit 2
Newton's Law of Motions Applied to Aeronautics: Evolution of Lift, Drag and Moment – Aerofoils – General Types of Construction: Monocoque and Semi-monocoque – Typical Wing and Fuselage Structure (visual content) – Basic Ideas about Piston, Turboprop and Jet Engines - Use of Propeller and Jets for Thrust Production (visual content) – Stealth Technology: History and Principles.

Lab Component:
Engines
Different types of aircraft engines; Identification of engines and their parts.
Thrust Generation principle.

Unit 3

History of Spaceflight (visual content) – Major Components of Rocket, Spacecraft and their Functions (visual content) – Principles of Rocket Engines – The Solar System and the Copernican Model - Kepler's Laws – Orbital Motion – Satellite Orbits - Earth's Outer Atmosphere (visual content).

Lab Component:

Aircraft

Ka-25 helicopter**:** Role of helicopters in Defence and Civilian operations; Anti-submarine capability; Helicopter parts: rotors, engine, controls and cockpit instruments.

Mig -23**:** Role of Mig-23 in ground attack; Control surfaces; swept wing and saw tooth leading edge; Components: spars, ribs etc.; Undercarriage system.

Various rocket models and the functions of various parts.

UAV models and their functioning

Text Book(s)

Anderson. J.D, "Introduction to Flight", 9th edition, Mc Graw Hill, 2022.

References(s)

Anderson, D.F and Eberhatdt. S, "Understanding Flight," 2nd edition, Mc Graw, 2009.

Turner.M.J, "Rocket and Spacecraft Propulsion," 3rd edition, Springer, 2009.

Curtis.H.D, "Orbital Mechanics for Engineering Students," 3rd edition, Butterworth-Heinemann, 2013.

Paul A Suhler, "From Rainbow to Gusto: Stealth and the Design of the Lockheed Blackbird," AIAA, 2009.

Evaluation Pattern

Assessment	Internal	End Semester
Midterm	20	
Continuous assessment	40	
End Semester/Project		40

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

23MEE102	Engineering Graphics and 3D Modelling	L-T-P-C: -2-0-3-3

Course Objectives

- To understand the BIS and its importance in Technical Drawings.
- To acquire proficiency in orthographic and isometric projection techniques for 2D representation of 3D objects.
- To appreciate the significance of 3D modeling in engineering design and drafting.
- To familiarize with 3D modeling software.
- Develop lateral surface development principles for creating 2D representations of 3D objects.

Course Outcomes

CO01 Demonstrate proficiency in using BIS for drafting.
CO02 Construct engineering drawings using principles of orthographic and isometric projection.
CO03 Develop models using principles of lateral surface development.
CO04 Create proficiency in developing 3D solid models using the software.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO01	3	1	3		1			3	3	3		1	1		
CO02	3	2	3	1	2				3	3		1	1	1	1
CO03	3	3	3	1	3	1		1	3	2		1	1	1	1
CO04	3	2	3	1	2			1	3	2		1		2	2

Syllabus

Unit 1
Introduction to Engineering Graphics and 3D Modeling.

- Introduction to BIS of Engineering Drawing – Line type, dimensioning,
- Significance of 3D modeling
- Introduction to 3D Modeling Software

Unit 2
Orthographic and Isometric Projections in 3D

- Understanding orthographic projections of points, lines, planes, and solids in 3D
- Developing 2D projections of 3D models.
- Developing sectional views of 3D models of solids
- Developing isometric projections from 3D models of solids
- Real-world applications of orthographic projections.

Unit 3
Development of Lateral Surfaces

- Developing lateral surfaces of right regular prisms, cylinders, pyramids, and cones
- Understanding the development of surfaces in 3D models
- Real-world applications of surface development

Unit 4
Advanced 3D Modeling Techniques

- Advanced modeling techniques in 3D Modeling Software (Autodesk® Fusion 360®)
- Creating complex 3D models using multiple tools and techniques
- Applications of advanced 3D modeling techniques in various industries
- Exporting 3D models for prototyping and manufacturing

Note: The course is designed to provide students with a comprehensive understanding of engineering graphics, including 2D and 3D modeling techniques. The course will also cover various real-world applications of these

techniques and how they are used in different industries. Students will be expected to complete assignments and projects using 3D Modeling Software (Autodesk® Fusion 360®).

The classroom learning will be supplemented with a workbook, where the students shall have manual drawing practice for all projection-related topics.

Text Book(s)

1. *Basant Agarwal and C M Agarwal., "Engineering Drawing," 2e, McGraw Hill Education, 2015*
2. *Autodesk Fusion 360: A Power Guide for Beginners and Intermediate Users by John Willis, Sandeep Dogra, and Cadartifex, 4e, CADArtifex*

Work Book

Engineering Graphics Workbook - Created by Department of Mechanical Engineering Faculty Members at Amrita School of Engineering, Coimbatore Campus.

References(s)

Jain, Maheshwari, Gautam (2021), Engineering Graphics & Design, Khanna Book Publishing.
Autodesk Fusion 360 For Beginners: Part Modeling, Assemblies, and Drawings – Tutorial Book
Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing.
John K.C., "Engineering Graphics for Degree", 1e, Prentice Hall India, 2009
Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson.

Evaluation Pattern

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

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

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

Course Objectives

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

Course Outcomes

CO1 Be able to enhance the understanding of true essence of India's cultural and spiritual heritage through learning analytically what it amounts to living a happy life, and about the richness of India's education system, while pondering on the serious damage caused by colonialism in India alongside learning about the means of decolonization and knowing about the early timeline of Indian subcontinent.

CO2 Learn about the sublime value of selflessness and final freedom alongside understanding the concept of circle of life and Indian approach toward it while delving into the means of celebrating life.

CO3 Familiarize on the topic of what true love is, by way of understanding the immense compassion of mahātmas, and Mātā Amṛtānandamayī's Amma's gospel on compassion, the role of metaphors and tropes whereafter focussing personality development through Yoga both theoretically and practically

CO4 Appreciate the discussion on what it takes to be a strategic thinker, how India was glorified by various scholars and travellers and how strong a human being's association with nature should be alongside getting introduced to the glimpses of Indian traditions like Advaita Vedanta: the theory of oneness.

CO-PO Mapping

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

Syllabus

Unit 1
Chapters 1-4
Educational Heritage of Ancient India
Life and Happiness
Impact of Colonialism and Decolonization
A timeline of Early Indian Subcontinent

Unit 2
Chapters 5-8
Pinnacle of Selflessness and ultimate freedom
Indian approach towards life
Circle of Life
Ocean of love; Indian Mahatmas.

Unit 3
Chapters 9 - 12
Man's association with Nature

Celebrating life 24/7.
Metaphors and Tropes
Become A Strategic Thinker (Games / Indic activity)

Unit 4
Chapters 13-16
India: In the Views of Other Scholars and Travellers
Personality Development Through Yoga.
Hallmark of Indian Traditions: Advaita Vedanta, Theory of oneness
Conversations on Compassion with Amma

Text Book(s)

Foundations of Indian Heritage- In house publication

References(s)

- The beautiful tree by Dharampal – Other India Press, Mapusa, 2000
- Peasants and Monks in British India by William Pinch – University of California Press.1996
- India, that is Bharat: Coloniality, Civilisation, Constitution by J Sai Deepak -Bloomsbury India, 2021
- Awaken Children Dialogues with Mata Amritanandamayi, MAM Publications
- Man, and Nature by Mata Amritanandamayi Devi , MAM Publications
- What Becomes of the Soul After Death, Sri Swami Shivananda, Divine Life Society,1999

Evaluation Pattern

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

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

SEMESTER II

23MAT119	DIFFERENTIAL EQUATIONS AND TRANSFORMS	L-T-P-C: -3-1-0-4

Course Objectives

- To model spatiotemporal variations in engineering systems and processes using differential equations
- To analyze and solve ordinary differential equations (ODE)
- To analyze stability of systems of first order ordinary differential equations
- To define Laplace transforms and utilize them to solve linear first and second order ODEs
- To understand partial differential equations and its applications in engineering.
- To Apply the numerical techniques for solving ODE and PDE.

Course Outcomes

CO1: Define first-order ordinary differential equations and demonstrate ability to use techniques to solve them and apply these solutions in engineering contexts.
CO2: Solving the higher order ODE using method of undetermined coefficient and other methods.
CO3: Define Laplace transforms and their inverses, apply their properties to solve linear ordinary differential equations.
CO4: Understand the types of partial differential equations arising from two-dimensional modeling. Use separation of variables to solve linear partial differential equations.
CO5: Using numerical techniques to solve simple ODE and PDE.

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	2	2	-	-	2	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	3	-	-	-	-	-		-	-	-
CO4	3	3	-	-	2	-	-	-	-	-		-	-	-
CO5	3	3	-	-	3	-	-	-	-	-	-	-	-	-

Syllabus

Unit 1
One-Dimensional Modeling: Origin of Ordinary Differential Equations (1^{st} and 2^{nd} Order); First Order OD: Direct Integration, Integrating Factor – Linear and Nonlinear Equations; Systems of First Order ODEs. Stability.

Unit 2
Second Order ODE: Homogeneous and Non-homogeneous – Linear equations with constant coefficients; Laplace Transforms: Definition, Properties and Inverse Laplace Transforms; Solution of Linear First and Second Order ODEs using Laplace Transforms. Fixed points, stability of fixed points.
Numerical methods for solving ODE: Euler's method, Improved Euler's method and Runge-Kutta method.

Unit 3
Two-Dimensional Modeling: Partial Differential Equations, classifications of PDE, method of characteristics, Separation of Variables: Fourier Series, arbitrary period, even and odd expressions, half range expressions. Fourier serious solutions of one dimensional Heat and wave Equations. Numerical methods for solving PDE: Finite difference method, solution of Laplace equation by FDM, Crank-Nicolson method.

Textbook

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India Pvt. Ltd., 2011

References

1. Michael Greenberg, Advanced Engineering Mathematics, 2nd Edition, Pearson, 2011

2. Bruce A. Finlayson, Introduction to Chemical Engineering Computing, John Wiley & Sons, 2006.
3. Engineering Mathematics, Srimanta Pal and Subodh C Bhunia, Oxford university press, 2015.
4. Advanced Engineering Mathematics, Wylie and Barrett, 6th Edition, McGraw Hall India, 2015.

Evaluation Pattern

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

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

23CSE114	Introduction to Python Programming	L-T-P-C: 1-0-3-2

Course Objectives

To introduce the syntactical constructs of Python programming Language.
To understand advanced data organization constructs.

Course Outcomes

CO1: Understand the basic programming language constructs such as variables, control structures, functions etc. to write simple programs.

CO2: Understand and analyze the given code by tracing, identifying bugs and correcting them.

CO3: Apply advanced concepts such as lists, tuples, dictionaries and libraries to solve real world problems.

CO4: Develop python programs for given problem scenarios.

CO-PO Mapping

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

Syllabus

Unit I
Introduction: Installing Python, basic syntax, interactive shell, editing, saving, and running a script. The concept of data types: variables, assignments, immutable variables, numerical types, arithmetic operators, and expressions. Comments in the program. Conditions, boolean logic, logical operators, ranges. Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation. Functions: defining and calling functions, parameter passing, return values, default parameters, variable scope.

Unit II
String manipulations: subscript operator, indexing, slicing a string. Lists, tuples, and dictionaries: basic list operators, replacing, inserting, removing an element, searching and sorting lists, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries.

Unit III
Text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated). Basic libraries in Python: NumPy, SciPy, Matplotlib, Pandas

Text Book(s)

Guttag, John. Introduction to Computation and Programming Using Python: With Application to Understanding Data Second Edition. MIT Press, 2016.

Reference Book(s)

Charles Dierbach. Introduction to Computer Science Using Python: A Computational Problem-Solving Focus. 2e., Wiley, 2013.
Python 3 Object-oriented Programming - Second Edition by Dusty Phillips Publisher: Packt Publishing, 2015.
Kenneth A. Lambert, "Fundamentals of Python: First Programs", Cengage Learning, 2nd Edition, 2018.

Evaluation Pattern

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

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

23AEE111	Engineering Mechanics for Aerospace	L-T-P-C: 3-0-0-3

Course Objectives

Understand the fundamental concepts of mechanics and application of the same in the engineering problems in order to solve problems for simple static equilibrium conditions.

Course Outcomes

CO1: Know how to write Force and Moment in vector format.
CO2: Perform static equilibrium analysis of a Particle and Rigid body.
CO3: Estimate the moment of inertia of composite areas.
CO4: Determine the kinematic variables of particles in different coordinates.
CO5: Calculate the velocity and acceleration of rigid bodies in moving frame.

CO-PO Mapping

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

Syllabus

Unit 1
Statics of rigid bodies: Introduction to vector approach – Forces in 2D and 3D - resolution of forces - Moment of force about a point and an axis – equivalent force couple system - Free body diagrams - support reactions- rigid body equilibrium , Application of statics: Structures-2D truss, Method of joints, Method of section. Friction- Dry friction (static and kinematics).

Unit 2
Centroid and canter of gravity of composite bodies, Moment of Inertia: First and second moment of area and mass, radius of gyration, parallel axis theorem, product of inertia.
Kinematics of Particles : Introduction to Reference frames, translation and rotation of a frame, Linear velocity, angular velocity , Linear and angular acceleration ,Rectilinear motion, curvilinear motion rectangular, normal tangential, polar, cylindrical, spherical (coordinates), relative and constrained motion, space curvilinear motion.

Unit 3
Kinetics of Particles: Newton second law of motion, work and energy, impulse and momentum, impact.
Dynamics of Rigid Bodies: Translation, fixed axis rotation, general planner motion, velocity and acceleration calculation in moving frames – Corioil's acceleration, impulse-momentum and associated conservation principles, Euler equations of motion and its application.

Text Book(s)

Beer,F.P. &Johnston,E.R., "Vector Mechanics for Engineers-Statics and Dynamics", 12 edition, McGraw Hill International Book Co., 2019.

Reference Book(s)

Hibbeler, R.C., "Engineering Mechanics- Statics and Dynamics", 14th edition, Pearson Education Pvt. Ltd., 2017.

J.L. Meriam and L.G. Kraige, "Engineering Mechanics - Statics", 9th edition, John Wiley & sons, 2018.
J.L. Meriam and L.G. Kraige, "Engineering Mechanics - Dynamics", 9th edition, John Wiley & sons, 2018.
Shames,I.H, "Engineering Mechanics-Statics and Dynamics", 4th edition , Prentice-Hall of India Pvt. Ltd., 2005.

Evaluation Pattern

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

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

23AEE112	INTRODUCTION TO AEROSPACE ELECTRONICS	L-T-P-C: 2-0-0-2

Course Objectives

- Provide fundamental knowledge on aircraft electronics to use in aircrafts and UAVs.

Course Outcomes

CO1: Basic understanding of Analog electronic circuits.
CO2: Basic understanding of Digital electronic circuits.
CO3: Understand the working principle of microprocessors and microcontrollers.
CO4: Understand the working principle of electromagnetic wave propagation.

CO-PO Mapping

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

Syllabus

Unit 1
Introduction to Analog Electronic Circuits: Working operation of Transistors (BJT, JFET, MOSFET), Amplifiers, Oscillators

Unit 2
Introduction to Digital Electronics: Fundamentals of Boolean Logic and the building blocks of digital circuits, Realization of digital blocks using combinational and sequential subsystems, design using state machine descriptions for practical real-life engineering problems,

Unit 3
Basic Microprocessor and Microcontroller – Introduction to Engineering Electromagnetics: electric field, magnetic field, electromagnetic wave propagation

Text Book(s)
S. Sedra, K. C. Smith, and A. N. Chandorkar, "Microelectronic Circuits – Theory and Applications," Seventh Edition, Oxford University Press, 2017.
M Morris Mano and Michael D Ciletti, "Digital Design with Introduction to the Verilog HDL," Pearson Education, Fifth Edition, Fifth Edition, 2015.
A. N. Kani, "Microprocessors and Microcontrollers", 2th edition, McGraw Hill, 2017.
W. H. Hayat, J. Buck, and M. J. Akhtar, "Engineering Electromagnetics," 8th edition, McGraw Hill, 2017.

Reference Book(s)
J. Millman, C. C. Halkias and C. D. Parikh, "Millman's Integrated Electronics – Analog and Digital Circuits and Systems," Second Edition, McGraw Hill Education, 2017.
John F. Wakerly, "Digital Design Principles and Practices," 4th Edition, Pearson Education, 2008.

Constantine A. Balanis, "Advanced Engineering Electromagnetics," Wiley, Second Edition, 2012.

Evaluation Pattern

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

*CA – Can be Quizzes, Assignments, Projects, and Reports

23MEE182	Manufacturing Practice - B	L-T-P-C: 0-0-3-1

Course Objectives

- Imparting the knowledge of general safety procedures that should be observed on the shop floor.
- Use modelling software to design and print simple geometry for additive manufacturing processes.
- Hands-on experience in edge preparation, plate, wire and sheet joining operations.
- Explain the different tools and equipment used for basic manufacturing processes.
- Get familiar with the essential components for automation and pneumatic circuit design.
- Discuss the components and functioning of various sub-systems of automobiles, such as the power train, steering system, suspension system, and braking system.

Course Outcomes

CO1: Practice safety procedures in a shop floor environment.
CO2: Se**lect** appropriate tools and methods for basic manufacturing processes.
CO3: Build simple geometries using an Additive Manufacturing process.
CO4: Perform basic metal joining using welding and soldering.
CO5: Design, simulate, and testing of simple pneumatic and electro-pneumatic circuits for automation application.
CO6: Understand the functioning of automotive systems and realize the importance of recent technological developments.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO01	3	1	1			1			1	1		2			
CO02	2	3				2			1	2		3		2	
CO03	2	2	1		3	1	1		1	2	1	3		2	
CO04	2	3	2						1	2	1	3		2	
CO05	3	2	2		3				1	2	1	3		2	2
CO06	3	2	2		3				1	3	1	3	1	1	2

Syllabus

Workshop Safety Measures and Practices - Proper training and supervision before operating unfamiliar or complex equipment.

a. **Additive Manufacturing Laboratory**
Introduction to digital manufacturing. Introduction to Additive Manufacturing - types – additive manufacturing applications - Materials for 3D printing, CAD Modelling for Additive Manufacturing, Slicing and STL file generation- G code generation - 3D printing of simple geometries.

b. **Mechanical Engineering Laboratory**
Study of tools and equipment used for basic manufacturing processes.
Manual arc welding practice for making Butt and Lap joints - Soldering Practice
Introduction to Machine Tools and Machining Processes

c. Automation Laboratory
Design, simulation, and testing of pneumatic and electro-pneumatic circuits. Introduction to PLC–PLC programming for automation applications.

d. Automobile Engineering Laboratory
Overview of automobiles – components –functioning of various sub-systems; Power train, steering system, suspension system and braking system. Introduction to electric vehicles, hybrid vehicles, alternate fuels. Introduction to E Mobility.

Text Book(s)

Laboratory Manual.

List of Exercises:

S.No.	List of Exercises	CO mapping
1.	**General Workshop Safety Measures and Practices**	**CO01**
2.	**Additive Manufacturing Laboratory** 1. Introduction to sketching and CAD modeling for Additive Manufacturing. 2. Conversation of CAD Model to STL file, slicing, and G-code generation 3. Prototyping using 3D printing	**CO02, CO03**
3.	**Mechanical Engineering Laboratory** 1. Manual arc welding practice: butt and Lap joint. 2. Soldering practice- wire joints 3. Introduction to basic Machine tools and Machining Process –Demonstration	**CO01** **CO02, CO04**
4.	**Automation Laboratory** 1. Study of pneumatic actuators and control valves. 2. Design, simulate, and testing of pneumatic circuits. 3. Design, simulate, and testing of electro-pneumatic circuits 4. PLC programming for automation applications.	**CO05**
5.	**Automobile Engineering Laboratory** 1. Demonstrate the working of various subsystems of automobiles- Power train, steering system, suspension system, and braking system. 2. Demonstrate the working of electric and hybrid vehicles.	**CO06**

Evaluation Pattern

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

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

23EEE186	ELECTRICAL AND ELECTRONICS ENGINEERING LAB - A	L-T-P-C: 0-0-3-1

#Offered to Aerospace Engineering and Chemical Engineering.

Course Objective

- To understand the basics of electrical connections and analyse the performance of electrical machines and electronic circuits.

Course Outcomes

CO1: Create basic electrical connections for domestic applications.
CO2: Measure the various electrical parameters in the circuit.
CO3: Analyse the performance of electrical machines.
CO4: Analyse basic electronic circuits.

CO-PO Mapping

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

Syllabus

1. Wiring practices
2. Study of Electrical protection systems.
3. Verification of circuit theorem.
4. Experiment on DC machine.
5. Experiment on single phase Transformer.
6. Experiment on induction motor.
7. VI characteristics of PN junction and Zener diode.
8. Implementation of Half wave and Full wave rectifier using PN junction diode.
9. Transistor as a switch.
10. Experiment on Thyristor.
11. Implementation of inverting and non-inverting amplifier using Op-amp.

Evaluation Pattern

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

*CA – Can be Experiments, Quiz, Viva, and Record.

