JEPPIAAR INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

Self-Belief | Self Discipline | Self Respect

Kunnam, Sunguvarchatram, Sriperumbudur-631604

DEPARTMENT OF MECHANICAL ENGINEERING

AUTONOMOUS SYLLABUS

REGULATION 2024

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DEPARTMENT OF MECHANICAL ENGINEERING

AUTONOMOUS CURRICULUM & SYLLABUS R2024

CHOICE BASED CREDIT SYSTEM

VISION AND MISSION OF THE INSTITUTION

VISION

Jeppiaar Institute of Technology aspires to provide technical education in futuristic technologies with the perspective of innovative, industrial, and social applications for the betterment of humanity.

MISSION

- To produce competent and disciplined high-quality professionals with the practical skills necessary to excel as innovative professionals and entrepreneurs for the benefit of society.
- To improve the quality of education through excellence in teaching and learning, research, leadership, and by promoting the principles of scientific analysis, and creative thinking.
- To provide excellent infrastructure, serene, and stimulating environment that is most conducive to learning.
- To strive for productive partnership between the Industry and the Institute for research and development in the emerging fields and creating opportunities for employability.
- To serve the global community by instilling ethics, values, and life skills among the students needed to enrich their lives.

VISION AND MISSION OF THE DEPARTMENT

VISION

To enhance advanced technical education in the field of Mechanical engineering with the view of transformation in societal and industrialized requirements offering a platform for excellence towards mankind.

MISSION

- **M1:** To develop quality education with the global need.
- **M2:** To provide state of art facilities to faculty members and students to apply their innovative thoughts towards communal development.
- **M3:** To facilitate team work culture and promote student community to adapt industrial setup.
- **M4:** To develop the research fervour among the students and encourage them to shape inventive ideas.
- **M5:** To serve the global community by ethical values and core skills.

PROGRAMME EDUCATIONAL OBJECTIVES

- **PEO1:** Have a successful career in Mechanical Engineering and allied industries.
- **PEO2:** Have expertise in the areas of Design, Thermal, Materials, Manufacturing and Management.
- **PEO3:** Contribute towards technological development through academic research and industrial practices.
- **PEO4:** Practice their profession with good communication, leadership, ethics and social responsibility.
- **PEO5:** Graduates will adapt to evolving technologies through life-long learning.

OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge:** (K3) Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** (K4) 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:** (K4) 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:** (K5) 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:** (K3, K5, K6) Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** (A3) 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:** (A2) 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:** (A3) Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** (A3) Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** (A3) 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:** (A3) 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:** (A2) 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 1:** Apply the fundamentals of mathematics, Science and Engineering acquaintance to solve real time problems with scientific principles under mechanical engineering profession.

- **PSO 2:** Develop the ability to synthesize data for application in modeling and analysis software's to enhance the capabilities in simulation and demonstrate leadership qualities in activities related to sustainable development of society.

- **PSO 3:** Understand the impact of Professional Engineering solutions in societal and environmental context, commit to professional ethics and communicate effectively.

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DEPARTMENT OF MECHANICAL ENGINEERING

AUTONOMOUS CURRICULUM R2024 (CBCS)

SEMESTER