22ADM111	GLIMPSES OF GLORIOUS INDIA	L-T-P-C: 2-0-1-2

Course Objective

The course aims at introducing Bhārath in nutshell to the student, which includes the sources of Indian thoughts, eminent personalities who shaped various disciplines, India's significant contribution to the man kind, the current stature of Indian in the geopolitics and Indian approach to science and ecology.

Course Outcome

CO1: Will be able to recognise the call of Upanishads and outstanding personalities for confronting the wicked in the real world while admiring the valour, pursuit and divinity in both classical and historical female characters of India.

CO2: Will get introduced to Acharya Chanakya, his works, and his views on polity and nation to find synchrony between public and personal life, alongside understanding India's cultural nuances and uniqueness concerning the comprehension of God across major global communities.

CO3: Will be able to appreciate Bhagavad Gita as the source of the Indian worldview through the various Yogic lessons enshrined in it, making it one of India's numerous soft powers, and also understand the faith-oriented mechanism of preserving nature.

CO4: Will be informed about the enormous contribution of Indian civilisation over two and a half millennia to humanity and develop awareness about India's approach toward science, devoid of dogmas and rooted in humanism.

CO-PO Mapping

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

Syllabus

Unit 1
Chapter 1 – Face the Brutes
Chapter 2 – Role of Women in India
Chapter 3 – Acharya Chanakya
Chapter 4 – God and Iswara

Unit 2
Chapter 5 – Bhagavad Gita: From Soldier to Samsarin to Sadhaka
Chapter 6 – Lessons of Yoga from Bhagavad Gita
Chapter 7 – Indian Soft powers
Chapter 8 – Preserving Nature through Faith

Unit 3
Chapter 9 - Ancient Indian Cultures (Class Activity)
Chapter 10 - Practical Vedanta
Chapter 11 - To the World from India (For Continuous Assessment)
Chapter 12 - Indian Approach to Science.

Text Books:

Glimpses of Glorious India- In-house publication

Reference Course material:

1. Fear Not: Be Strong (Swami Tathagatananda)

2. Essays on Gita (Sri Aurobindo)- Aurobindo Ashram
3. Indian Contribution to Science (Vijana Bharati Publication)
4. The Culture And Civilisation Of Ancient India In Historical Outline (D. D. Kosambi)
5. The Kautilya Arthashastra by Chankaya – Translation with critical and explanatory note by R P Kangle – Motilal Banarasidass Publishers- 1972
6. Chanakya Neeti – Strategies for success – Radhakrishnan pillai – Jaico Publishing house -2020.
7. Universal Message of the Bhagavad Gita: An exposition of the Gita in the Light of Modern Thought and Modern Needs. - Swami Ranganathananda, Advaita Ashrama Belur Math, 2000.
8. A Concise History Of Science In India – D M Bose, S N Sen, B V Subbarayappa,The Indian National Science Academy 1971.
9. Indian Culture and India's Future – Michel Danino - D.K. Printworld (P) Ltd -2011.

Evaluation Pattern

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

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

22AVP103	**Mastery Over Mind**	**L-T-P-C: 1-0-2-2**

Course Objectives

The course will enable the students to

- Mastery Over Mind (MaOM) is an Amrita initiative to implement schemes and organize university-wide programs to enhance health and wellbeing of all faculty, staff, and students (UN SDG -3)
- It gives an introduction to immediate and long-term benefits of MA OM meditation and equips every attendee to manage stressful emotions and anxiety, in turn facilitating inner peace and harmony.

- This course will enhance the understanding of experiential learning based on the 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 Outcomes

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

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								1	2	2		2			
CO2			2		2				2	2		2			
CO3					2			2	2	2		2			
CO4			3		3		2	3	2	3		3			
CO5			2		2			2	2	3		3			
CO6			2					2	2	3		3			

Syllabus:

Unit 1: Describe Meditation and Understand its Benefits (CO1)
A: Importance of meditation. How does meditation help to overcome obstacles in life *(Pre-recorded video with Swami Shubhamritananda Puri)*
Reading 1: Why Meditate? (Swami Shubamritananda ji)

Unit 2: Causes of Stress and How Meditation Improves Well-being (CO2)
A: Learn how to prepare for meditation. Understand the aids that can help in effectively practicing meditation. Understand the role of sleep, physical activity, and a balanced diet in supporting meditation. (*Pre-recorded video with Dr. Ram Manohar)*
B: Causes of Stress. The problem of not being relaxed. Effects of stress on health. How meditation helps to relieve stress. Basics of stress management at home and the workplace. *(Pre-recorded video with Prof Udhaykumar)*
Reading 1: Mayo Clinic Staff (2022, April 29). *Meditation: A Simple, Fast Way to Reduce Stress.* Mayo Clinic. https://www.mayoclinic.org/tests-procedures/meditation/in-depth/meditation/art-20045858 (PDF provided)
Reading 2: 'Efficient Action.' Chapter 28 in *Amritam Gamaya* (2022). Mata Amritanandamayi Mission Trust.

Unit 3: The Science of Meditation (CO3)
A: A preliminary understanding of the Science of meditation. What can modern science tell us about this tradition-based method? *(Pre-recorded video with Dr. Shyam Diwakar)*
B: How meditation helps humanity according to what we know from scientific research *(Pre-recorded video with Dr. Shyam Diwakar)*
Reading 1: Does Meditation Aid Brain and Mental Health (Dr Shyam Diwakar)
Reading 2: 'Science and Spirituality.' Chapter 85 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Unit 4: Practicing MA OM Meditation in Daily Life (CO4)
Guided Meditation Sessions following scripts provided (Level One to Level Five)
Reading 1: MA OM and White Flower Meditation: A Brief Note (Swami Atmananda Puri)
Reading 2: 'Live in the Present Moment.' Chapter 71 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Unit 5: Improving Communication and Relationships (CO5)
How meditation and mindfulness influence interpersonal communication. The role ofmeditation

in improving relationship quality in the family, at the university and in theworkplace. (Pre-recorded video with Dr Shobhana Madhavan)

Reading 1: Seppala E (2022, June 30th) 5 Unexpected Ways Meditation Improves Relationships a Lot. Psychology Today. https://www.psychologytoday.com/intl/blog/feeling-it/202206/5-unexpected-ways-meditation-improves-relationships-lot

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

Unit 6 Meditation and Compassion-driven Action (CO6)

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

Reading 1: Schindler, S., & Friese, M. (2022). The relation of mindfulness and prosocialbehavior: What do we (not) know?. Current Opinion in Psychology, 44, 151-156.

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

Text Books/Reference Books:

1. Meditation and Spiritual Life-Swami Yatiswarananda, Ramakrishna Math
2. The Complete Works of Swami Vivekananda Vol Vii by Advaita Ashram Mayavati Almora Himalayas
3. Dhyana Yoga-Holy Gita Swami Chinmayanda
4. Voice of God, Chandrasekharendra Saraswati, 68th Acharya of Sri Kanchi Kamakoti Peetam,
5. Hindu Dharma-Chandrasekharendra Saraswati, 68th Acharya of Sri Kanchi Kamakoti Peetam,
6. Mind: It's Mysteries and control-Swami Sivananda Saraswati
7. Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.
8. Books on Amma's teachings like Awaken children, From Amma's Heart etc.
9. The Science of Meditation: How to Change Your Brain, Mind and Body by Daniel Goleman and Richard. J. Davidson.
10. Allen, Cynthia (2020) The Potential Health Benefits of Meditation
11. Seppala E (2022, June 30th Unexpected Ways Meditation Improves Relationships a Lot.Psychology Today
12. Sharma, Hari (2022) Meditation: Process and Effects
13. Mayo Clinic Staff (2022, April 29). Meditation: A Simple, Fast Way to Reduce Stress.
14. Schindler, S., & Friese, M. (2022). The relation of mindfulness and prosocial behavior: Current Opinion in Psychology

Evaluation Pattern

Assessment	Internal	End Semester
Midterm	20	
Continuous assessment	40	
End Semester/Project		40

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

SEMESTER III

23MAT208	COMPLEX ANALYSIS AND CALCULUS OF VARIATIONS	L-T-P-C: 3-0-0-3

Course Objectives

- To perform calculus for complex variables.
- To understand the concepts of Taylor and Laurent series.
- To understand complex integrations and residues.
- To Familiarize the concepts of calculus of variations and its applications.

Course Outcomes

CO1: To learn differentiation for complex functions.

CO2: To Understand the basic concepts of complex integrations and residues.

CO3: To Understand the maximum and minimum principle, and variations of functionals.

CO4: To understand the Lagrange multiplier method and problems related to Sturm-Liouville and Hamilton's principle.

CO-PO Mapping

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

Syllabus:

Unit I
Complex Variables – Revision of complex numbers. Definitions of continuity, differentiability, analyticity. Cauchy-Riemann equations.

Unit 2
Integration along a smooth curve; integration along a contour; Cauchy's theorem. Cauchy's integral formula, Laurent's theorem, Taylor's theorem. Calculus of residues. Contour integration.

Unit 3
Calculus of Variations: Maxima and minima - The simplest case - Illustrative examples - Natural boundary conditions and transition conditions – Concept of functional with simple example – Variation of a functional (only necessary conditions) - Simple variational problem - Euler equation - The more general case of variational problems - Constraints and Lagrange multipliers - Variable end points - Sturm-Liouville problems - Hamilton's principle - Lagrange's equations - Generalized dynamical entities - Constraints in dynamical systems.

Text Books

1. Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2016.
2. A. S. Gupta, calculus of Variations with Applications, Prentice Hall of India, 1997

Reference Books

1. Advanced Engineering Mathematics, Ray Wylie and Louis Barrett, McGraw Hill, Sixth Edition, 2016.
2. Engineering Mathematics, Srimanta Pal and Subodh c Bhunia, Oxford press, 2015.
3. M. Gelfand and S. V. Fomin, Calculus of Variations, Dover Publications, 2000

Evaluation Pattern

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

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

23AEE201	MECHANICS OF FLUIDS	L-T-P-C: 3-1-0-4

Course Objectives

The purpose of this subject is to impart basic concepts pertinent to Newtonian fluid flow physics. Thereby, students will acquire and be capable to utilize this fundamental understanding for the characterization of flow domains of relevance in aerospace. In other words, with a strong background in fluid mechanics, aerodynamic optimization of flying machines can be accomplished.

Course Outcomes

CO1: Enables to distinguish fluid from solid.
CO2: Understand the stability of floating bodies based on hydrostatic force concept.
CO3: Synthesize conservation principles for mass and momentum for the description of incompressible fluid flow dynamics.
CO4: Characterize the inherent features of steady laminar incompressible flows.
CO5: Understand the concept of boundary layer – its formation, control of separation and significance in Aerospace applications.

CO-PO Mapping

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

Syllabus

Unit 1

Concept of a Fluid: Continuum, Primary Properties, Compressibility of Fluids, Bulk Modulus, Isothermal & Isentropic Processes, Speed of Sound – Secondary Properties: Viscosity, Newton's Law of Viscosity, Sutherland Equation, Andrade Equation, Surface Tension, Capillarity, Vapor Pressure, Boiling, Cavitation – Hydrostatics: Pascal's Law, Hydrostatic Force on Planar and Non-planar Surfaces, Area Moment of Inertia, Archimedes' Principle, Buoyancy, Stability of Floating Bodies.

Unit 2

Fluid Dynamics: Lagrangian & Eulerian Concepts, Reynolds Transport Theorem, Extensive Property, Intensive Property, Continuity Equation (Differential & Integral Forms) – Conservation of Momentum and Energy: Euler Equation of Motion, Stream Function, Velocity Potential, Bernoulli Equation (Inviscid Steady Flow & Potential Steady Flow)

Unit 3

Laminar flow solutions at steady state: Hagen-Poiseuille Flow, Plane Couette Flow, Plane Poiseuille Flow.
Boundary Layer Development: Boundary Layer Thickness, Displacement Thickness, Momentum Thickness – Momentum Equations: von Karman Momentum Integral Equation (zero pressure gradient), Skin-friction Drag on a Surface – Boundary Layer Equations: Prandtl Boundary Layer Equation and Blasius Solution.
Modelling and Similitude: Geometric, Dynamic and Kinematic Similarities, Use of Buckingham's Pi Theorem to derive correlations.

Text Book(s)

Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, "Fundamentals of Fluid Mechanics," 4th edition, John Wiley, 2002.

Reference book(s)

Frank M. White, Henry Xue., ``Fluid Mechanics", 9th Edition, McGraw-Hill, 2022
Piyush K Kundu., Ira Cohen., David R Dowling``, Fluid Mechanics"., 6th Edition, Elsevier., 2016.
G. K. Batchelor., ``An introduction to Fluid Mechanics"., 2nd Edition, Cambridge University press., 2000.

Videos and visualizations

VanDyke., ``An Album of Fluid Motion"., Stanford, 1982.
Video lectures by Ascher Shapiro (National Committee for Fluid Mechanics Films)

Evaluation Pattern

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

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

23AEE202	MECHANICS OF MATERIALS	L-T-P-C: 2-1-0-3

Course Objectives

Understand the fundamental concepts of stresses and strains and the relationship between both through the strain-stress equations in order to solve problems for simple elastic solids subjected to axial, bending and torsional loads.

Course Outcomes

CO1: Analyse the axial members for stress, strain and deformation.
CO2: Know how to draw Shear Force, Bending Moment, and Horizontal Force diagrams.
CO3: Obtain stresses in beams due to bending deformation.
CO4: Calculate stresses in structural members due to torsional deformation.
CO5: Estimate the deflection in beams using energy methods.

CO-PO Mapping

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

Syllabus

Unit 1
Stresses in axial members: Normal stress – St. Venant's principle – normal strain – tension and compression test – stress and strain diagrams – factor of safety – Hooke's law. Axial deformation – principle of superposition – lateral strain – Poisson's ratio – shear stress and strain – shear modulus – volumetric strain – bulk modulus – relation between elastic constants. Stresses in joints – shear and bearing stresses – temperature stress and strain – stress concentration.

Unit 2
Stresses in transverse members: Isolation of beam element – intensity of load, shear force and bending moment relation – shear force and bending moment diagrams – bending stresses in transverse members – Euler – Bernoulli' s simple beam theory – bending stress distribution – shear stresses in transverse members – shear stress distribution. Stresses in torsional members: Torsional shear stress – torsion equation for circular section – polar moment of inertia – torsional deformation – stresses due to combined loading

Unit 3
Deflection in transverse members: Moment-curvature relation – double-integration, Energy Methods: Strain and potential energies, Castigliano's theorem, Maxwell- Betti's theorem, unit load method, principle of virtual work, principle of virtual displacement and principle of virtual force.

Text Book(s)
James M Gere, Barry J. Goodno "Mechanics of Materials", 9th Edition, Cengage Learning, USA, 2017.

Reference(s)

Irving H. Shames and James M. Pitarresi, "Introduction to Solid Mechanics" 3rd edition, Prentice-Hall of India Pvt. Ltd. 2006
Egor P. Popov, "Engineering Mechanics of Solids", 2nd edition, Prentice-Hall of India Pvt. Ltd., 2004
S. H. Crandall and N. C. Dahl, "Introduction to Mechanics of Solids", 3rd Edition, Tata McGraw Hill, India, 2013.
R.C. Hibbeler "Mechanics of Materials",11th Edition, Pearson Prentice Hall, New Jersey, USA, 2022.

Evaluation Pattern

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

•CA – Can be Quizzes and Assignment

23AEE203	MATERIALS FOR AVIATION AND SPACE	L-T-P-C: 3-0-0-3

Course Objectives

Provide fundamental knowledge on Material Science and clear in-sight of materials for aviation and space. Basic understanding on necessity of polymer based materials and basic understanding of different characterization techniques of materials and smart materials for future generation aviation and space

Course Outcomes

CO1: Learn thermo-mechanical properties of materials in respect of aviation.
CO2: Gain clarity on mechanical properties of materials such as steel, aluminum and application to aviation.
CO3: Understand classification between engine materials and structural materials.
CO4: Apply the knowledge of characterization of materials.

CO-PO Mapping

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

Syllabus

Unit 1
Atomic structure, bonding and crystal structure in materials. Imperfections in crystalline solids and their role in influencing material properties. Mechanical properties: Stress and strain curves for brittle and ductile alloys, elastic, plastic, anelastic, visco-elastic behavior, ductility, resilience, toughness of metals, strengthening mechanisms, grain boundary hardening, solution hardening and work hardening.

Unit 2
Metals and Alloys: Microstrcture, properties and applications of ferrous and non-ferrous materials in aviation and space. Solid solutions, solubility limit, phase rule, binary phase diagrams, intermediate phases, intermetallic compounds, recrystallization and grain growth.
Ceramics: Structure, properties and applications of traditional and advanced ceramics for re-entry of space vehicles.

Unit 3
Polymers: Classification of engineering and high performance polymers, additives for engineering and high performance polymers, elastomers. Smart materials and superconductivity, nanomaterials, superalloys. Materials characterization techniques such as, scanning electron microscopy, transmission electron microscopy, atomic force microscopy, differential scanning calorimetry and X-Ray photo electron spectroscopy.

Text Book(s)
Cantor B, Assender H, and Grant P (2001), Aerospace Materials, ISBN 07503 0742 0, IOP Publishing Ltd

Reference(s)
Gauthier M. M. (1995). Engineered Materials Handbook Materials Park, OH: ASM International. [Comprehensive overview on engineering plastics, elastomers, composites, ceramics and ceramic matrix composites.]
Boyer R., Welsch G., and Collings E. W. (1994). Materials Properties Handbook: Titanium alloys. Materials Park, OH: ASM International. [Extensive coverage of Ti alloy data.]
Davis J. R. (1997). ASM Speciality Handbook Heat Resistant Materials. Materials Park, OH: ASM International. [Comprehensive overview on superalloys,, ferrous and non-ferrous heat-resistant materials.]

Evaluation Pattern

Assessment	Internal	End Semester

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

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

23AEE204	INTRODUCTION TO THERMODYNAMICS	L-T-P-C: 2-1-0-3

Course Objectives

- To familiarize the students with the application of various law of thermodynamics
- To study the application of heat and work transfer processes in the energy extraction efficiencies using air standard cycles

Course Outcomes

CO1: Apply the first law of thermodynamics to various forms of work and energy interactions that can occur.
CO2: Apply the understandings of phase change process of pure substances to the flow and non-flow process devices
CO3: Apply second law of thermodynamics and entropy concepts for determining the thermal efficiencies of heat engines and analyze the reversibility or irreversibility of a process using change in entropy
CO4: Apply ideal cycle analysis to simple heat engine cycles to estimate thermal efficiency and work as a function of pressures and temperatures at various points in the cycle.

CO-PO Mapping

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

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

Unit 1

Review of the Laws of Thermodynamics – Introduction to Engineering Applications of Thermodynamic Equilibrium – Quasi-static Process – Cyclic Process – Work and Heat – Application of First Law for Open and Closed Systems: Typical Work Transfer and Heat Transfer Devices – Perfect Gas – Equation of State - Specific Heats – Real Gas Models – Compressibility Chart – Thermodynamic Properties of Fluids – Pure Substance – Phase-change Process of Pure Substance – P-V-T Surface – Steam Tables.

Unit 2

Introduction to the Application of Second Law of Thermodynamics – Heat Engine – Heat Pump –Refrigerator – Irreversible Processes – Reversible Processes – Carnot Cycle – Carnot Engine – Carnot Theorems – Clausius Inequality – Concept of Entropy and Entropy Change – Introduction to Compressibility and Compressible Flow – Propagation of Sound – Mach number.

Unit 3

Thermodynamic Property Relations: Cyclic Rule, Maxwell Relations, T-D-S Equations – Clausius-Clapeyron Euation – Joule-Thomson coefficient and Inversion Line - Fundamentals of Power cycles: Air Standard Otto and Diesel Cycles, Rankine Cycle, Reversed Carnot Cycle, Brayton Cycle and its Application in Propulsion Systems. Use of applets for thermodynamics cycle calculations – Processes with heat addition - Demonstration of parametric studies for design.

Text Book(s)

Cengel, Y.A. and Boles, M.A., "Thermodynamics: An Engineering Approach," Tata McGraw, 2002.

Saad, M.A., 'Thermodynamics: Principles and Practice," Prentice Hall, New Jersey, 1998.

Reference(s)

Borganakke, S. and Wylen V., "Fundamentals of Thermodynamics," Wiley, New York, 2003.

Evaluation Pattern

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

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

23AEE205	INTRODUCTION TO CONTROL THEORY	L-T-P-C: 2 1 0 -3

Course Objectives

Introduce students to modelling, analysis and design of Linear Time Invariant (LTI) systems

Course Outcomes

CO1: Represent LTI electro-mechanical systems, as a transfer function and state space models
CO2: Obtain time response of first and second order systems
CO3: Determine steady state error performance of a given system
CO4: Use methods like Routh, root locus, Nyquist and Bode plots to analyse a system
CO5: Apply root locus and Bode plots in design of systems
CO6: Apply basic state space design methods

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	2	1	-	-	1	1	-	-	3	1	1
CO2	3	3	2	1	2	1	-	-	1	1	-	-	3	1	1
CO3	3	3	2	1	2	1	-	-	1	1	-	-	3	1	1
CO4	3	3	2	1	2	1	-	-	1	1	-	2	3	1	1
CO5	3	3	3	1	3	1	-	-	1	1	-	2	3	2	1
CO6	3	3	3	1	3	1	-	-	1	1	-	2	3	2	1

Syllabus

Unit 1
Mathematical Modeling: Linear Systems, Block Diagrams, Feedback, Input Test Signals, Laplace Transforms. Transfer Functions, State Space Representation.

Unit 2

Definition of Stability – Response Vs. Pole Locations – Time Domain Specifications – System Type and Steady-State Errors – Routh's Stability Criterion – Root Locus – Guidelines for Sketching – Bode Plot Techniques – Nyquist Criterion – Stability Margins (Gain and Phase),

Unit 3

Root Locus Design Method: Dynamic Compensation (Lead/Lag), PID Controllers – Frequency Response Design Method – Robust Stability and Robust Performance – Introduction to State Space Design, Controllability and Observability – Introduction to State-Feedback and Estimator Design.

Text Book(s)

Norman S. Nise, "Control Systems Engineering," 8th Edition, Wiley, 2019.

Reference(s)

Ogata, K., "Modern Control Engineering", 5th edition, Prentice Hall, 2021.
R.C. Dorf and R.H. Bishop, "Modern Control Systems," 13th edition, Prentice-Hall, 2016.

Evaluation Pattern

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

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

23AEE281	INSTRUMENTATION AND CONTROL LAB	L-T-P-C: 0-0-3-1

Course Objectives

To understand and learn the classic control theory and implement a PID controller for dynamic systems like inverted pendulum and Vertical take-off and landing setup using virtual instrumentation (VI) platform.

Course Outcomes

CO1: Understand the dynamics of Single degree of freedom systems- Single input single output systems (SISO).
CO2: Know how to simulate the SISO systems using VI platform.
CO3: Implement PID controller for SISO systems in VI platform.
CO4: Obtain the PID gains for real time system using VI platform.

CO-PO Mapping

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

Syllabus

Introduction to Single degree of freedom – SISO systems, equation of motion, transfer functions, Introduction to virtual instrumentation platforms, Introduction to PID controller
Simulation: Simulation of Inverted pendulum, rotary pendulum and VTOL setup using victual instrumentation platform. Implementation of PID controllers for above systems in Simulation platform.
Experiments: Tuning of PID controllers for Inverted pendulum, rotary pendulum and VTOL setup and compare it with simulation studies.
Mini Projects: Interdisciplinary in content based on application of course work completed by the student.

Reference(s)
Norman S. Nise, "Control Systems Engineering," 8th Edition, Wiley, 2019.
Ogata, K., "Modern Control Engineering", 5th edition, Prentice Hall, 2021.

Evaluation Pattern

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

•CA – Can be Quizzes, Projects, and Reports

22ADM211	LEADERSHIP FROM RAMAYANA	L-T-P-C: 1-0-0-1

Course Objectives

Through a study of the Rāmāyaṇa, the student should gain a deeper understanding of the ethical grandeur of Indian culture, and be inspired to follow the ideals of the characters depicted therein.

Course Outcomes

CO1: Appreciate the significance of *Rāmāyaṇa* as an *itihāsa,* and important aspects of *Bālakāṇḍa*.
CO2: Understand the family values and ideal human relationships portrayed in the *Ayodhyakāṇḍa* and *Aranyakāṇḍa* of *Rāmāyaṇa*.
CO3:Understand *dharma* and its nuances, emphasizing its applicability in an individual's life through*Kishkindhakāṇḍa* and *Sundarakāṇḍa* of Ramayana.
CO4: Appreciate the triumph of *dharma* over *adharma* through *Yuddhakāṇḍa* of *Rāmāyaṇa*
CO5: Appreciate the spiritual values from *Rāmāyaṇa* in resolving personal and social conflicts through varied effective presentations of important episodes of the *Rāmāyaṇa.*

CO-PO Mapping

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

Syllabus

Unit 1
An overview of Valmiki's epic. Introdcution to the content and structure of the epic text and it's principal characters.
Bala-Kāṇḍa: Preparing for the renowned mission.

Unit 2
Ayodhya-Kāṇḍa: Harbinger of an Entire Tradition of Nobleness.
Araṇya-Kāṇḍa: Tale of the forest life.

Unit 3
Kishkindha-Kāṇḍa: The Empire of Holy Monkeys.
Sundara-Kāṇḍa: Heart of the Ramayana

Unit 4
Yuddha-Kāṇḍa:The most popular part of the Ramayana
Uttara-Kāṇḍa: An attempt to explain the untold stories.

Unit 5
Ramayana and Modern-day learning
Ecological Awareness in the Ramayana
Different Ramayana: Epic that connects the world.

Text Books/References:

1. *Leadership Lessons from the Ramayana*, ASCSS
2. Rajagopalachari. C, *The Ramayana*
3. Valmiki, *The Ramayana*, Gita Press

Evaluation Pattern

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

•CA – Can be Quizzes, Projects, and Reports

23LSE201	**LIFE SKILLS FOR ENGINEERS I**	**L-T-P-C: 1 0 2-P/F**

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

Course Objectives

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

Course Outcomes

CO1: Soft Skills: To develop greater morale and positive attitude to face, analyse, and manageemotions in real life situations, like placement process.
CO2: Soft Skills: To empower students to create a better impact on a target audience through content creation, effective delivery, appropriate body language and overcoming nervousness, in situations like presentations, Group Discussions and interviews.
CO3: Aptitude: To 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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								2	3	3		3
CO2									2	3		3
CO3		3		2								
CO4		3		2								
CO5										3		3
CO6									3	3		3

Syllabus

Soft Skills
Soft Skills and its importance: Pleasure and pains of transition from an academic environment to work-environment. New-age challenges and distractions. Learning to benefit from constructive criticisms and feedback, Need for change in 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 wordanalysis 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 identifyerrors 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 worldthrough various individual speaking activities.

Reference(s):

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

Evaluation Pattern: 50:50

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

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

SEMESTER IV

23MAT212	LINEAR ALGEBRA	L-T-P-C: 3-0-0-3

Course Objectives

- Understand the basic concepts of vector space, subspace, basis and dimension.
- Familiar the inner product space. Finding the orthogonal vectors using inner product.
- Understand and apply linear transform for various matrix decompositions.
- Familiarize the concepts of eigenvalues and eigenvectors and its applications.

Course Outcomes

CO1: To Understand the basic concepts of vector space, subspace, basis and dimension.
CO2: To Understand the basic concepts of inner product space, norm, angle, Orthogonality and projection and implementing the Gram-Schmidt process, to obtain least square solution
CO3: To Understand the concept of linear transformations, the relation between matrices and linear transformations, kernel, range and apply it to change the basis and to transform the given matrix to diagonal matrix.
CO4: To understand the eigen values and eigen vectors and apply to transformation problems.
CO5: To perform case studies on least square and image transformations.

CO-PO Mapping

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

Syllabus

Unit 1
Vector Spaces: Vector spaces - Sub spaces - Linear independence - Basis – Dimension. (8 hrs)
Inner Product Spaces: Inner products - Orthogonality - Orthogonal basis - Gram Schmidt Process - Change of basis - Orthogonal complements - Projection on subspace - Least Square Principle. QR- Decomposition.

Unit 2
Linear Transformations: Linear transformation - Relation between matrices and linear transformations - Kernel and range of a linear transformation - Change of basis - Nilpotent transformations. Symmetric and Skew Symmetric Matrices, Adjoint and Hermitian Adjoint of a Matrix, Hermitian, Unitary and Normal Transformations, Self Adjoint and Normal Transformations.

Unit 3
Eigen values and Eigen vectors: Eigen Values and Eigen Vectors, Diagonalization, Orthogonal Diagonalization, Quadratic Forms, Diagonalizing Quadratic Forms, Conic Sections. Similarity of linear transformations - Diagonalisation and its applications - Jordan form and rational canonical form.
Case Studies: Applications on least square and image transformations.
Lab Practice Problems: Matrices, Matrix operations. Solving system of linear equations, rank and nullity. Orthogonality. Matrix of linear transformations. Affine transformations, scaling, shifting and rotation of images. Eigen values and eigen vectors and matrix decompositions.
Text books

1. Howard Anton and Chris Rorres, "*Elementary Linear Algebra*", Tenth Edition, John Wiley & Sons, 2010.

References

1. Nabil Nassif, Jocelyne Erhel, Bernard Philippe, Introduction to Computational Linear Algebra, CRC press, 2015.
2. Sheldon Axler, Linear Algebra Done Right, Springer, 2014.

3. Gilbert Strang, "*Linear Algebra for Learning Data*", Cambridge press, 2019.
4. Kenneth Hoffmann and Ray Kunze, *Linear Algebra*, Second Edition, Prentice Hall, 1971.
5. Mike Cohen, Practical Linear Algebra for Data Science, Oreilly Publisher, 2022.

Evaluation Pattern

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

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

23AEE211	**AERODYNAMICS I**	**L-T-P-C: 3-0-0-3**

Course Objectives

This subject provides fundamental understanding of aerodynamics by considering an infinite wing / airfoil. In doing so, the flow domain turns out 2-D and thereby the analysis is simplified. It also facilitates the student to apply superposition of potential flows to simulate flow around geometries of practical relevance.

Course Outcome

CO1: Understand fundamentals and know the non-depersonalization of aerodynamic forces and moments; familiar with airfoil nomenclature and airfoil characteristics.

CO2: Apply conformal mapping to Jowkowski transformation.

CO3: Understand plane potential flow and apply to aerodynamic problems of academic and practical interest.

CO-PO Mapping

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

Syllabus

Unit 1
Importance of Aerodynamics – Classification and Practical Objectives – Aerodynamic Forces – Moments and their Non-dimensionalization – Airfoil Nomenclature – Airfoil Characteristics.

Unit 2
Complex Functions: Analytic Functions and Cauchy-Riemann Criteria, Conformal Mapping, Joukowski Transformation.

Unit 3
Concept of Circulation – Plane Potential Flow – Laplace Equation – Elementary Flows and its Superposition – Kutta Condition – Kutta-Joukowski Theorem – Kelvin's Circulation Theorem – Starting Vortex.

Text Book(s)
John D Anderson, "Fundamentals of Aerodynamics," 6th edition, McGraw Hill, 2016.

Reference(s)

Valentine Daniel T , E.L. Houghton and P.W. Carpenter, "Aerodynamics for Engineering Students," 7th edition, Butterworth-Heinemann, 2016.
Milne-Thomson, "Theoretical Aerodynamics," Dover, 1974.
Krishnamurthy Karamcheti, "Principles of Ideal-Fluid Aerodynamics," 2nd edition, Krieger Pub Co, 1980.

Evaluation Pattern

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

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

23AEE212	COMPRESSIBLE FLUID FLOW	L-T-P-C: 2-1-0-3

Pre-Requisites: 23AEExxx-Mechanics of Fluids

Course Objectives

- Introduce students to the basics of compressibility of flow and the related phenomena.
- Enable them to analyze subsonic and supersonic flows with simplified analytical models.
- Provide an introduction to the applications of compressible flow analysis in aerospace engineering.

Course Outcomes

CO1: Study the impact of compressibility on gas flows and analyze shock waves
CO2: Analyze expansion waves.
CO3: Learn about compressible flow through CD nozzles.
CO4: Study the impact of friction and heat transfer on compressible flow.

CO-PO Mapping

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

Syllabus

Unit 1

Review of Thermodynamics: Energy Equation - Compressible Flows: Isentropic Flow, Stagnation Properties. Propagation of Sound, Mach number, Distinction between Subsonic and Supersonic flows, Introduction to Pressure Coefficient and Prandtl–Glauert transformation, Formation of Shock waves.

Unit 2

Flow Through Varying-area Ducts – Normal Shock Wave – Oblique Shock Wave – Shock Polar – Shock Wave Interactions – Prandtl-Meyer Expansion – Effect of Back Pressure on Nozzle Flows – Supersonic Wind Tunnels.

Unit 3

Fanno Flow – Rayleigh Flow – Representation of Shock Waves on the T-S Diagram – Small Perturbation Theory – Similarity Rules – Introduction to the Method of Characteristics .Sessions with more emphasis on Experiential learning: Parametric design of supersonic inlets/nozzles: Calculations using Applets; Schlieren demonstration of shock flows.

Text Book(s)

John D Anderson, "Modern Compressible Flow," 4th edition, Mcgraw-Hill, 2021.

Reference(s)

Shapiro.A.H, "The Dynamics and Thermodynamcis of Compressible Fluid Flow," Vol.1, Ronald Press Company, 1977.
Zucker.R.D and Biblarz.O, "Fundamentals of Gas Dynamics," 3rd edition, John Wiley, 2020.

Evaluation Pattern

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

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

23AEE213	AEROSPACE STRUCTURES I	L-T-P-C: 3-0-0-3

Course Objectives

To make students understand and appreciate the importance of theory of elasticity, concept of principal stress and strains. And also, to make the students understand the importance of column bucking and theories of failure in design of structural elements.

Course Outcomes

CO1: Understand stress and strain transformation on different plane for combined loading.
CO2: Obtain critical loads for columns with different end conditions.
CO3: Apply the theories of failure in designing the structures.
CO4: Derive equation of motion for systems under translational and rotational motions.

CO-PO Mapping

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

Syllabus

Unit 1
Introduction to theory of elasticity: Stresses and strains at a point, equilibrium equations, boundary conditions, stress and strain transformations, principal stresses and strains, Mohr's circle, bi-axial and tri-axial stresses, constitutive relations, plane stress and plane strain conditions, stress and displacement formulations, strain compatibility relation, governing equations, Airy's stress function, analysis of thin and thick walled pressure vessels.

Unit 2
Buckling of columns: Euler's formula, effective length, load versus deflection plot, load eccentricity, imperfections, South-well plot; Theories of Failure: Maximum principle stress theory, maximum principle strain theory, maximum strain energy theory, maximum shear stress (Tresca) theory, and maximum distortion (von-Mises) theory. Application of failures theories in the design of structural members like bar, beam, column, shaft and pressure vessels.

Unit 3
Introduction to vibration, undamped vibration, natural frequency, damped vibration, viscous damped system, under, over and critically damped system, logarithmic decrement, Coulomb damping, response to initial condition, response to simple harmonic motion, rotating unbalance, base excitation, whirling of shafts, vibration measuring instruments, response to periodic motion

Text Book(s)
James M Gere, Barry J. Goodno "Mechanics of Materials", 9th Edition, Cengage Learning, USA, 2017.
W. T. Thomson, "Theory of vibrations with applications," Pearson, 1997.

Reference(s)
R.C. Hibbeler "Mechanics of Materials",11th Edition, Pearson Prentice Hall, New Jersey, USA, 2022.
James M Gere, Stephen P. Timoshenko " Mechanics of Materials", 2nd Edition,CBS Publishers, New Delhi, 1986.
C. T. Sun, "Mechanics of Aircraft Structures", 3rd Edition, John Wiley & Sons, New York, 2021.

Evaluation Pattern

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

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

23AEE214	AVIONICS	L-T-P-C: 3-0-0-3

Course Objectives

To introduce students to basic avionics systems used in aircrafts and UAVs

Course Outcomes

CO1: Learn the importance, subsystems and environmental specifications of Avionics systems.
CO2: Be able to derive air data laws and explain its use in air data computer.
CO3: Gain insight to the working principle of an embedded systems with applications in avionics.
CO4: Comprehend basic elements of electronic communication systems and its applicability to radio navigational aids.
CO5: Learn the working principle of Inertial sensors like gyros and accelerators and its use in inertial navigation systems.
CO6: Understand the basic principle of autopilot and UAV systems.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	1	3	1	3
CO2	3	1	1	-	-	-	-	-	-	-	-	1	3	1	3
CO3	3	1	1	-	-	-	-	-	-	-	-	1	3	1	3
CO4	3	1	1	-	-	-	-	-	-	-	-	1	3	1	3
CO5	3	1	1	-	-	-	-	-	-	-	-	1	3	1	3
CO6	3	1	1	-	-	-	-	-	-	-	-	1	3	1	3

Syllabus

Unit 1
Introduction: Importance and role of avionics, the avionic environment – Air Data Systems: Air Data Information and its use, Air data laws, sensors and computations.

Unit 2
Embedded systems: Basic hardware building blocks of a typical embedded system – Software concepts relevant to avionics: Interrupts and Real Time Operating Systems – case studies illustrating importance of embedded systems in avionics – Introduction to electronic communication systems – Utility of Radio Navigation Aids.

Unit 3
Inertial sensors and systems: Laser and MEMS Gyros, Accelerometers, Attitude Heading Reference System – Navigation Systems: Basic principles, Inertial Navigation, Strapped-down inertial systems – Introduction to Autopilot and UAV Avionics. Safe disposal of electronic waste

Text Book(s)
R.P.G Collinson, "Introduction to Avionics systems", 4th edition, Springer, 2023.

Reference(s)
Kayton And Fried, "Avionics Navigation Systems", 2nd edition, Wiley, 2009.
Frank Vahid ,Tony Givargis, "Embedded System Design", Wiley, 2006.

Evaluation Pattern

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

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

23AEE282	MECHANICS OF FLUIDS LAB	L-T-P-C: 0-0-3-1

Course Objectives

To validate the static and dynamic characteristics of fluids using standard experimental set ups.

Course Outcomes

CO1: Verification of concepts in fluid statics and stability of a body.
CO2: Experimental analysis of systems involving fluid flow.
CO3: Estimation of drag of a body at low Reynolds number.
CO4: Determination of performance parameters of internal flow measuring devices.
CO5: Visualize and interpret the physical phenomenon in fluid flows.

CO-PO Mapping

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

Syllabus

- Determination of metacentric height of a floating body.
- Determination of centre of pressure and resultant force on a given surface.
- Experimental verification of Bernoulli's principle.
- Impact of jet experiment.
- Drag measurement of a sphere (Stokes flow).
- Determination of friction factor in a pipe flow.
- Coefficient of discharge of an orifice meter.
- Coefficient of discharge of a venturi meter.
- Flow visualization using Hele-shaw apparatus.

Reference(s)
VanDyke., ``An Album of Fluid Motion"., Stanford, 1982.
Video lectures by Ascher Shapiro (National Committee for Fluid Mechanics Films)

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

23AEE283	MATERIALS TESTING LAB	L-T-P-C: 0-0-3-1

Course Objectives

To supplement the theoretical knowledge gained in Mechanics of Materials, this course provides students opportunities to become familiar with standard mechanical testing methods and provides fundamental properties of engineering materials under axial, bending, torsional and impact loads.

Course Outcomes

CO1: Know how to estimate the strength of the materials using Universal testing machine and Impact test.
CO2: Obtain the material properties like young modulus and Poisson's ratio experimentally.
CO3: Verify the fundamental theories using experiment.
CO4: Identify the open lab problem statement, perform the experiment and presentation.

CO-PO Mapping

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

Syllabus

- Tension test on metals.
- Hardness test on metals using the Rockwell and Brinell equipment.
- Impact tests on metals using the Charpy and Izod equipment.
- Helical spring tests.
- Static bending test on Wood.
- Static bending test on metals.
- Compression tests on Wood.
- Deflection test to verify the Maxwell reciprocal theorem.
- Axial loading testing for Poisson's ratio

In addition to the conventional tests, students are assigned to open lab projects that involve experimental studies including fabrication and setting up unconventional testing methods to understand the basic concepts of strength of materials.

Reference(s)

Egor P. Popov, "Engineering Mechanics of Solids", 2nd edition, Prentice-Hall of India Pvt. Ltd., 2004
James M Gere, Barry J. Goodno "Mechanics of Materials", 9th Edition, Cengage Learning, USA, 2017.

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

23LSE211	LIFE SKILLS FOR ENGINEERS II	L-T-P-C: 1-0-2-2

Pre-requisite(s): An inquisitive mind, basic English language skills, knowledge of high schoollevel 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 manageemotions 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 andCircular 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 rightwords. Usage of more appropriate words in different contexts is emphasized.
Grammar (**Basic-intermediate**): Help students master usage of grammatical forms and enablestudents 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 themunderstand different tones in comprehension passages.
Speaking Skills: Make students be aware of the importance of impactful communication throughindividual speaking activities in class.
Writing Skills: Introduce formal written communication and keep the students informed about the etiquette of email writing.

Reference(s)

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

Evaluation Pattern: 50:50

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

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

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

Course Objectives

Through a study of the Mahabharata, the student should gain a deeper understanding of the ethical grandeur of Indian culture, and be inspired to follow the ideals of the characters depicted therein.

Course Outcomes

CO1: Understanding the impact of itihasas on Indian civilization with a special reference to the Adiparva of Mahabharata.
CO2: Enabling students to importance of fighting adharma for the welfare of the society through Sabha and Vanaparva.
CO3: Understanding the nuances of dharma through the contrast between noble and ignoble characters of the epic as depicted in the Vana, Virata, Udyoga and Bhishma parvas.
CO4: Getting the deeper understanding of the Yuddha Dharma through the subsequent Parvas viz., Drona, Karna, Shalya, Sauptika Parvas.
CO5: Making the students appreciative of spiritual instruction on the ultimate triumph of dharma through the presentations of the important episodes of the MB with special light on Shanti, Anushasana, Ashwamedhika, Ashramavasika, Mausala, Mahaprasthanika and Swargarohana Parvas..

CO-PO Mapping

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

Syllabus

Unit 1

Introduction and Summary of the Mahabharata
A Preamble to the Great Itihasa
Unbroken Legacy

Unit 2

Dharmic Insights of a Butcher

The Vows We Take

Kingship and Polity Acumen

Unit 3

Karna – The Maestro that Went Wide off the Mark

Tactics of Krishna

Yajnaseni

Unit 4

Popular Regional Tales

Maha Prasthanam – The Last Journey.

Unit 5

Mahabharata - An All-Encompassing Text

Mahābhārata- Whats and WhatNots

Nyayas in Mahabharata

TEXT BOOKS/REFERENCES:

Leadership Lessons from the Mahabharat, ASCSS

Rajagopalachari. C, *The Mahabharata*

Evaluation Pattern

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

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

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

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

SEMESTER V

23MAT304	FOUNDATIONS OF DATA SCIENCE	L-T-P-C: 3-0-0-3

Course Objectives:

- Understand the basic concepts of data interpretations and data visualizations.
- Familiar the descriptive statistics and apply these concepts to some data sets.
- Understand and apply the concepts of regression to some data sets.

Course Outcomes:

CO1: Understand various the data visualization methods.

CO2: Understand the basics of the descriptive statistics.

CO3: Understand and apply the basic concepts of correlations and regressions to the given data.

CO4: Understand and apply the basic concepts of sampling techniques and simple hypothetical testing to the given data.

CO-PO Mapping

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

Syllabus:

Unit 1

Introduction, Causality and Experiments, Data Preprocessing: Data cleaning, Data reduction, Data transformation, Data discretization. Visualization and Graphing: Visualizing Categorical Distributions, Visualizing Numerical Distributions, Overlaid Graphs, plots, and summary statistics of exploratory data analysis, Randomness, Probability, Introduction to Statistics, Sampling, Sample Means and Sample Sizes.

Unit 2

Descriptive statistics – Central tendency, dispersion, variance, covariance, kurtosis, five point summary, Distributions, Bayes Theorem, Error Probabilities; Permutation Testing, Statistical Inference; Hypothesis Testing, Assessing Models, Decisions and Uncertainty, Comparing Samples, A/B Testing, P-Values, Causality.

Unit 3

Estimation, Prediction, Confidence Intervals, Inference for Regression, Classification , Graphical Models, Updating Predictions.

Text books

1. Adi Adhikari and John DeNero, “Computational and Inferential Thinking: The Foundations of Data Science”, e-book.

References

1. Data Mining for Business Analytics: Concepts, Techniques and Applications in R, by Galit Shmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel, Kenneth C. Lichtendahl Jr., Wiley India, 2018.
2. Rachel Schutt & Cathy O’Neil, “Doing Data Science” O’ Reilly, First Edition, 2013.

Evaluation Pattern

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

End Semester		40

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

23AEE301	AERODYNAMICS II	L-T-P-C: 2-1-0-3

Pre-Requisites: 23AEE211 Aerodynamics-I

Course Objectives

This subject deals with basic concepts pertinent to finite wings. In other words, it highlights the deficiency of classical approaches based on airfoil theory by incorporating the real effects of wing-tip vortices that causes the additional induced drag on finite wings.

Course Outcomes

CO1: Learn thin airfoil theory and extend it to evaluate thickness and flap deflection effects.
CO2: Apply finite wing theory to evaluate the aerodynamic coefficients and forces for high aspect ratio finite wings
CO3: Understand flow over swept & delta wings, Leading Edge Vortex Flap technology for delta wing and an introduction to buffeting.

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	2	2	-	-	-	-	2	-	-	3	3	-
CO2	3	3	3	2	2	-	-	-	-	2	-	-	3	3	-
CO3	3	2	-	1	-	-	-	-	-	-	-	-	3	3	1

Syllabus

Unit 1
Classical Thin Airfoil Theory for Symmetric and Cambered Airfoils: Lift and Moment Coefficients, Center of Pressure, Predicting Zero Lift Angle of Attack, Flapped Airfoils, Effects of Thickness.

Unit 2
Finite Wing Theory: The Concept of Downwash and Induced Drag – Classical Theorems: Curved Vortex Filament, Biot-Savart Law, Helmholtz's Vortex Theorems – Method of Analysis: Prandtl's Classical Lifting Line Theory, Modern Numerical Lifting Line Method, Lifting Surface Theory, Modern Vortex Lattice Numerical Method.

Unit 3
Swept Wing Aerodynamics, Flow Physics Associated with Delta Wings: Subsonic Flow Pattern, Pressure Envelope, Leading Edge Vortex Flap (LEVF) Technology and Performance Comparison, Buffeting Phenomena and Types of Vortex Breakdown.

Text Book(s)
John D Anderson, "Fundamentals of Aerodynamics," 6th edition, McGraw Hill, 2016.

Reference(s)

Valentine Daniel T , E.L. Houghton and P.W. Carpenter, "Aerodynamics for Engineering Students," 7th edition, Butterworth-Heinemann, 2016.

Evaluation Pattern

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

•CA – Term project with Report Submission

23AEE302	AEROSPACE PROPULSION	L-T-P-C: 2-1-0-3

Pre-Requisites: 23AEExxx Compressible Fluid Flow

Course Objectives

Provide introduction to the functioning of aircraft engines and their performance characterization. Explain the components of aircraft engines and enable students to the carry out thermodynamic analysis of the engine cycles. Provide an introduction to rocket propulsion.

Course Outcomes

CO1: Apply momentum conservation laws to the process of propulsive thrust production in various system.
CO2: Analyze propulsion cycle using thermodynamics.
CO3: Study combustion and combustor functioning.
CO4: Comprehend the fundamentals of rocket propulsion.

CO-PO Mapping

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

Unit 1

Momentum Analysis of Thrust Generation – Types of Propulsion Systems and their Components – Performance Measures – Propellers: Performance Coefficients – Review of Thermodynamic Cycles - Ideal Cycle Analysis: Ramjets, Turbojets and Turbofan Engines.

Unit 2

Component Performance – Analysis of Real Engines –*Review of Combustion chemistry* – Heat of Combustion – Reaction Rate – Flames – Stability Considerations – Application to Gas Turbine Combustion

Design Practice Sessions: Use of NASA's Engine Simulator App will be stated in the syllabus, Parametric studies of Engine Cycles & design modifications

Unit 3

Rocket Vehicle Mechanics – Multistaging – Thermodynamics of Rocket Engine – Rocket Engine Performance – Types of Rocket Engines – Fuels for Solid and Liquid Propellant Rockets – Rocket Cooling.

Text Book(s)

Mattingly.Jack.D and Keith M. Boyer, "Elements of Propulsion: Gas Turbines and Rockets," 2nd edition, AIAA Education Series, 2016.

Reference(s)

Turner.Martin, "Rocket and Spacecraft Propulsion," 3rd edition, Springer, 2009.

Mukunda.H.S, "Understanding Combustion," 2nd edition, Macmillan India Limited, 2009.

Evaluation Pattern

Assessment	Internal	End Semester

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

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

23AEE303	AEROSPACE STRUCTURES II	L-T-P-C: 3-0-0-3

Course Objectives

To study and analyse the behaviour of various thin-walled aerospace structural components under different load conditions.

Course Outcomes

CO1: Understand the behavior of aerospace structures.
CO2: Analysis of non-circular torsional members.

CO3: Evaluate the bending stresses and flexural shear flows in thin-walled sections.
CO4: Investigate the torsional shear flows in thin-walled sections.
CO5: Illustrate the concepts of buckling for thin-walled sections.

CO-PO Mapping

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

Syllabus

Unit 1
Introduction to different aerospace structures, loads on an aircraft, characteristics of aircraft structures, basic structural members in aircraft structures and their functions; Torsion in non-circular bars, Prandtl stress function, St. Venant warping function, membrane analogy, torsion in narrow rectangular section.

Unit 2
Euler – Bernoulli and Timoshenko beam theories, bi-directional bending, bending and transverse shear stresses, bending stresses in narrow rectangular section, general symmetric sections, and thin-walled sections, flexural shear flows (FSF), FSF in thin-walled open sections, shear center in open sections.

Unit 3
Torsional shear flows (TSF) in thin-walled open sections, TSF in thin-walled closed sections (single and multiple cells) and warping in open and closed thin-walled sections, combined flexural and torsional shear flows in thin-walled closed sections (single and multi-cells) and shear center in closed sections, buckling of non-symmetrical sections and buckling of thin-walled sections

Text Book(s)
C. T. Sun, "Mechanics of Aircraft structures",3rd Edition, John Wiley & sons, New York, 2021.

Reference(s)
Megson,T.H.G., "Aircraft Structures for Engineering Students", 6th Edition Butterworth-Heinemann, USA, 2016
Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, McGraw–Hill, New York, 1993.
Bruhn. E.H. "Analysis and Design of Flight vehicles Structures", Tri – state off set company, USA, 1985.
Rivello, R. M., " Theory and analysis of flight structures" McGraw-Hill, New York,1969.

Evaluation Pattern

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

End Semester		40

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

23AEE304	FLIGHT MECHANICS	L-T-P-C: 2-1-0-3

Course Objectives

This course aims to equip the student with the knowledge to carry out performance estimation of turbojet and piston prop aircrafts and conduct static stability analysis in the subsonic regime. It also aims to introduce the concept of dynamic stability.

Course Outcomes

CO1: Apply equations of motion for an aircraft. Evaluate performance of turbojet aircrafts for climb, steady flight and turn.

CO2: Evaluate Glide and take-off and landing performance of turbojet. Evaluate the climb, steady flight and turn performance of piston-engine aircrafts

CO3: Estimate longitudinal static stability and understand the principle of dynamic stability.

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	-	-	-	-	-	1	-	3	3	2	2
CO2	3	3	-	3	-	-	-	-	-	1	-	3	3	2	2

CO3	3	3	-	3	-	-	-	-	-	1	-	3	3	2	2

Syllabus

Unit 1

Equations of Motion – Forces Acting on the Aircraft – Review of Aerodynamic Characteristics of the Wing and Compressibility Effects – Review of Propulsion Systems and their Performance Characteristics – Drag Contribution from Aircraft Components – Airplane Performance of Turbojets: Steady Flight, Range, Endurance, Conditions for Maximum Range and Endurance, Climb Performance, Turn Performance, Maximum Load Factor During Turn.

Unit 2

Glide Performance - Take-Off and Landing Performance – Performance of Piston-Props: Steady Flight Climb and Turn Performance, Climb Performance, Turn Performance, Comparison with Turbojets - Turbofan and Turboprop Performance Evaluation Guidelines, performance in head wind, tail-wind and cross-winds.

Unit 3

Concept of Static and Dynamic Stability – Longitudinal Stability: Neutral Point, Stick-Fixed and Stick Free Stability – Longitudinal Control – Hinge Moments – Control Power – Directional Stability and Control – Lateral Stability and Control – Introduction to Dynamic Stability – Stability Derivatives.

Text Book(s)

Hale, Francis J, "Introduction to Aircraft Performance, Selection, and Design". Wiley, 1984.
Nelson.R.C, "Flight Stability and Automatic Control", 2nd edition, McGraw-Hill, 2017

Reference(s)

Perkins.C.D and Hage.R.E, "Aircraft Performance, Stability and Control", 11th edition, Wiley, 1966.
Anderson.J.D,, "Aircraft Performance and Design", McGraw-Hill, .2017.
Russel.J.B,, "Performance and stability of aircraft", Elsevier,2010

Evaluation Pattern

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

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

23AEE381	AERO-STRUCTURES LAB.	L-T-P-C: 0-0-3-1

Course Objectives

To provide the basic knowledge of the testing equipment for various thin-walled structural components and to impart the practical exposure with the measuring equipment and sensors.

Course Outcomes

CO1: Perform the beam bending experiments and know how to estimate the bending stress using strain gauges.
CO2: Estimate the column bucking loads for different end conditions experimentally.
CO3: Obtain the stress and strain when the structural member is subjected to torsional and bending loads.
CO4: Determine the principal stress and axis for different cross sections.
CO5: Apply the concepts by doing an open lab experiments and presentation.

CO-PO Mapping

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

Syllabus

- Determination of principal axis in unsymmetrical bending of beams.
- Experiment on constant strength beam.
- Determination of shear centre location for open and closed thin-walled sections.
- Testing of beam with combined loading.
- Measurement on vibrations of beams.
- Wagner beam – Tension field beam experiments.

- Determination of stresses in thin-walled cylinder.
- Finding the buckling strength of column using the South well plot test.

In addition to the conventional tests, students are assigned to open lab projects that involve experimental studies including fabrication and setting up unconventional testing methods to understand the basic concepts of thin-walled member behaviour.

Reference(s)

Egor P. Popov, "Engineering Mechanics of Solids", 2nd edition, Prentice-Hall of India Pvt. Ltd., 2004
James M Gere, Barry J. Goodno "Mechanics of Materials", 9th Edition, Cengage Learning, USA, 2017.
Megson,T.H.G., "Aircraft Structures for Engineering Students", 6th Edition Butterworth-Heinemann, USA, 2016

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

23AEE382	AVIONICS LAB.	L-T-P-C: 0-0-3-1

Course Objectives

To expose students to carry out experiments related to avionics and aircraft control systems.

Course Outcomes

CO1: Know how to set up ground station for data acquisition from avionic systems.
CO2: Installation and configuration of various sensors on flying platforms.
CO3: Estimation of position, attitude, and altitude from sensor data.
CO4: Able to design basic autopilot in the simulation environment.

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CO-PO Mapping

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

Syllabus

1. Installation and configuration of data transmission and acquisition cards and set up ground station.
2. Testing of data transmission and reception.
3. Installation of GPS in UAV system.
4. Installing Inertial Measurement units and configuration in UAV system.
5. Acceleration measurement and position estimation.
6. Angular rate measurement and attitude measurement.
7. Altitude measurement using UAV.
8. Design of displacement longitudinal autopilot.
9. Design of Lateral Autopilot.
10. Implementation of Hardware-In-Loop Simulation (HILS) for fixed-wing aircraft.
11. Development of basic stabilization of multicopter.

Mini Project: Related to Control, Electronics, and Autopilot.

Text Book(s)

Norman S. Nise, "Control Systems Engineering," 6th edition, Wiley India, 2012.
R.P.G Collinson, "Introduction to Avionics", Springer, 2002.
R. C. Nelson, "Flight Stability and Automatic Control," 2nd Edition, McGraw Hill, 2017.

Reference Book(s)

Ogata, K., "Modern Control Engineering," 5th edition, Prentice Hall, 2010.
B. N. Pamidi, "Performance, Stability, Dynamics, and Control of Airplanes," 3rd edition, American Institute of Aeronautics and Astronautics, 2015.

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

23LSE301	LIFE SKILLS FOR ENGINEERS III	L-T-P-C: 1-0-2-2

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

Course Objectives

- Help students understand corporate culture, develop leadership qualities and becomegood 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 forarriving 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 questionson 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. Beingenterprising. 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 ina group discussion. Personality traits evaluated in a group discussion. Initiation techniques andmaintaining 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, CircularArrangements, 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 Grammarand empower them to spot errors in sentences and correct them.
Reasoning: Enable students to connect words, phrases and sentences logically.
Oral Communication Skills: Aid students in using the gift of the gab to interpret images, do a video synthesis, try a

song interpretation or elaborate on a literary quote.
Writing Skills: Practice closet tests that assess basic knowledge and skills in usage and mechanics of writing such as punctuation, basic grammar and usage, sentence structure and rhetorical skills such as writing strategy, organization, and style.

Reference(s)

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

Evaluation Pattern: 50:50

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

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

23LIV390	LIVE-IN-LAB I	3 CREDIT

Course Objectives

- Identify and analyse the various challenge indicators present in the village by applying concepts of Human Centered Design and Participatory Rural Appraisal.
- User Need Assessment through Quantitative and Qualitative Measurements
- Designing a solution by integrating Human Centered Design concepts
- Devising proposed intervention strategies for Sustainable Social Change Management

Course Outcome

CO1: Learn ethnographic research and utilise the methodologies to enhance participatory engagement.
CO2: Prioritize challenges and derive constraints using Participatory Rural Appraisal.
CO3: Identify and formulate the research challenges in rural communities.
CO4: Design solutions using human centered approach.

CO-PO Mapping

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

Syllabus

This initiative is to provide opportunities for students to get involved in coming up with technology solutions for societal problems. The students shall visit villages or rural sites during the vacations (after 4th semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth semester.
Thematic Areas

- Agriculture & Risk Management
- Education & Gender Equality
- Energy & Environment
- Livelihood & Skill Development
- Water & Sanitation
- Health & Hygiene
- Waste Management & Infrastructure

The objectives and the projected outcome of the project will be reviewed and approved by the department chairperson and a faculty assigned as the project guide.

Evaluation Pattern

Assessment	Marks
Internal (Continuous Evaluation) [75 marks]	

Workshop (Group Participation)	15
Village Visit Assignments & Reports	15
Problem Identification and Assessment	15
Ideation: Defining the Needs, Proposed Designs & Review	20
Poster Presentation	10
External [25 marks]	
Research Paper Submission	25
Total	**100**

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

SEMESTER VI

23AEE311	FLIGHT DYNAMICS AND CONTROL	L-T-P-C: 3-0-0-3

Course Objectives

The objective of the course is to introduce students to flight dynamics and handling qualities of the aircraft and their importance in the design of an aircraft.

Course Outcomes

CO1: Know how to derive equation of motion of an aircraft.
CO2: Obtain the linearized flight dynamic model using 'Small perturbation theory'
CO3: Understand concept and physics of dynamic stability and associated modes.
CO4: Recognise the importance of Flying and Handling qualities.
CO5: Understand concepts like stability augmentation system and autopilot.

CO-PO Mapping

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

Syllabus

Unit 1
Review of Static Stability – Concepts and Introduction to Dynamic Stability – Review: Body Axis, Stability Axis, Earth Axis – Euler Angles – Transformation between axis – Advantages of different axis – Aircraft Equations of Motion- Aircraft Trim: Steady level flight and Steady level turn.

Unit 2
Small Perturbation Theory: Linear Equations of Motion, Stability Derivatives, Longitudinal and Lateral Modes – Concept and Physics – Characteristic Equation – Transfer Function Approach – State Space Modelling and its application to Modes.
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Unit 3
Autopilots – Stability Augmentation System (SAS). Active Control Technology (ACT): Relaxed static stability, gust load alleviation, direct lift control, direct side force generator - Introduction to Flying and Handling Qualities.

Text Book(s)
M.V. Cook, Flight Dynamics Principles, "A Linear Systems Approach to Aircraft Stability and Control," 3rd Edition, Elsevier, 2013.

Reference(s)
Robert C Nelson, "Introduction To Flight Stability And Automatic Control," 2nd Edition, McGraw-Hill, 1998.
Warren F Philips, "Mechanics of Flight", Wiley, 2004.

Evaluation Pattern

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

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

23AEE383	AERO DESIGN LAB	L-T-P-C: 2-0-3 -3

Course Objectives

To provide experience for the students in the conceptual design of aircraft applying aero design principles and methodologies.

Course Outcomes

CO1: Apply basic aerodynamic, propulsion, structural, and flight mechanics concepts to practical design problems and to analyze the effects of design parameters theoretically.

CO2: Appreciate and understand constraints and compromises needed in practical cases.

CO3: Understand issues in various types of flying vehicle design and able to apply basic aerospace concepts for the design of these vehicles

CO4: Select and conceptually design Propulsion systems and estimate the weight, volume, shape and size of aero-vehicles.
CO5: Evaluate weights and stability issues and able to design control surfaces
CO6: Evaluate a design and conduct trade-off studies and market and technological trend studies.

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	-	-	1	2	3	2	1	3	2	3	3
CO2	2	3	3	3	-	1	1	3	3	2	2	3	1	3	3
CO3	3	3	3	3	3	1	1	2	3	2	3	3	2	3	3
CO4	3	3	3	3	3	1	1	2	3	2	3	3	3	3	3
CO5	3	3	3	3	3	-	-	2	3	2	-	3	3	3	3
CO6	3	3	3	3	2	1	1	3	3	2	3	3	1	3	3

Syllabus

Unit 1
Introduction to Design Process (conventional to Unmanned Aerial Vehicles): Design Requirements, Data Collection & Statistical Study, Conceptual, Preliminary and Detailed Designs, Regulatory Requirements. Preliminary weight estimation for fixed wing and Rotary wing vehicles, selection of wing loading, thrust loading.

Unit 2
Wing section, and plane form, and high lift devices. Fuselage layout and weight balance, estimation of aerodynamic characteristics, and performance evaluation. Power plant selection for both Fixed wing & rotary wing configurations: rotor selection, selection of IC engines/ Electric motor and its accessories.

Unit 3
Design of tail areas and control surfaces, Estimation of spanwise load distributions on the wing and tail. CG estimation of Vehicle and stability of the vehicle. Airworthiness requirements.
As lab component, students will conceptually design various class of flying vehicles for manned and unmanned missions. The design will end by listing all the performance parameters and trade-off studies

Text Book(s)
Sadraey, Mohammad H. *Design of Unmanned Aerial Systems*. John Wiley & Sons, 2020.

Reference(s)
Kundu, Ajoy Kumar, Mark A. Price, and David Riordan. *Conceptual Aircraft Design: An Industrial Approach*. John Wiley & Sons, 2019.
Daniel P. Raymer, "Aircraft Design - A Conceptual Approach," 5th edition, AIAA Education Series, 2012.
Leeland M Nicolai and Grant E.Carichner, "Fundamentals of Aircraft and Airship Design-Volume I," AIAA, 1st Edition, 2010.
Leeland M Nicolai, and Grant E.Carichner, "Fundamentals of Aircraft and Airship Design-Airship Design & Case Studies -Volume II," AIAA, 1st Edition , 2013.
Anderson.J.D., "Aircraft Performance and Design", McGraw-Hill, 2010.
Thomas Corke, "Aircraft Design", Prentice-Hall, 2003.

Evaluation Pattern

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

•CA – Project oriented Lab

23AEE312	MACHINE LEARNING FOR AEROSPACE	L-T-P-C: 1-0-3- 2

Course Objectives

This course provides the foundations of Machine Learning.

- Gain an overview of cluster analysis process and cluster quality evaluation techniques.
- Design and performance evaluation of classifiers for typical classification problems.
- Apply the concepts of machine learning to aerospace problems.

Course Outcomes

CO1: Generate, analyse and interpret data summaries,

CO2: Carry out analysis using machine learning algorithms,

CO3: Design and implement classifiers for machine learning applications,

CO-PO Mapping

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

Syllabus

Unit-1:
Introduction: Machine learning, Terminologies in machine learning, Types of machine learning: supervised, unsupervised, semi-supervised learning.

Unit-2
Basic parametric models for regression and classification: Linear regression, Classification and logistic regression, Polynomial regression, and regularization, and generalized linear models. Understanding, evaluating, and improving the performance

Unit-3:
Neural networks and deep learning: The neural network model, Training a neural network, Convolutional neural networks, and Dropout. Ethics in Machine learning. Application: Airfoil design through neural network.

Text Book(s)
Lindholm, Andreas, Niklas Wahlström, Fredrik Lindsten, and Thomas B. Schön. Machine learning: a first course for engineers and scientists. Cambridge University Press, 2022.

Reference(s)
Kevin P. Murphy, "Machine Learning, a probabilistic perspective", The MIT Press Cambridge, Massachusetts, 2012.
Alex Smola and SVN. Viswanathan, "Introduction to Machine Learning", Cambridge University Press, 2008.
Introduction to Machine Learning *| Nils J. Nilsson, Stanford University.*

Evaluation Pattern

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

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

23AEE384	PROPULSION LAB	L-T-P-C: 0-0-3-1

Course Objectives

To learn the thermal and fluid flow measurement techniques pertaining to the aircraft and rocket propulsion systems using experimental simulation of thermal fluid flow behaviour.

Course Outcomes

- **CO1**: Gain insight to the experimental performance characterization of propellers using static testing.
- **CO2**: Analyze the velocity field of an incompressible free jet experimentally and understand how cascade testing is performed.
- **CO3**: Study the flow through a CD nozzle based on wall-static pressure measurements and gain insight to intrusive measurements in supersonic flows.
- **CO4**: Learn how flame speed is measured and use measurements to analyze its variation with equivalence ratio.

CO-PO Mapping

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

Syllabus

Propeller Testing: Estimation of Static Performance, Estimation of Figure of Merit – Nozzle Testing: Mach number Distribution along a Convergent-divergent Nozzle – Flame Speed Measurement: Variation of Flame Speed with Equivalence Ratio – Study of Free Incompressible Jet: Study of Velocity Profiles and the Entrainment Process – Cascade Testing: Measurements of Velocity and Pressure in a Cascade Flow Field: Effect of the Variation in Angle of Attack.

Text Book(s)

Phillip Hill and Carl Peterson, "Mechanics and Thermodynamics of Propulsion," 2nd edition, Pearson (India), 2009.

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

23AEE385	LOW-SPEED AERODYNAMICS LAB.	L-T-P-C: 0-0-3-1

Course Objectives

To effectively implement aerodynamic study of moving / flying machines.

Course Outcome

CO1: Wind Tunnel Calibration that characterizes the quality of flow in the test section.
CO2: Developing valid test models based on dimensional analysis, and model design criteria.
CO3: Qualitative and Quantitative measurements that include flow visualization and image processing, and static pressure distribution with respect to Reynolds number.
CO4: Extracting flow structures, and the form-drag for aircraft configurations, UAV, locomotives and automobiles.
CO5: Experimentally analyze the external aerodynamics of flying or moving machines.

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

Syllabus

Wind Tunnel Calibration: Velocity Measurements, Boundary Layer Thickness Characterization - Quantification of Level of Turbulence in the Wind Tunnel: Sphere Test – Pressure or Form Drag Measurements: Finite and Infinite Wings, Fuselage, UAV, Locomotives – Flow Visualization: Smoke, Tuft, Surface Coating – Image Processing: Essential Aspects of Image Enhancement Utilizing Commercial Software MATLAB to extract Flow Structures – Open Projects relevant to Aerodynamics.

Text Book(s)

Cameron Tropea, Alexander L Yarin, John F Foss, "Springer Handbook of Experimental Fluid Mechanics," Springer, 2007.

Reference(s)

Richard J Goldstein, "Fluid Mechanics Measurements," 2nd edition, Taylor & Francis, 1996.
Wolfgang Merzkirch, "Flow Visualization," Academic Press, 1974.

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

23AEE386	INNOVATIONS LAB.	L-T-P-C: 0-0-3-1

Course Objectives

To enable students to convert their innovative ideas to products.

Course Outcomes

CO1: Market survey to identify under-served needs of common people, existing solutions and predict demand.
CO2: Propose solution (engineering/social) to meet the under-served need.
CO3: Analyze the impact of the proposed solution on environment and society.
CO4: Fabricate prototype with emphasis on industrial design.
CO5: Formulate a business model.
CO6: Develop the ability to convince funding agencies (pitching).

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	2	2	3	-	-	2	3	1	2	1	-	1
CO2	2	2	2	-	2	3	-	-	2	2	1	-	2	-	1
CO3	1	1	-	1	1	3	3	3	2	2	1	2	2	-	1
CO4	3	3	3	3	3	2	2	3	3	2	2	2	2	-	1
CO5	-	2	-	-	2	1	-	-	2	3	3	2	-	-	1
CO6	-	-	-	-	-	1	-	-	3	3	3	2	-	-	1

Syllabus

Activities: Identification of Problem – Identification of Criteria and Constraints – Market Study – Brainstorming for Possible Solutions – Generation of Ideas – Exchange of Ideas and Obtaining Feedback From Mentors and Batch-mates – Exploration of Possibilities – Study of Environmental and Social Impact of Innovative Ideas – Convergence on Methodology and Solution to the Problem – Viability for Scaling Up – Build a Model or Prototype – Paper Submissions / Patent Proposals.

Evaluation Pattern

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

•CA –Presentations and Reports

23LSE311	LIFE SKILLS FOR ENGINEERS IV	L-T-P-C: 1-0-2-2

Pre-requisite(s): Self-confidence, presentation skills, listening skills, basic English languageskills, 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 theirknowledge, 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 questionson 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/deductivereasoning 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
Teamwork: Value of teamwork in organizations, Definition of a team. Why team? Effective team building. Parameters for a good team, roles, empowerment and need for transparent communication, Factors affecting team effectiveness, Personal characteristics of members and its influence on team. Project Management Skills, Collaboration skills.
Leadership: Initiating and managing change, Internal problem solving, Evaluation and co-ordination, Growth and productivity, Importance of Professional Networking.
Facing an interview: Importance of verbal & aptitude competencies, strong foundation in core competencies, industry orientation / knowledge about the organization, resume writing (including cover letter, digital profile and video resume), being professional. Importance of good communication skills, etiquette to be maintained during an interview, appropriate grooming and mannerism.

Aptitude

Problem Solving II

Sequence and Series: Basics, AP, GP, HP, and Special Series.
Data Sufficiency: Introduction, 5 Options Data Sufficiency and 4 Options Data Sufficiency.
Logical reasoning: Clocks, Calendars, Cubes, Non-Verbal reasoning and Symbol based reasoning.
Campus recruitment papers: Discussion of previous year question papers of all major recruiters ofAmrita 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 ofgrammar.
Reasoning: Facilitate the student to tap his reasoning skills through Syllogisms, critical reasoningarguments and logical ordering of sentences.
Reading Comprehension (**Advanced**): Enlighten students on the different strategies involved intackling reading comprehension questions.
Public Speaking Skills: Empower students to overcome glossophobia and speak effectively andconfidently 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 VishwaVidyapeetham.
2. Soft Skill Handbook, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
3. Adair. J., (1986), "Effective Team Building: How to make * winning team", London, U.K
4. Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Public Sector – Engineer Management Trainee Recruitment Exam (General English)
9. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
10. A Modern Approach to Verbal Reasoning – R.S. Aggarwal
11. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations,Amrita Vishwa Vidyapeetham.
12. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
13. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.
14. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
15. How to Prepare for Logical Reasoning for the CAT, Arun Sharma.
16. Quantitative Aptitude for Competitive Examinations, R S Aggarwal.
17. A Modern Approach to Logical Reasoning, R S Aggarwal.
18. A Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal

Evaluation Pattern: 50:50

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

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

23LIV490	LIVE-IN-LAB II	L-T-P-C: 0-0-0-3

Course Objectives

- Proposal writing in order to bring in a detailed project planning, enlist the materials required and propose budget requirement.

- Use the concept of CoDesign to ensure User Participation in the Design Process in order to rightly capture user needs/requirements.
- Building and testing a prototype to ensure that the final design implementation is satisfies the user needs, feasible, affordable, sustainable and efficient.
- Real time project implementation in the village followed by awareness generation and skill training of the users (villagers)

Course Outcome

CO1: Learn co-design methodologies and engage participatorily to finalise a solution
CO2: Understand sustainable social change models and identify change agents in a community.
CO3: Learn Project Management to effectively manage the resources
CO4: Lab scale implementation and validation
CO5. Prototype implementation of the solution

CO-PO Mapping

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

Syllabus

The students shall visit villages or rural sites during the vacations (after 6th semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth semester.
Thematic Areas
- Agriculture & Risk Management
- Education & Gender Equality
- Energy & Environment
- Livelihood & Skill Development
- Water & Sanitation
- Health & Hygiene
- Waste Management & Infrastructure

Evaluation Pattern

Assessment	Marks
Internal (Continuous Evaluation) [63 marks]	
1. Proposed Implementation Presentation Round 1	**2**
2. Proposal Submission + Review	**6**
3. Co-design	**6**

i. Village Visit I (Co-Design Field Work Assignments)	4
ii. Presentation of Co-design Assessment	2
4. Prototype Design	**14**
i. Prototype Design	4
ii. Prototype Submission	8
iii. Sustenance Plan	2
5. Implementation	**35**
i. Implementation Plan Review	3
ii. Implementation	24
iii. Testing & Evaluation	4
iv. Sustenance Model Implementation	4
External [37 marks]	
6. Research Paper	**18**
7. Final Report	**15**
8. Poster Presentation	**4**
Total	**100**

SEMESTER VII

23AEE401 COMPUTATIONAL FLUID DYNAMICS FOR AEROSPACE L-T-P-C: 2-0-3-3

Pre-Requisites: 23AEExxx Mechanics of Fluids

Course Objectives

The course's objective is to introduce students to the finite difference method and related numerical techniques involved in studying fluid flow problems.

Course Outcomes

CO1: Understanding of conservation and non-conservation form of the governing equation of fluid dynamics.
CO2: Utilize finite difference method for the discretization of the fluid flow problems.
CO3: Make use of suitable numerical methods for solving the governing equations in the discretized domain by understanding stability and convergence.
CO4: Choose proper structured/ unstructured 2D grids specific to fluid flow problems.
CO5: Apply the FDM to develop CFD techniques: Lax-Wendroff, MacCormack techniques.
CO6: Experiment numerically the theoretical understanding of Computational Fluid Dynamics using software packages.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	-	-	-	-	-	-	-	1	3	1	2
CO2	3	3	1	2	2	-	-	-	-	-	-	1	3	2	2
CO3	3	3	1	2	3	-	-	-	2	-	-	1	3	3	2
CO4	2	3	1	1	3	-	-	-	-	-	-	2	3	3	2
CO5	3	3	3	1	3	-	-	-	-	-	-	2	3	3	2
CO6	2	3	3	3	3	-	-	-	3	3	-	3	3	3	3

Syllabus

Unit 1
Introduction to Numerical Methods – Properties of Numerical Solutions: Errors, Consistency, Accuracy, Stability, Convergence, Conservation – Review of Governing Equations of Fluid Dynamics – Review of Classification of PDE's.
Lab Components: Introduction to ANSYS Fluent

Unit 2
Introduction to the Finite Difference Methods: Discretization of Temporal and Spatial Derivatives, Explicit and Implicit Formulations – Mccormack's Scheme, Extensions to Viscous Flows – Shock Capturing – Lax-Wendroff Method.
Lab Components: Simulation of incompressible flow over external objects such as flow over cylinder and flow over airfoil

Unit 3
Stability Analysis: Von Neumann Stability Criteria, CFL Criterion for Stability – Introduction to Grid Generation: Body Conforming Grids, Algebraic and Elliptic Grids, 2D Unstructured Grids, C-Grids, O- Grids and H-Grids for Flow Past Airfoils and Wings.
Lab Components: Simulation of compressible flow through nozzle, jet expansion study, and flow over nose cone.

Text Book(s)
John D Anderson, "Computational Fluid Dynamics – The Basics with Application", McGraw-Hill, 2017.

Reference(s)

T. J. Chung, "Computational Fluid Dynamics", Cambridge University Press,2010.

Evaluation Pattern

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

•CA – Term Projects with Reports Submission

23AEE402	FINITE ELEMENT METHODS FOR AEROSPACE	L-T-P-C: 3-0-0-3

Pre-Requisites: 23AEExxx Mechanics of Materials

Course Objectives

Understand the concepts of mathematical modelling of engineering problems by introducing the Finite Element (FE) Methods and to help the students use this method to solve simple aerospace structures and introducing different commercial FE software packages.

Course Outcomes

CO1: Understand the concepts behind the variational methods and weighted residual methods in FEM.

CO2: Illustrate the shape function concepts of 1D, 2D and 3D elements for development of stiffness matrix and load vector.

CO3: Apply numerical methods on one dimensional bar and beam elements for obtaining displacements,

stresses, strains and reaction forces.

CO4: Understand the formulation of 2D and 3D and isoparametric elements.

CO5: Understand the numerical integration schemes and use of FE packages.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction: Historical background, basic concept of the finite element method, Variational methods: calculus of variation, the Rayleigh-Ritz and Galerkin methods; Finite element analysis of 1-D problems: formulation by different approaches (direct, potential energy and Galerkin); Derivation of elemental equations and their assembly, solution and its postprocessing. Analysis of Truss members.

Unit 2

Coordinate systems, convergence criteria, Beam (bending) element: formulations and formation of shape function, Analysis of beams and frame members– 2D elements: Plane stress and Plane strain element formulation, shape function development, simple problems using 2D elements - axi-symmetric elements- iso-parametric formulation of elements.

Unit 3

Introduction to FE formulation of Plate bending and shell elements - Introduction to 3D element formulations - Numerical integration - Solution techniques of the numerical equations- Discussion about preprocessors, postprocessors and finite element packages.

Text Book(s)

Daryl L. Logan, "A First Course in the Finite Element Method", 5th edition, CL, New Delhi,2010.

Reference(s)

C. S. Krishnamoorthy, "Finite Element Analysis" , Tata McGraw-Hill Publishing Company Limited, New Delhi, 1999.

David V. Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017.

Megson, T. H. G., " An introduction to aircraft structural analysis", Butterworth-Heinemann, USA, 2010.

Tirupathi R. Chandrapatla and Ashok D. Belegundu, "Introduction to Finite Element in Engineering", Fourth Edition, Pearson, 2015.

Evaluation Pattern

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

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

23AEE403	SPACE FLIGHT MECHANICS	L-T-P-C: 3-0-0-3

Course Objectives

This course aims to introduce the student to several concepts of orbital mechanics and applications such as ground trace, basic orbital manoeuvres, ballistic missiles and interplanetary trajectories

Course Outcomes

CO1: Understand classical orbital elements, physical principles of orbital motion and various coordinate systems used.
CO2: Orbit element determination from position and velocity vectors. Know effects of perturbations to orbits, know ground trace and basic orbital manoeuvres
CO3: Know Kepler and Gauss problem, Universal variables, ballistic missile trajectories, interplanetary trajectories and basics of satellite attitude dynamics

CO-PO Mapping

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

Syllabus

Unit 1
Elements of Conics – The n-Body Problem and Reduction to Two-Body Problem – Types of Orbits – Conservation of Energy and Angular Momentum in Orbits – Spherical Trigonometry – Geocentric-Equatorial, Heliocentric-Ecliptic, Right

Ascension Declination, Topocentric-Horizon and Perifocal Co-Ordinate Systems and Transformations between them – Classical Orbital Elements.

Unit 2

Orbital Elements Determination from Position and Velocity at a Point – Determining Position and Velocity from Orbital Elements – Orbit Determinations from a Single Radar Observation, Three Position Vectors and Optical Sightings – Ellipsoidal Earth Model: Geodetic and Geocentric Latitudes – Ground Trace of Satellites – Solar and Sidereal Times – Precession of The Equinoxes – Low and High Earth Orbits: Orbital Perturbations due to Oblateness of Earth – Orbital Manoeuvres: General Coplanar Orbit Transfer, Hohmann Transfer, Simple Plane Changes to an Orbit.

Unit 3

Time-Of Flight and Eccentric Anomalies for Elliptic, Parabolic And Hyperbolic Orbits – Kepler's Problem and Solution Algorithm – Gauss Problem: General Methods of Solution –Concept of Universal variables approach- Intercept and Rendezvous with Examples – Ballistic Missile Trajectories: Effect of Earth Rotation – Interplanetary Trajectories: Spheres of Influence and the Patched Conic Approximation, Synodic Periods – Satellite Attitude Dynamics: Torque Free Motion, Stability of Torque Free Motion, Spin Stabilization, Gyroscopic Attitude Control, Gravity Gradient Attitude Control.

Text Book(s)

Roger R Bate, Donald D Mueller, Jerry E White and William W Saylor, "Fundamentals of Astrodynamics," 2nd edition, Dover, 2015.

Marshall H Kaplan, "Modern Spacecraft Dynamics and Control," Wiley, 1976.

Reference(s)

Howard Curtis, "Orbital Mechanics for Engineers and Scientists," 3rd edition, Elsevier, 2010.

Marcel J. Sidi, "Spacecraft Dynamics and Control: A Practical Engineering Approach," Cambridge University Press, 1997.

Evaluation Pattern

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

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

23AEE481	UAV and FLIGHT-TESTING LAB	L-T-P- C: 1-0-3-2

Course Objectives

- Performance evaluation of real-time unmanned aerial vehicle
- Performance evaluation of various aircraft using the flight simulator setup

Course Outcome

CO1: Understand the given experiment along with the underlying theory.
CO2: Flight test the given vehicle in the flight simulator.
CO3: Flight test of real-time unmanned aerial vehicle,
CO4: Draw inferences from both the real-time Flight & simulations and report the findings.

CO-PO Mapping

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

Syllabus

- Real-time Flight Testing using a UAV/Drone (multicopter):
    - Tuning of flight controller for multirotor operations.
    - Hover manoeuvre in presence of gust.
    - Altitude/position hold.
- Flight testing using a simulator, to determine the following:
    - Glide performance
    - Climb rate
    - Range and endurance
    - Turn rate
    - Introduction to dynamic stability concepts: short period and phugoid mode

** Students may build and fly their own model and demonstrate various manoeuvres as part of open Lab

Evaluation Pattern

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

•CA – Project Oriented Lab

23AEE498	**PROJECT PHASE I**	**L-T-P-C: 0-0-6-2**

Course Objectives

To introduce a group task to work on theoretical, computational or experimental projects and ask students to finish the projects in time and present their results both orally and as written reports.

Course Outcomes

CO1: Ability to identify a problem, formulate a methodology, analyse, investigate the results, using acquired theoretical knowledge.
CO2: Work as an effective team member.
CO3: Manage the cost and time of the project.
CO4: Ethically communicate the results both orally and as written reports.
CO5: Assess the societal and environment effects of the project.

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

Syllabus

Various project titles based on areas covered up to 7th semester are allotted to batches of 3 to 4 students. Preliminary studies and investigations on the allotted topic.

Evaluation Pattern

Assessment	Internal	End Semester
Internal	60	
External		40

23AEE497	INDUSTRY INTERNSHIP	P/F

Course Objectives

- To expose the students to industry setting and get acquainted with its various functions.
- To gain direct experience so as to relate and reinforce the concepts learned in the class room
- To promote collaboration between industry/Research Laboratory and the institution

Course Outcomes

CO1: Familiarize with the industry environment/Research Laboratory
CO2: Understand the application of theoretical concepts in a practical setting.
CO3: Prepare technical documents/presentations related to the work completed.

CO-PO Mapping

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

Syllabus

Students have to undergo minimum of one week of practical training in Aerospace or allied industries/research laboratory of their choice with the approval of the department. At the end of the training student should submit a report and certificate of completion to the department in the prescribed format.

Evaluation Pattern

This course is mandatory and a student has to pass this course to be eligible for the award of degree. The student shall make a report. The committee constituted by the department which will assess the student based on the report submitted.

23AEE499	PROJECT PHASE II	L-T-P-C: 0-0-30-10

Course Objectives

To introduce a group task to work on theoretical, computational or experimental projects and ask students to finish the projects in time and present their results both orally and as written reports

Course Outcomes

CO1: Ability to identify a problem, formulate a methodology, analyse, investigate the results, using acquired theoretical knowledge.
CO2: Work as an effective team member.
CO3: Manage the cost and time of the project.
CO4: Ethically communicate the results both orally and as written reports.
CO5: Assess the societal and environment effects of the project.

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

Syllabus

To achieve objectives and to carry out detailed investigation towards the outcome of each allotted project.

Evaluation Pattern

Assessment	Internal	End Semester
Internal	60	
External		40

PROFESSIONAL ELECTIVES

23AEE331	EXPERIMENTAL AERODYNAMICS	L-T-P-C: 3-0-0-3

Pre Requisite(s): 23AEExxx - COMPRESSIBLE FLUID FLOW

Course Objectives

In order to get a flavor and hands on experience in measurement techniques and data analysis pertinent to fluid mechanics.

Course Outcome

CO1: Understand and appreciate the fundamentals of measurements and turbulence in experimental aerodynamics.
CO2: Know the various flow visualization techniques and their applications for different scenarios.
CO3: Understand various velocimetry techniques and instrumentation.

CO-PO Mapping

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

Syllabus

Unit 1
Examples of Fluid Mechanics Measurements: Wind-Tunnel Studies, Turbulent Mixing Layer, Spatial and Temporal Resolution in Measurements, Classification of Deterministic Data, Random Data, Signal Analysis and Uncertainty Analysis.

Unit 2
Qualitative Characterization: Flow Visualization in Liquid and Gaseous Medium, Colored Filament, Smoke, Vapor and Tufts Visualization, Image Processing Techniques, Identifying Structures - Optical Systems for Flow Measurement: Shadowgraph, Schlieren and Interferometric Techniques

Unit 3
Quantitative Characterization: Drag Measurements, Static Probes, Pressure Sensitive Paints (PSP), Velocity Measurements, Pitot-Static Probe, Thermocouple, Thermal Anemometers (Hot Wire and Film Sensors), Laser Velocimetry (LDA), Particle Image Velocimetry (PIV).

Text Book(s)
Cameron Tropea, Alexander L Yarin, John F Foss, "Springer Handbook of Experimental Fluid Mechanics," Springer, 2007.

Reference(s)
Richard J Goldstein, "Fluid Mechanics Measurements," 2nd edition, Taylor & Francis, 1996.
Wolfgang Merzkirch, "Flow Visualization," Academic Press, 1974.

Evaluation Pattern

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

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

23AEE332	STRUCTURAL DYNAMICS	L-T-P-C: 3-0-0-3	Pre

Requisite(s): 23AEExxx AIRCRAFT STRUCTURES 1

Course Objectives

To make students to understand and appreciate the importance of vibrations in mechanical design of dynamically active parts that operate in vibratory conditions by deriving equations of motion and solution methods for free and forced vibratory systems.

Course Outcomes

CO1: Know how to obtain response to Initial conditions or forced excitations.
CO2: Obtain equations of motion for MDOF systems and obtain normal modes.
CO3: Calculate the response of MDOF systems for any excitations.
CO4: Derive equation of motion for continuous (1D) systems like beam, bar and shaft.
CO5: Estimate natural frequencies and mode shapes of the continuous system.

CO-PO Mapping

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

Syllabus

Unit 1
Recap of SDOF**,** response to simple harmonic motion, Response to non-periodic motions, impulse response, step response, convolution and Du Hamel integrals, Numerical methods: Runge-Kutta method, Normal mode analysis, response to initial conditions.

Unit 2
Modelling of multi-degree freedom system, stiffness and flexibility influence coefficients, beat phenomenon, response to simple harmonic motion, damped vibration, static and dynamic coupling, principal coordinate, decoupling, Rayleigh's proportionality damping, vibration absorber. response to periodic and non-periodic motions, modal analysis (mode – synthesis method).

Unit 3
Vibration of continuous: Free vibration of string, bar, shaft and beam. Free vibration analysis of basic structural members with different boundary conditions, analytical and approximate solutions, response of basic structural members to periodic and non-periodic forces, mode synthesis, approximate solutions. Application of Continuous vibration in Aerospace problems.

Text Book(s)

W. T. Thomson, "Theory of vibrations with applications,", 5th Edition, Pearson, 2008.

Reference(s)

Leonard Meirovitch, "Elements of vibration Analysis," Tata McGraw Hill, 1986.
Leonard Meirovitch, "Fundamentals of vibration," McGraw Hill, 2001.
S. S. Rao, "Mechanical vibrations," Pearson, 2010.

Evaluation Pattern

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

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

23AEE333	FUNDAMENTALS OF HEAT TRANSFER	L-T-P-C: 3-0-0-3

Pre Requisite(s): 19AEExxx- MECHANICS OF FLUIDS

Course Objectives

The objective of this course is to provide the students with a basic understanding of phenomena of heat transfer: Conduction, convection and radiation, and the methods to solve engineering problems that involve heat transfer.

Course Outcomes

CO1: Obtain temperature distribution and heat transfer through solid slabs, extended surfaces, cylinders as well as spheres during steady state heat transfer.

CO2: Develop solutions involving semi-infinite and infinite solids during unsteady heat transfer.

CO3: Develop theoretical basis and empirical correlations for the analysis of forced and free convection problems.

CO4: Understand the properties of radiation, physical mechanism, shape factors and radiation shields and applythe concepts to basic problems in radiative heat transfer.

CO5: Understanding heat transfer in high-speed flows, cooling of thrust chambers and re-entry vehicles.

CO-PO Mapping

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

CO2	3	3	2	1	1								3	1	2
CO3	3	3	2	1	1								3	1	2
CO4	3	3	2	1	1								3	1	2
CO5	3	3	2	1	1								3	1	2

Syllabus

Unit 1

Fundamentals of Conduction: Fourier Law of heat conduction, General heat conduction equation, Thermal diffusivity and significance, thermal conductivity of solids, liquids and gases, Concept of thermal resistance, Steady State heat transfer calculations and determination of temperature distribution in Composite plates, cylinders and spheres, Critical Thickness and its significance, Effect of Variation of Thermal Conductivity in Solids, Heat transfer through extended surfaces, fin performance parameters, Unsteady State Heat Conduction: Biot number and its significance, Lumped System Analysis, Heat Transfer in Semi-infinite and Infinite Solids.

Unit 2

Fundamentals of Convection: Physical mechanism of forced and free convection, Newton's law of cooling, Determination of heat transfer coefficient, Thermal and hydrodynamic boundary layer, Laminar and turbulent flow, development of correlation for Nusselt numbers, Reynolds Analogy - Free Convection involving plates – vertical and horizontal, Grashoff number and Rayleigh number.

Unit 3

Radiative Heat Transfer: Introduction to Physical Mechanism, Radiation Properties, Radiation Shape Factors, Heat Exchange between Non-Black Bodies, Radiation Shields. Introduction to cooling of rocket nozzles, Rocket Thrust Chambers and rocket motors.

Text book(s)

Incorpera F.P., and Dewit D.P., ``Fundamentals of Heat and Mass Transfer",6th Edition, John Wiley & Sons, NewYork 2019.

Reference books

Yunus A Cengel., ``Heat and Mass Transfer: Fundamentals & Applications", 4th Edition, Tata McGraw-Hill, 2022.
Holman J. P, ``Heat Transfer"., 4th Edition, Tata McGraw-Hill, 2011.

Evaluation Pattern

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

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

23AEE334	ADVANCED AVIONICS	L-T-P-C: 3-0-0-3

Pre Requisite(s): 23AEExxx – AVIONICS

Course Objectives

To introduce students to advanced avionics systems used in both aircrafts and UAVs.

Course Outcomes

CO1: Basic understanding of electronic communication system.
CO2: Explain digital communication blocks and its application in telemetry.
CO3: Understand the operating principles of electronic navigation aids.
CO4: Understand working principles of Autopilots and Flight management systems.
CO5: Explain data bus used in aircraft and its utility in realising modular avionics.
CO6: Understand the working principle of fly by wire flight control system

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	-	-	-	1	-	-	1	3	1	2
CO2	3	1	1	1	-	-	-	-	1	-	-	1	3	1	2
CO3	2	1	1	1	-	-	-	-	1	-	-	1	3	1	2
CO4	3	1	1	1	-	-	-	-	1	-	-	1	3	1	2
CO5	2	1	1	1	-	-	-	-	1	-	-	1	3	1	2
CO6	3	1	1	1	-	-	-	-	1	-	-	1	3	1	2

Syllabus

Unit 1

Electromagnetic wave propagation and its relevance to aviation – Electronic communication systems: Functional Description of basic building blocks: Antenna, Amplifier, Filter, Modulator and Demodulator – Introduction to Digital communication and telemetry.

Unit 2

System level description of Radio Navigation Aids: Instrument Landing System, Very High Frequency Omni Range, Automatic Direction Finder, Distance Measuring Equipment, GPS, Radar, Traffic Alert and Collision Avoidance.

Unit 3

Autopilots and Flight Management System: Autopilots, Flight Management Systems – Avionic system integration: Background, Data bus systems, Integrated modular avionics, UAV Avionics. Fly by wire flight Control System.

Text Book(s)

R.P.G Collinson, "Introduction to Avionics", Springer, 2002.

Frenzel Louis, "Principles of Electronic Communication Systems", 4th Edition, McGraw-Hill, 2015.

Reference(s)

Kayton and Fried, "Avionics Navigation Systems", 2nd edition, Wiley, 1997.

Dale R. Cundy, Rick S. Brown, "Introduction to Avionics", Prentice Hall, 1997.

Evaluation Pattern

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

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

23AEE341	TURBULENT FLOWS	L-T-P-C: 3-0-0-3

Pre Requisite(s): 23AEExxx MECHANICS OF FLUIDS

Course Objectives

The purpose of this subject is to familiarize instability analysis and its application in the theoretical characterization of laminar-turbulent transition. In addition, it will also help students to appreciate and understand the relevance of credible hypothesis crucial for turbulence models. Thereby, students will acquire and be capable to utilize this fundamental understanding for many practically relevant turbulent flows.

Course Outcomes

CO1: Develop theoretical characterization for laminar-turbulent flow transition.
CO2: Examine the nature of turbulence based on classical theory and empirical results.
CO3: Comprehend closure problem pertinent to turbulence and make use of turbulence models to study the nature of turbulence.
CO4: Apply standard hypothesis to quantify eddy structures and implement the basic concepts to refine existing turbulence models.
CO5: Distinguish the delicate aspects of turbulent boundary layer flows from free turbulent flows.

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

Syllabus

Unit 1

Onset of Turbulence: Laminar Flow, Transition, Turbulent Flow – Laminar-Turbulent Transition: Taylor's Rotating Cylinder Experiment, Benard's Natural Convection Experiment, Reynolds Experiment, Reynolds Number Concept Based on Volume Flux and Pressure Gradient – Stability Theory of Laminar Flows: Method of Small Disturbances, Orr-Sommerfeld Equation, Modes of Stability, Curve of Neutral Stability, Indifference Reynolds Number, Absolute and Convective Instabilities.

Unit 2

Inviscid Instability: Rayleigh Equation, Point of Inflection Criteria, Critical Layer – Fundamentals of Turbulent Flow: Mean Motion, Fluctuations, Quasi-steady Approach, Apparent Viscosity, Reynolds Stresses (Momentum Theorem & Navier-Stokes Equations), Classical Empirical Results on Turbulence, Wind-tunnel Turbulence.

Unit 3

Semi-empirical Hypothesis: Eddy Viscosity, Prandtl Mixing Length – Isotropic Turbulence: Kolmogorov Hypothesis, Kolmogorov Length and Time Scales - Free Turbulent Flows: Jet Boundary, Free Jet, Wake.

Text Book(s)

Herrmann Schlichting, Klaus Gersten, "Boundary Layer Theory," 8th edition, Springer-Verlag, 2000.

Reference(s)

Pijush K. Kundu, Ira M. Cohen, David R. Dowling, "Fluid Mechanics," 5th edition, Academic Press, 2012.
Davidson, P.A., "Turbulence: An Introduction for Scientists and Engineers," Oxford University Press, 2004.

Evaluation Pattern

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

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

23AEE342	**COMPOSITE MATERIALS AND MECHANICS**	**L-T-P-C: 3-0-0-3**

Course Objectives

Provide students with a basic understanding of different fibers, matrices and uses of composite materials, their structural and mechanical properties and the capability to perform basic analysis of the mechanical response of composite materials.

Course Outcomes

CO1: Understand the general classification of composite materials.
CO2: Introduce different types of composite material systems.
CO3: Understand different manufacturing techniques used to develop the composites.
CO4: Know the various testing procedures used to predict the strength of composite materials.
CO5: Apply the laminated theory for designing of composite laminates and its failures.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction to Composites: Concept of Composite materials, Classification of Composites, Various types of composites, Classification based on Matrix Material: Organic Matrix Composites (Polymer matrix composites (PMC)/Carbon Matrix Composites or Carbon-Carbon Composites, Advantages of Composites materials. Reinforcements and Matrices for various types of composites Fibers/Reinforcement Materials, Role and Selection of reinforcement materials, Types of fibers, Mechanical properties of fibers,

Unit 2

Functions of Matrix, Desired Properties of Thermosets and Thermoplastics, Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc. Laminated composites, Lamina and Laminate Lay-up, Ply-orientation definition, Manufacturing processes. Testing of Composites: Mechanical testing of composites, Tensile testing, Compressive testing. Functions of honeycomb structures and hybrid composite.

Unit 3

Determination of longitudinal and transverse strengths of lamina, mechanics of short fiber composites, stress-strain relationships of anisotropic lamina with arbitrary orientations, analysis of laminated composites, types of laminates, stress-strain variation in laminates using classical lamination theory, thermal stresses in laminates, different types of failure criteria, introduction to inter-laminar stresses in composites.

Text Book(s)

Jones R. M., " Mechanics of Composite Materials", 2nd edition, Hemisphere Publishing Corporation, New York, 1998.

Reference(s)

Agarwal B. D. and Broutmen L. J. "Analysis and performance of Fiber Composites", John Wiley and Sons, New York 1990.
***Chawla,** Krishan K (2012), Composite Materials, Science and Engineering, ISBN: 978-0-387-74365, Springer.*
Sam Zhang, Dongliang Zhao (2013), Aerospace Materials Handbook, ISBN: 978-1-4398-7329-8, Taylor and Francis.
*Leonard Hollaway (1994), Handbook of Polymer Composite for Engineers**, ISBN: 1-85573-1290,** Woodhead Publishing Ltd.*

Evaluation Pattern

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

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

23AEE343	AIR BREATHING ENGINES	L-T-P-C: 3-0-0-3

Pre-Requisite(s): 23AEExxx AEROSPACE PROPULSION

Course Objectives

Introduce the design parameters and momentum analysis of turbo machines. Enable the students to do velocity triangle analysis. Introduce the details of design of combustors, intakes and nozzles of air breathing engines.

Course Outcomes

CO1: Review concepts of Propulsion engine cycle.
CO2: Study momentum transfer through turbo machines.
CO3: Analyze design and performance of axial flow turbo machines.
CO4: Analyze flow through centrifugal compressors.
CO5: Learn parameters that govern combustor design.
CO6: Analyze flows through intakes and nozzles.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	1	3	2	2
CO2	3	3	2	-	-	-	-	-	-	-	-	1	3	2	2
CO3	3	3	3	-	-	-	-	-	-	-	-	1	3	2	2
CO4	3	3	2	3	-	-	-	-	-	-	-	2	3	2	2
CO5	3	3	2	3	-	-	2	-	-	-	-	2	3	2	2
CO6	3	3	-	3	-	-	-	-	-	-	-	2	3	2	1

Syllabus

Unit 1
Review of Cycle Analysis of Air-Breathing Engines – Application of Euler's Turbo Machinery Equation to Axial and Centrifugal Machines: Velocity Diagrams, Stage Parameters, Three Dimensional Flows In Turbo-Machinery – Components of Axial and Centrifugal Turbines – Performance Maps – Compressor Turbine Matching -Compressor Surge.

Unit 2
Thermal Limits of Blades and Vanes – Blade Cooling, Film Cooling and Regenerative Cooling –Subsonic, Supersonic and Hypersonic Inlets – Inlet Sizing – Inlet Performance – The Combustion Process: Stability, Length, Scaling.

Unit 3
Types of Combustors – Combustor Performance– Flame Stabilization – Fuels and Emissions; Alternate fuels- Nozzles, Thrust Vectoring – Nozzle Performance. Ramjets: Design Considerations.

Text Book(s)
Flack.R.L, "Fundamentals of Jet Propulsion with Applications," Cambridge University Press, 2005.

Reference(s)
Hill and Peterson, "Mechanics and Thermodynamics of Propulsion," Dorling Kindersely (India), 2010.
Mattingly. Jack.D, "Elements of Propulsion: Gas Turbines and Rockets," AIAA Education Series, 2006.

Evaluation Pattern

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

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

23AEE344	AIRCRAFT SYSTEMS	L-T-P-C: 3-0-0-3

Pre-Requisites: 23AEExxx INTRODUCTION TO AEROSPACE ENGINEERING AND TECHNOLOGY

Course Objectives

To provide the knowledge about the different aircraft auxiliary systems required for the operation of aircraft main systems.

Course Outcomes

CO1: Describe different systems of an aircraft and also explain advantages and disadvantages with different systems.
CO2: Apply the knowledge about system functions and characteristics for different cases of problem solutions according to a project design.
CO3: Understand the operation of airplane control system, such as Engine system, Air conditioning and pressurization system.
CO4: Understand the operating methods involved in the fuel control and injection system.

CO-PO Mapping

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

Syllabus

Unit 1

Types of aircraft system-airframe, vehicle, avionics, mission and their subsystems. Specifications of requirements (mission and performance requirements). Operating environmental conditions. Need for integration.
Function, merits and system loads. Principle components, pumps, reservoir and accumulator. Flight control actuation, need for redundancy. Hydraulic fluid properties' requirements. Application of Hydraulic systems in Landing gear and brake management system.

Unit 2
Engine as a high-pressure air source. Engine starting system. Pitot-static system. Principal heat sources in aircraft. Method of cooling-ram air, fuel cooling. Cooling system-air cycle refrigeration-types-turbo fan, bootstrap, reverse bootstrap systems. Cabin pressurization. g-tolerance and protection. Molecular-Sieve oxygen concentrator.

Unit 3
Principle of operation of aircraft gas turbine engine. Engine-airframe interface. Control of fuel flow, air flow, exhaust gas flow- need, means, system parameters, basic input and outputs. Limited authority and full authority engine control systems. Engine monitoring sensors and indicators. Power offtakes-need, types and effect on engine performance. Fuel system-components, fuel tank safety-fuel injection system.

Text Book(s)
David A Lambro, Aircraft systems by Tata Mc Graw Hill. 2009

Pallet, E.H.J, "Aircraft Instruments & Principles", Pitman & Co 1993.

Moir, I. and Seabridge, A., Aircraft Systems: mechanical, Electrical and Avionics sub -systemsIntegration,3rd edition, John Wiley 2008

Reference(s)
Moir, I. and Seabridge, A., Design and development of aircraft systems-an introduction, AIAA education series, AIAA,2004.

Treager, S., "Gas Turbine Technology", McGraw Hill 1997.

Mekinley, J.L. and R.D. Bent, "Aircraft Power Plants", McGraw Hill 1993.

Evaluation Pattern

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

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

23AEE351	ADVANCED COMPOSITE STRUCTURES	L-T-P-C: 3-0-0-3

Pre Requisite(s): 23AEExxx COMPOSITE MATERIALS AND MECHANICS

Course Objectives
Provide students with a basic knowledge on High performance polymeric composite and effect of space environments on polymeric composites. Durability of thermosetting and thermoplastic polymers, repair of composite and simulation and Testing of composite. Application of hybrid composite for ballistic and IED blast resistance.

Course Outcomes

CO1: Demonstrate understanding of fundamentals in materials, manufacturing, mechanics, design, and repair of polymeric matrix composites.
CO2: Identify advantages and disadvantages of polymeric matrix composites with respect to metals.

CO3: Apply the knowledge acquired to the design and manufacturing of high-performance composite Structures.
CO4: Apply the knowledge of hybrid composites.

CO-PO Mapping

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

Syllabus

Unit 1
Concept of aviation and space environments. Ionizing and non-ionizing radiation at Low Earth Orbit (LEO) and Geo Synchronous Earth Orbit (GEO). Charged plasma and atomic oxygen in space. Different thermosetting and thermoplastic polymers and their applications as structural and semi structural components for aviation and spacecraft.

Unit 2
Durability of thermosetting and thermoplastic polymers under aviation and space environments. Scope of high-performance polymers. Scope of high performance and ultra high-performance polymers. Defects of composites under mechanical fatigue, thermal fatigue, humidity, lightning strike, ultra violet radiation, ultra-high vacuum and high energy radiations.

Unit 3
Hybrid composite for ballistic, IED explosive and fireproof application. Simulation of test facilities in laboratory. State of the art technologies to repair composite defects. Importance of nano composite and nano adhesive bonding. Importance of fire-resistant polymeric composites and electrically conductive composites.

Text Book(s)
Omari V. Mukbaniani, Marc J. M. Abadie, Tamara Tatrishvili (2015), High-Performance Polymers for Engineering-Based Composites, ISBN 9781771881197 - CAT# N11265, CRC Press.

Reference(s)
Yu Bai, Thomas Keller (2014), High Temperature Performance of Polymer Composites, ISBN: 978-3-527-32793-5, Wiley-VCH.
Eric Baer (1991), High Performance Polymers: Structures, Properties, Composites, Fibers, ISBN-13: *978-1569900024, Amazon Prime*

Evaluation Pattern

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

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

Pre-Requisite(s): 23AEExxx COMPRESSIBLE FLUID FLOW

Course Objectives

- To build up necessary background for understanding the Rocket and Spacecraft Propulsion systems.
- To learn the propulsion system performance parameters and its influence on the various atmospheric conditions.
- To understand the various properties of the rocket propellants and its selection pertaining to the needs of propulsive system performance.

Course Outcomes

CO1: Understand the operating principle of the rocket and spacecraft propulsion systems.
CO2: Develop the expressions for the performance parameters such as thrust, specific impulse, thrust coefficient, characteristic velocity, etc.,
CO3: Interpret the influence of atmospheric conditions on the performance parameters of the rocket and spacecraft propulsion systems.
CO4: Distinguish solid rocket motor, liquid propellant rocket, and hybrid rocket motor in terms of general characteristics, propellant properties with its relative advantages and disadvantages.
CO5: Demonstrate the working principle with relative advantages and disadvantages of advanced propulsion systems such as electric propulsion and nuclear propulsion.

CO-PO Mapping

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

Syllabus

Unit 1
Principle of Rocket Propulsion – Rocket Equation – Application of rocket equation to the optimization of rocket trajectory - Development of Thrust – Nozzle Design – Effect of Atmosphere – Thermodynamic Thrust Equation – Characteristic Velocity – Performance Parameters.

Unit 2
Liquid Propellant Rocket Engine – Cryogenic and Semi-cryogenic Engines – Basic Configuration – Types of Propellants – Propellant Feed Systems – Combustion of Liquid Propellants – Injectors and Thrust Chambers – Combustion Instability – Solid Propellant Fundamentals – Types of Solid Propellants – Propellant Processing and Manufacture – Grain Configuration – Igniter Hardware – Combustion of Solid Propellants – Hybrid Rocket Engines – Classification of missiles – Components of missiles – Drag estimation – Introduction to guidance of missiles – Rocket dispersion.

Unit 3
Electric Propulsion: Electrothermal and Electromagnetic Thrusters, Applications of Electric Propulsion, Electric Power Generation – Nuclear Propulsion – Operational Issues – Practical Approaches for Single Stage to Orbit Vehicles.

Text Book(s)
Truner.Martin, "Rocket and Spacecraft Propulsion," 3rd edition, Springer, 2009.
Sutton.G.P, Biblarz.O, "Elements of rocket propulsion," 9th edition, John Wiley & Sons Inc, 2017.

Reference(s)
Alessandro de Iaco Veris. "Fundamental Concepts of Liquid-Propellant Rocket Engines", 1st edition, Springer, 2020.

K Ramamurthi, “Rocket Propulsion”, 2nd edition, Laxmi Publications Pvt. Ltd, 2020
Chin, S. S., “Missile Configuration Design”, 1st edition, McGraw-Hill, 1961

Evaluation Pattern

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

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

23AEE353	**SATELLITE ENGINEERING**	**L-T-P-C: 3-0-0-3**

Course Objectives
This subject deals with basic concepts pertinent to satellites. The objective of this course is to introduce students about the satellite, its functionalities, and operations.

Course Outcomes
CO1: Understand the basic principles of satellite
CO2: Understand about the satellite launch and In-orbit operations
CO3: Understand about the satellite hardware, communication techniques and satellite application

CO-PO Mapping

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

Syllabus

Unit 1
Introduction: satellite and its functionalities, History, evolution and future trends, Satellite orbits and Trajectories: orbiting satellites –basic principles, orbital parameter, and types of satellite orbits.

Unit 2
Satellite launch and In-orbit operations: Desired orbit, launch sequence, launch vehicles, space centres, orbital perturbations, satellite stabilization, orbital effects on satellite performance, look angles of satellite, earth coverage and ground tracks.

Unit 3
Satellite hardware: mechanical structure, propulsion subsystem, thermal, power, and attitude & orbit control. Payload. Communication techniques: types of information signals, amplitude modulation, frequency modulation, digital modulation techniques. Satellite link design fundamentals. Satellite application : communication, remote sensing, and weather forecasting satellites.

Text Book(s)
Maini, Anil K., and Varsha Agrawal. *Satellite Technology: principles and applications*. John Wiley & Sons, 2011.

Reference(s)
Inglis, Andrew F., and Arch Luther. *Satellite Technology: An introduction*. Routledge, 1997.

Pelton, Joseph N., Scott Madry, and Sergio Camacho-Lara, eds. *Handbook of satellite applications.* New York: Springer, 2017.

Evaluation Pattern

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

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

23AEE354	COMPUTATIONAL METHODS FOR ENGINEERS	L-T-P-C: 3-0-0-3

Course Objectives

The objective of the course is to introduce students to the numerical techniques commonly used in solving engineering problems.

Course Outcomes

CO1: Given an engineering problem, understand the mathematical model required to describe the problem.
CO2: Comprehend the physics represented by the mathematical model to select an appropriate method/algorithm.
CO3: Apply the numerical solution method via a well-designed computer program.
CO4: Analyse the numerical solutions that were obtained in regard to their accuracy and suitability for applications.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction to Numerical Techniques: Numerical Methods – Round off and truncation errors – Approximations – Order of Convergence – Numerical interpolation. Solution techniques of a linear system of equations: Gauss elimination – Gauss-Jordan method– LU Decomposition – Iterative methods for linear systems.

Unit 2

Taylor series expansion of multivariate functions, conditions for maxima, minima and saddle points, Concept of gradient and hessian matrices, Multivariate regression and regularized regression.

Unit 3

Theory of convex and non-convex optimization, Newton method for unconstrained optimization. Computational methods for ODEs: Newton-Raphson method, Eigen values – Single step methods – multi-step methods. Stability, consistency, accuracy and efficacy of these methods.

Text Book(s)

S. C. Chapra, and R. P. Canale. Numerical methods for engineers. Boston: McGraw-Hill Higher Education, 2010.
Gilbert Strang, Linear Algebra and Learning from Data, Wellesley, Cambridge press, 2019.
William Flannery, "Mathematical Modeling and Computational Calculus", Vol-1, Berkeley Science Books, 2013.
Stephen Boyd and Lieven Vandenberghe, "Convex Optimization ", Cambridge University Press, 2018.

Reference(s)

S. P. Venkateshan, and P. Swaminathan. Computational methods in engineering. Elsevier, 2013.
R.H. Landau, M.J.Paez and C.C.Bordeianu, Computational Physics -Problem Solving with Computers, Wiley-VCH, 2001.
Stephen Boyd and Lieven Vandenberghe, "Introduction to Applied Linear Algebra – Vectors, Matrices, and Least Squares", Cambridge University Press, 2018.

Evaluation Pattern

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

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

23AEE431	HELICOPTER THEORY	L-T-P-C: 3-0-0-3

Course Objectives

To make students to understand the fundamentals of helicopter (momentum and blade element) theory and apply these theories to hover and forward flight conditions.

Course Outcomes

CO1: Estimate the performance of a helicopter using momentum theory.
CO2: Understand the blade element theory for hover and vertical flight.
CO3: Understand the blade element momentum theory for forward flight.
CO4: Analyse the blade response and trim condition of a helicopter rotor system.

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

Syllabus

Unit 1
Historical development, configurations of helicopters, rotor system, flight control and mechanism, hovering theory, momentum theory for hover and vertical flight, blade element theory for hover and vertical flight, combined blade element momentum (BEM) theory.

Unit 2
Momentum theory for forward flight, various non-uniform inflow models, blade element theory for forward flight, non-dimensional hub forces and moments, estimation of power for forward flight.

Unit 3
Idealization of rotor blades, flap-lag and torsional dynamics of the blade, rotor blade flapping motion: A simple model, helicopter trim analysis.

Text Book(s)
C. Venkatesan, "Fundamentals of helicopter dynamics," CRC Press, 2015

Reference(s)
W. Johnson, "Helicopter theory", Princeton University, 1980.
R. S. Bramwell, "Helicopter dynamics", Edward Arnold Publications, 1976

Evaluation Pattern

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

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

23AEE432	ENGINEERING FRACTURE MECHANICS	L-T-P-C: 3-0-0-3

Pre Requisite(s): 23AEExxx MECHANICS OF MATERIALS & 23AEExxx AEROSPACE STRUCTURES-I

Course Objectives

Introduce the physical and mathematical principles of linear and nonlinear fracture mechanics and their applications in wide range of engineering design using energy release rate and stress intensity approaches.

Course Outcomes

CO1: Illustrate the types of fractures with characteristic features and different growth mechanisms.
CO2: Understanding the principles of energy release rate and determining the energy release rate on different failure modes.
CO3: Determination of stress intensity factor (SIF) for plane, surface and embedded cracks under various types of loads.
CO4: Study of J-Integral approach to determine fracture energy and introduction to CTOD method.
CO5: Identifying the various testing procedures to determine fracture toughness.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction to Linear and Elasto-plastic fracture mechanics (FM), historical development of FM, modes of fracture, crack growth mechanisms, brittle and ductile fracture behaviour. study on energy release rate (G), derivation of ‘G’ on Double cantilever beam, Energy release rate derivation on different modes of failure, Necessary and sufficient conditions of FM and stable and unstable fracture mechanisms.

Unit 2

Introduction to stress to intensity factor, K, (SIF)– Cauchy- Riemann conditions, Westergaard's stress function, stress intensity factors derivations for different failure modes. Determination of crack-tip stresses and displacement field, principal of superposition – study on K and G relation. SIF of surface and embedded cracks.

Unit 3

Determination of Crack Opening Displacement (CTOD/COD). Energy release rate by J-integral approach, Evaluation of failure energy by numerical approach. Study on different fracture toughness tests: plane strain test, Compact tension test, three-point bending test, C-specimen test, Chevron notch test.

Text Book(s)

Anderson, T.L., "Fracture Mechanics", Fourth Edition, CRC Press, 2017.

Reference(s)

Ramesh, K., "e-book on Engineering Fracture Mechanics", IIT-Madras, 2007.
Prashant Kumar, "Elements of Fracture Mechanics" Tata McGraw-Hill Education, 2009.

Evaluation Pattern

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

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

23AEE433	**HYPERSONIC FLOW THEORY**	**L-T-P-C: 3-0-0-3**

Pre-Requisite: 23AEExxx Compressible Fluid Flow

Course Objectives

· Appreciate the difference and commonalities between supersonic and hypersonic flows.
· Understand the basic physics of hypersonic flow and their applications in space shuttles, atmospheric re-entry, scramjet engines and other practical situations.
· Understand and apply approximate and exact methods in hypersonic flow theory.

Course Outcomes

CO1: Identify the critical flow physics phenomenon associated with hypersonic flows.
CO2: Use simplified methods to analytically model hypersonic flows - for the estimation of pressure distribution of simple shapes.
CO3: Analyze the influence of viscous effects in hypersonic flows.
CO4: Formulate and solve the problems involving inviscid hypersonic flow over blunt bodies.

CO-PO Mapping

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

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

Syllabus

Unit 1
Introduction – Basic Considerations and Definitions – Videos of Atmospheric Re-Entry – Thin Shock Layer – Entropy Layer – Viscous Interaction – Low Density Flows – High Temperature Effects – Visual Presentation of Damages Due to High Temperature Effects – Hypersonic Flight Paths.

Unit 2
Inviscid Hypersonic Flow Theory: Shock Expansion Method, Surface Inclination Methods – Small Disturbance Equations and Approximate Methods – Similarity Laws. Application of CFD tools for modelling inviscid hypersonic flows.

Unit 3
Exact Methods – Method of Characteristics Review – Unit Processes for Method of Characteristics: Planar, Axisymmetric and 3-D Flows – Blunt Body Problem and Shock Interaction Types -Introduction to Viscous Hypersonic Flows – Modelling viscous hypersonic flow using CFD, with heat transfer analysis.

Text Book(s)
John D. Anderson, "Hypersonic and High Temperature Gas Dynamics," McGraw Hill, 2002.

Reference(s)
Wallace D. Hayes and Ronald F. Probstein, "Hypersonic Flow Theory," 2nd edition, Academic Press, 1959.

Evaluation Pattern

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

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

23AEE434	MANUFACTURING ENGINEERING	L-T-P-C: 3-0-0-3

Pre-Requisites: 23AEExxx MATERIALS FOR AVIATION AND SPACE

Course Objectives

The objective of this course is to provide the students with the basic concepts of Conventional/ unconventional manufacturing process involved in the production of aerospace components.

Course Outcomes

CO1: Acquire knowledge of manufacturing processes and the skills to develop and manipulate the operating parameters for a given process to avoid defect and improve quality.
CO2: Understand basic parts and assemblies manufactured using powered and non-powered machine shop equipment in conjunction with mechanical documentation.
CO3: Learn about the enhancement in the physical and thermal properties of metals and its alloys by heat treatment processes.
CO4: Understand the principles and operating procedure involved with Non-Destructive Techniques

CO-PO Mapping

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

Syllabus

Unit 1
Reviews of Stress-Strain Behaviour associated with aerospace materials. Brief knowledge in Casting & Welding, Conventional Machining & Forming of metals, alloys and composites, sheet metal operations, bonding of metals, alloys, and composites. Unconventional machining methods involved in aerospace materials.

Unit 2
Heat treatment of Aluminium alloys, titanium alloys, & steels - case hardening, initial stresses and the stress alleviation procedures. Corrosion prevention and protective treatment for aluminium alloys and steels - anodizing of titanium alloys, organic coating, and thermal spray coatings.

Unit 3
Jigs, fixtures, stages of assembly, types and equipment for riveted joints, botted joints. Aircraft Tooling Concepts. Brief introductions of software tools used for Jigs and Fixture designs.
Non-Destructive Techniques and Other Inspection Techniques: Dye Penetrant Test, X-ray, magnetic particle and ultrasonic testing. Acoustic holography.

Text Book(s)
F.C.Campbell, "Manufacturing Technology for Aerospace Structural materials", Elsevier Science Ltd; 1 edition (15 August 2006)
Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009
M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014.

Reference(s)
E. P. DeGarmo, J. T. Black, and R. A. Kohser, DeGarmo's materials and processes in manufacturing, 11th edition, John Wiley & Sons, 2013.
American Welding Society, Welding Handbook, AWS, 2009. 4. G. E Dieter, Mechanical Metallurgy, Tata McGraw Hill, 2007

Evaluation Pattern

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

*CA – Can be Quizzes, Assignment, Projects, and Report

23AEE441	AERO-ELASTICITY	L-T-P-C: 3-0-0-3

Pre-Requisite(s): – 23AEExxx STRUCTURAL DYNAMICS and 23AEExxx AERODYNAMICS II

Course Objectives

To make students to understand and appreciate the importance of Aeroelasticity in design of aircrafts those operate in steady and unsteady aerodynamic environment by deriving the governing equations and obtain the solution for static and dynamic aero elastic problems.

Course Outcomes

CO1: Calculate divergence and aileron effeteness of a straight wing.
CO2: Obtain divergence and aileron effeteness of a swept wing.
CO3: Understand flutter phenomena of a wing.
CO4: Know how to perform system dynamic analysis using finite element methods.

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

Syllabus

Unit1
Recap of Free vibration of continuous structures, Static aeroelasticity, divergence of a typical airfoil section, aileron reversal, divergence of one-dimensional structures: straight and swept wings, aileron reversal of one-dimensional straight wing.

Unit 2
Aeroelastic flutter, stability characteristics, aeroelastic analysis of a typical airfoil section: single degree and two-degree freedom, classical flutter analysis, classical unsteady aerodynamic theory, Introduction to engineering solution for flutter, U-g and p-k methods, response to gust loads.

Unit 3

Principles and methods of computational structural dynamics and vibration analysis. Introduction to dynamic analysis using the finite element method. System dynamic response via mode superposition, frequency response, Intro to Fatigue analysis.

Text Book(s)

Dewey H. Hodges, and G. Alvin Pierce, "Introduction to structural dynamics and aeroelasticity," 2nd edition, Cambridge University Press, 2012

Reference(s)

Raymond L. Bisplingoff, Holt Ashley, Robert L. Haffman., "Aeroelasticity", Dover Publications, 1996.

Raymond L. Bisplingoff, Holt Ashley, "Principles of Aeroelasticity", Dover Publications, 2002.

Leonard Meirovitch, "Elements of vibration Analysis," Tata McGraw Hill, 1986.

Evaluation Pattern

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

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

23AEE442	**ATOMIZATION & COMBUSTION**	**L-T-P-C: 3-0-0-3**

Pre-Requisites: 23AEExxx AEROSPACE PROPULSION

Course Objectives

To empower the students with the knowledge of atomization of fuels and other liquids in terms of spray forming and its characterization. Also, to impart the knowledge about the combustion process and its kinetics that happen in the combustor.

Course Outcomes

CO1: Understand the necessity of atomization of fuels and any other liquids.
CO2: Apply the fluid physics kinematics to understand spray formation and characterization methods for measuring spray quality.
CO3: Apply the knowledge of thermodynamics and fluid mechanics in understanding the fluid flow process and heat release rate in the combustor.
CO4: Apply the physical and chemical processes in understanding the thermodynamics behind combustion, flame propagation and flame stabilization techniques.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction to Atomization process - Factors influencing spray formation; Sheet and ligament formation and its breakup; Introduction to instability analysis for sheet and ligaments breakup; Drop size distribution – Mass distributions – Empirical Correlation; Secondary atomization - Drop collisions and coalescence; Trajectory of the drop motion and its interaction with surroundings – Interaction of drops pertaining to the applications involving in gas turbines, spray cooling, Different Types of Atomizer.

Unit 2

External spray characteristics - Cone angle - Radial and circumferential mass flux distributions; Measurement techniques - Drop sizing by Malvern and P/DPA - Drop velocity by P/DPA - Mass flux distribution via patternators and P/DPA.

Unit 3

Review of Chemical kinetics and chemical equilibrium, Activation energy, Combustion waves; Premixed flames: flame velocity, analytical models and flammability limits; Diffusion flames: droplet combustion, analytical models for droplet combustion; Aircraft combustors, geometry, combustor sizing; Injection, Ignition and flame stabilization, flame holding in high-speed combustion systems; Combustion instabilities, active and passive control of instabilities; Methods of combustor cooling. Introduction to supersonic combustion, the challenges, methods for mixing enhancement and flame stabilization.

Text Book(s)

Stephen Turns, "An Introduction to Combustion: Concepts and Applications", 2nd Edition, McGraw-Hill, 1999.

Lefebvre, A.H., McDonnel, V.G., Atomization and Sprays, 2nd Edition, CRC Press, 2017.

L. Bayvel and Z. Orzechowski, Liquid Atomization, Taylor and Francis-Washington DC, 1993.

Reference(s)

Chung K. Law, "Combustion Physics", Cambridge University Press, 2010.

Kenneth Kuan-yun Kuo, "Principles of Combustion", 2nd Edition, Wiley, 2005.

Eugene L. Keating , "Applied Combustion", Second Edition, CRC Press, 2007.

Ashgriz, N., Hand Book of Atomization and Sprays: Theory and Applications, Springer Publishers, 2011.

Lin, S.P., Breakup of Liquid Sheets and Jets, Cambridge University Press, 2009.

Evaluation Pattern

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

*CA – Can be Quizzes, Assignment, Projects, and Report

23AEE443	**STATE SPACE TECHNIQUES**	**L-T-P-C: 3-0-0-3**

Course Objectives

- To revisit vector spaces and matrix algebra and to explain basis vectors and span of vector spaces.
- Define terms: degeneracy, orthonormal sets, linear transformations and solution of simultaneous linear algebraic equations.
- Derive state space equations and associated canonical forms, explain eigen values and eigen vectors, establish relation between transfer functions and state space forms.

- Apply Controllability and Observability criteria to state feedback and output feedback systems. Execute arbitrary pole placement techniques and design State Observers.

Course Outcomes

CO1: Recall Matrix Algebra and Vector Spaces, Understand basis vectors, dimension & span of vector spaces.
CO2: Define degeneracy, orthonormal set, linear transformation, Change of basis and solve simultaneous linear algebraic equations.
CO3: Derive and understand State space equations, Canonical realizations, Relate Transfer function and State space form to obtain any one from the other.
CO4: Evaluate Eigen values and Eigen vectors, Analyse Functions of square matrices and Cayley-Hamilton theorem.
CO5: Apply Controllability & Observability criteria to State feedback and Output feedback systems.
CO6: Execute arbitrary Pole placement and design State Observers to reconstruct state variables.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	2	-	-	-	-	-	-	1	-	-	3
CO2	3	2	-	2	2	-	-	-	-	-	-	1	-	-	2
CO3	3	2	-	2	2	-	-	-	-	-	-	1	1	-	-
CO4	2	3	-	3	3	-	-	-	-	-	-	1	-	-	2
CO5	2	2	2	2	2	-	-	-	-	-	-	1	3	3	1
CO6	2	3	3	3	2	-	-	-	-	-	-	1	1	3	-

Syllabus

Unit 1
Concepts of Matrix Algebra and Vector Spaces (revision) – Solution of Simultaneous Equation for Squares – Under-Determined and Over-Determined Systems – Concepts of Basis Vector Transformations; Similarity and Adjoint Transformation – Eigen Values and Eigen Vectors: Canonical Forms, Jordon Forms, Characteristic Equations, Analytical Functions of Square Matrices, Cayley-Hamilton Theorem.

Unit 2
Concepts of State, State-Space and State-Vector – Mathematical Modes in the State Space Form – State Equation and High-Order Differential Equations – State Space Form for Aerospace Systems, for e.g., Dynamic Behavior of Aircraft, Missile, Satellites, INS., etc. – Solution of Homogenous State Equations.

Unit 3
Solution of Non-Homogenous State Equations – Controllability and Observability of Systems – Concepts of Output Feedback and Full State Feedback, Pole-Placement Design – Concept of an Observer – Basics of Optimal Control.

Text Book(s)
Friedland, B. "Control System Design", illustrative edition, Dover publications, 2005.
Nise, Norman S. "Control Systems Engineering," 8th Edition, Wiley, 2019.

Evaluation Pattern

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

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

23AEE444	MULTI DISCIPLINARY DESIGN OPTIMIZATION	L-T-P-C: 3-0-0-3

Course Objectives

The objective of this course is to provide the students with the basic concepts of optimization, the modeling skills necessary to formulate and solve the optimization problems.

Course Outcomes

CO1: Understand the terms optimization, design variables, objective functions, constraints and the types of optimizations.
CO2: Understand the single variable, multi-variable optimization with and without constraints.
CO3: Apply the suitable optimization algorithm for the given problem.
CO4: Analyse the accuracy of the optimization algorithms.
CO5: Apply the non-conventional optimization methods for multi-objective functions. and to know about types of non-conventional optimization methods.

CO-PO Mapping

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

Syllabus

Unit 1
Single Variable Optimization: Introduction to Optimization, Optimality Criteria – Bracketing Methods: Exhaustive Search Method, Bounding Phase Method, Region Elimination Methods, Golden Section Search Method, Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic Search Method.

Unit 2
Multivariable Optimization: Optimality Criteria – Gradient Based Methods: Steepest Descent Method, Conjugate Direction Method, Conjugate Gradient Method and Newton's Method – Constrained Optimization: Karush-Kuhn-Tucker Optimality Criteria, Direct Methods, Indirect Methods, Penalty Function Methods.

Unit 3
Global Optimization: Simulated Annealing, Genetic Algorithm, Particle Swarm Optimization, Multi-Objective Optimization – Pareto Optimality – Global Function /Weighted Sum.

Text Book(s)
Kalyanmoy Deb, "Optimization for Engineering Design Algorithms and Examples", 2nd edition, Prentice Hall of India, New Delhi, 2012.

Reference(s)
Kalyanmoy Deb, "Multi-Objective Optimization using Evolutionary Algorithms", Wiley, 2010.
J. Arora, "Introduction to Optimum Design," 3rd Edition, Elsevier, 2012.

Evaluation Pattern

Assessment	Internal	End Semester

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

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

23AEE451	ADVANCED COMPUTATIONAL FLUID DYNAMICS	L-T-P-C: 3-0-0-3

Pre Requisite(s): 23AEExxx COMPUTATIONAL FLUID DYNAMICS FOR AEROSPACE

Course Objectives

The course aims to introduce students to the finite volume method and related advanced numerical techniques and algorithms.

Course Outcomes

CO1: Understanding the strong and weak forms of governing equations and the Finite Volume Method (FVM) basics to discretize partial differential equations.
CO2: Applying FVM schemes like upwind, Central Difference, power-law, quick, Total Variation Diminishing schemes for convection-diffusion type problems and assessing the schemes.
CO3: Applying solution methodologies like SIMPLE, SIMPLER, SIMPLEC, and PISO for staggered and collocated grids.
CO4: Understanding Turbulence Models and Associated parameters.
CO5: Understanding of advanced concepts: multigrid, flux-vector splitting, spectral methods, aerodynamic shape optimization.
CO6: Numerically model the fluid dynamic problems using open-source packages such as OpenFoam.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	2	-	-	2	3	2	1
CO2	2	2	-	-	-	-	-	-	2	-	-	2	2	2	1
CO3	2	2	-	-	-	-	-	-	2	-	-	-	2	2	1
CO4	2	-	-	-	-	-	-	-	2	-	-	2	3	2	1
CO5	2	2	-	-	-	-	-	-	2	-	-	2	2	2	1
CO6	2	2	-	2	3	-	-	-	3	3	-	2	2	3	3

Syllabus

Unit 1
Strong and Weak Form of Conservation of Equations – Introduction to Finite Volume Method: Discretization Schemes and their Properties for Finite Volume Method.

Unit 2
Finite Volume Method for Convection-Diffusion Problems: Central Differencing, Upwind Differencing, Power-Law Differencing, Quick and TVD Schemes with their Assessments – Staggered and Collocated Grids – Introduction to Multigrid – Flux-Vector Splitting.

Unit 3
Introduction to Solution Algorithms: SIMPLE, SIMPLER, SIMPLEC, and PISO Algorithms – Introduction to Turbulence Models and Associated Parameters – Introduction to Aerodynamic Shape Optimization – Introduction to Spectral Methods.

Text Book(s)
Veertseeg.H, Malalasekara.W, "An Introduction to Computational Fluid Dynamics- The Finite Volume Approach", 2nd edition, Pearson Education Limited, 2008.

Reference(s)
Hirsch, "Numerical Computation of Internal and External Flows- Vol 1-2", 2nd edition, Elsevier, 2007.

Tu, Jiyuan, Guan Heng Yeoh, and Chaoqun Liu. *Computational fluid dynamics: a practical approach*. Butterworth-Heinemann, 2018.
John Tannehill, Dale Anderson, Richard Pletcher, "Computational Fluid Mechanics and Heat Transfer," 3rd Edition, CRC Press, 2013.
Canuto C., Hussaini M. Y., Quarteroni A., and Zang T.A., "Spectral Methods. Fundamentals in Single Domains." Springer-Verlag, 2006.

Evaluation Pattern

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

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

23AEE452 SURFACE ENGINEERING, COATING AND JOINING TECHNOLOGIES L-T-P-C: 3-0-0-3

Course Objectives

Knowledge will be provided to the students on fundamentals of Science Engineering, Coating Technology and necessity of surface modification of materials. Also, knowledge will be given on basics of adhesive bonding and its advantages, welding and its advantages and vaporised solvent bonding.

Course Outcomes

CO1: Understanding of surface Engineering.
CO2: Application of surface Engineering.
CO3: Understanding of plasma processing of material.
CO4: Understanding of adhesive bonding.
CO5: Application of adhesive bonding.

CO-PO Mapping

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

Syllabus

Unit 1
Introduction: Engineering components, surface dependent properties and failures, importance and scope of surface engineering. Surface and surface energy: Structure and types of interfaces, surface energy and related equations. Surface modification of steel and ferrous components, Surface modification using gaseous medium: Nitriding carbonitriding (diffusion from gaseous state) (principle and scope of application).

Unit 2
Surface engineering by energy beams: General classification, scope and principles, types and intensity/energy deposition profile. Surface engineering by energy beams: Laser assisted microstructure modification – surface melting, hardening,

shocking and similar processes. Surface engineering by spray techniques: Plasma coating (principle and scope of application). Characterization of surface microstructure and properties.

Unit 3

Fundamentals of Adhesive Bonding, Stress Distribution in Adhesive Bonding, Adhesive Bonding geometry and fracture analysis, Adhesive bonding of similar and dissimilar materials, Fundamentals of welding, Stress Distribution in welding. Vaporized solvent bonding for joining of transparent polymers.

Text Book(s)

Peter M. Martin (2011), Introduction to Surface Engineering and Functionally Engineered Materials, ISBN 978-0-470-63927-6, Scrivener Publishing LLC.

Reference(s)

Arthur A. Tracton (2006), Coatings Technology Handbook, ISBN 978-1-57444-649-4, Taylor & Francis Group LLC.
*Samuel Benavides (2009), Corrosion Control in the Aerospace Industry, **ISBN 13:** 9781845693459, Woodhead Publishing Ltd.*

Evaluation Pattern

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

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

23AEE453	INTRODUCTION TO AIRPORT MANAGEMENT	L-T-P-C: 3-0-0-3

Course Objectives

To introduce students to basic elements of Airport Management.

Course Outcomes

CO1: Understand the historical evolution and current trend of the various elements of airport operation.
CO2: Gain exposure to environmental concerns related to airport operations.
CO3: Understand airline operations.
CO4: Appreciate role of logistics in airport management.

CO-PO Mapping

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

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

Syllabus

Unit 1

Introduction: History of Aviation- Development of Air transportation in India-SWOT analysis in Airline Industry-Market potential of Indian Airline Industry—Current Trends & challenges in Airline Industry-The role of IATA & ICAO in Global Aviation Industry; Airport codes

Airport Operations: Components of Airport-Operational area and Terminal- Airport Operations-Airport Functions-Organizational structure of Airline and Airports Sectors-Airport Authorities-Global and Indian scenario of Airport management – DGCA –AAI; Airport Planning & Design – Environmental Impact

Unit 2

Design & Planning: International Trends-Emerging Indian scenario-PPP- Public Private Participation in Indian Airports-Environmental Regulations-Private participation in international developments-Environment Regulations-Regulatory Issues-Meteorological services for Aviation-Airport fees, rates, and charges

Airline Operations: Airline Terminal Management-Flight Information Counter/Reservation and Ticketing-Check In-Customs and Immigration formalities -Security Clearance-Baggage Handling - Unaccompanied minors and Disabled/Stretchered Passengers- Human Remains– Services for CIP, VIP & VVIP-Coordination of Supporting Agencies /Departments.

Unit 3

Logistics and air cargo management: Concept of Logistics- Role of Ware Housing-trend in material handling-Global Supply Chain-Quality concept and Total Quality Management-improving Logistic Performance-Air Cargo Concept- Cargo Handling-Booking of Perishable Cargo and Live Animals- Industry Relation-Type of Air Cargo-Air Cargo Tariff, ratios and Charges-Airway Bill, Function, Purpose.

Text Book(s)

Wells.A, "Airport Planning and Management," 4th edition, McGraw-hill, London, 2000.
Alexander T.Well, Seth Young, "Principles of Airport Management," McGraw Hill 2003

Evaluation Pattern

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

*CA – Can be Quizzes, Assignment, Projects, and Report

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 involvingiterative methods, matrix algebra, Curve fitting.

Molecular mechanics: Basic theory - Harmonic oscillator – Parameterization - Energy equations - Principle ofcoupling - Matrix formalism for two masses - Hessian matrix - enthalpy of formation - enthalpy of reactions.

Introduction to Quantum mechanics - Schrodinger equation - Position and momentumMO 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 EHTmethod - 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 tomolecular 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

SyllabusUnit

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) indicatorand ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler- Volmer equation -Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafelplots - 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

SyllabusUnit

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 forjet 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 ofzero 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.

SyllabusUnit

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 andphysical 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 - acidbase, 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 DiffractionStudies - 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

SyllabusUnit

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) indicatorand ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler- Volmer equation -Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafelplots - 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 - Galvanicand 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

SyllabusUnit

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 lawof 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 - gyroscopicattitude 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 inSi 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, collisiontime, 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'sconsequences, 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 inmatter, 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 broadeningin 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 surfacemodes.

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

SyllabusUnit

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												

SyllabusUnit

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 - planklength and time, different cosmic models - inflationary, steady state. Variation of G. anthropic principle.

REFERENCES:

1. *"Textbook of Astronomy and Astrophysics with elements of Cosmology", V. B. Bhatia, Narosa publishing 2001.*
2. *William Marshall Smart, Robin Michael Green "On Spherical Astronomy", (Editor) Carroll, Bradley W Cambridge University Press ,1977*
3. *Bradley W. Carroll and Dale A. Ostlie. "Introduction to modern Astrophysics" Addison-Wesley, 1996.*
4. *Bradley W. Carroll and Dale A. Ostlie, "An Introduction to Modern Astrophysics" Addison-Wesley*

Publishing Company,1996

5. *'Stellar Astronomy' by K. D Abhayankar.*
6. *'Solar Physics' by K. D Abhayankar.*

Evaluation Pattern

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

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

MATHEMATICS

23MAT240	STATISTICAL INFERENCE	L-T-P-C: 3-0-0-3

Syllabus

Unit 1
Introduction to Statistics: Data Collection and Descriptive Statistics, Populations and Samples, describing data sets, summarizing data sets, Normal Data Sets, Paired Data Sets and the Sample Correlation Coefficient. Review of Random Variables and Distributions, Distributions of Sampling Statistics, The Sample Mean, The Central Limit Theorem, The Sample Variance, Sampling Distributions from a Normal Population, Distribution of the Sample Mean, Joint Distribution of $\bar{X}$ and S^2, Sampling from a Finite Population.

Unit 2
Parameter Estimation: Introduction, Maximum Likelihood Estimators, Interval Estimates, Estimating the Difference in Means of Two normal populations, Approximate Confidence Interval for the Mean of a Bernoulli random variable, Confidence Interval of the Mean of the Exponential Distribution, Evaluating a Point Estimator, The Bayes Estimator. Hypothesis Testing: Introduction, Significance Levels, Tests Concerning the Mean of a Normal Population, Testing the Equality of Means of Two Normal Populations, Hypothesis Tests Concerning the Variance of a Normal Population, Tests Concerning the Mean of a Poisson Distribution.

Unit 3
Regression: Introduction, Least Squares Estimators of the Regression Parameters, Distribution of the Estimators, Statistical Inferences about the Regression Parameters, the Coefficient of Determination and the Sample Correlation Coefficient, Analysis of Residuals, transforming to Linearity, Weighted Least Squares, Polynomial Regression, Multiple Linear Regression, Predicting Future Responses, Logistic Regression Models for Binary Output Data.

TEXTBOOK:

1. Ross S.M., Introduction to Probability and Statistics for Engineers and Scientists, 3rd edition, Elsevier Academic Press.

REFERENCES:

1. *Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons Inc., 2005*
2. *Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.*
3. *Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 8th Edition, Pearson Education Asia, 2007.*
4. *Hogg, R.V., Tanis, E.A. and Rao J.M., Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.*

Evaluation Pattern

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

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

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 ofgames.

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 STREAMCOMMON 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			

SyllabusUnit

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 inPractice – 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 MANAGEMENT	L-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		

SyllabusUnit

1
Introduction: Introduction to SCM-the complexity and key issues in SCM – Location strategy – facility locationdecisions – 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 routingand scheduling models – traveling salesman problems – exact and heuristic methods.

Unit 2
Inventory: Inventory Management and risk pooling-managing inventory in the SC. Value of Information-bullwhipeffect-lead time reduction.
Supply Chain Integration: Supply chain integration-distributed strategies-push versus pull systems. Distribution Requirements Planning – DRP and demand forecasting, DRP and master production scheduling. DRP techniques –time-phased order point – managing variations in DRP – safety stock determination-Strategic alliances-third partylogistics-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 moderntrends 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

SyllabusUnit

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 crashingResource 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 implementationissues. 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		

SyllabusUnit1
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		

SyllabusUnit

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 ofwork 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 ofwork 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 awork 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 quantitativedata 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 isknown 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 lifeapplications

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

SyllabusUnit

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 completedFuture 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

SyllabusUnit

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 andAOA-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 valuesof 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 structureof 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

SyllabusUnit

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, valuechain ,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 - ImplementationChallenges- 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 STREAMSCOMMON 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 possibilitiesfor manifesting excellence in life. This course presents to the students, an opportunity to study the Indian perspectiveof Personality Enrichment through pragmatic approach of self analysis and application.

SyllabusUnit 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.

SyllabusUnit 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. Thecourse includes experiential components centering on meditation and spiritual practice.

SyllabusUnit 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 allYoga-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 – Unfoldedbelief - 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 thecross-cultural aspects in a globalised world; to introduce the students to the art of persuasion and negotiation inbusiness 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			

SyllabusUnit 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 thesocietal changes in the recent past.

SyllabusUnit 1

Poems
Rabindranath Tagore's Gitanjali (1-10); Nizzim Ezekiel's Enterprise; A.K. Ramanujam's Small-Scale Reflections on a Great House.

Unit 2Prose
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 literaryinsights; to enhance creative thinking; to promote aesthetic sense.

SyllabusUnit 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 3Prose

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, Bookreviews, 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 helpthem 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.

SyllabusUnit 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

SyllabusUnit 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) inthe 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; Thecity (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 thetime.
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

SyllabusUnit 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, choosea 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 upan 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; Divisibleand 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 endeavourof 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					

SyllabusUnit 1
Introduction to Hindi Language, National Language, Official Language, link Language etc. Introduction to Hindi language, Devanagari script and Hindi alphabet.

Shabda Bhed, Roopanthar ki Drishti se- Bhasha – Paribhasha aur Bhed – Sangya - Paribhasha Aur Bhed - Sangyake Roopanthar - kriya.

Unit 2
Common errors and error corrections in Parts of Speech with emphasis on use of pronouns, Adjective and verb indifferent 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. Newsreading and presentations in Radio and TV channels in Hindi.

Unit 4
Gadya Manjusha – Budhapa, Kheesa, Sadachar ka Thavis

Unit 5
Translation: Theory and Practice - Letter writing: Formal and Personal – Introduction to Hindi Software.

BOOKS:

1. *Kavay Tarang: Dr. 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; JawaharlalNehru; 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 – classicalsanskrit literature – Harsavardhana; Trade and commerce in classical and medieval India and the story of Indiansupremacy 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 ofIndian education and history; Indian economy – before and after colonization: a brief survey; The emergence ofmodern 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 Mrichchhakatikamof 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, RabindranathTagore; 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-historicpolity 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'strade 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 theIndo-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 productionand urban economy, currency system; Vijayanagara samrajya and maritime trade – the story of Indian supremacyin 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 ofSurat and Porbander, businessmen of Bombay, etc. may be referred to here) – the evolution of the modern bankingsystem; 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 ofscience 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

SyllabusUnit 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 andpostures, 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 aboutthe far-reaching contributions of India to world culture and thought during the course of its long journey from thehoary antiquity to the present times. Every nation takes pride in its achievements and it is this sense of pride andreverence towards the achievements that lays the foundation for its all-round progress.

SyllabusUnit 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.

SyllabusUnit 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 PsychologyCO 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

SyllabusUnit 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

SyllabusUnit 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 andtechnology: 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 ofNew 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 thedetermination.

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 - Conceptof 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 messagecan be applied in daily life for achieving excellence.

SyllabusUnit 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 ModernScience.

Unit 2
The challenge of human experience & problems discussed in the Upanishads – the True nature of Man – theMoving power of the Spirit – The Message of Fearlessness – Universal Man - The central problems of theUpanishads – 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

SyllabusUnit 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, advancedresearch.

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 givea thorough knowledge on Japanese scripts that is Hiragana and Katakana. Classes will be conducted throughoutin 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 towrite 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 Japaneselanguage 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 Japaneselanguage 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 andreading for appreciating literary works; to analyse language in context to gain an understanding of vocabulary, spelling, punctuation and speech.

SyllabusUnit 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 andreading 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.

SyllabusUnit 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 ourculture & 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**	-	-

SyllabusUnit 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 ofKerala 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 ourculture & values; to equip students read & write correct Malayalam; to correct the mistakes in pronunciation; tocreate 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 translationCO2: Identify and appreciate the Romantic elements of modern literatureCO3: Analyze the genre of autobiographical writing
CO4: Critically evaluate the significance of historical, political and socio cultural aspects in literatureCO5: 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**	-	-

SyllabusUnit 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 appreciationof 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 Sanskritverses 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.

SyllabusUnit 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-kartharipra yoga

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 - verse5, 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 Sanskritverses 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.

SyllabusUnit 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 underSection 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, whyinvest 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 literatureCO 2:
To understand the creative literature
CO 3: To understand the literary work on religious scripturesCO 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	-	-

SyllabusUnit1
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 usageCO 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	-	-

SyllabusUnit 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.
Aṟaṉūlkaḷ: 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 parimārram - 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.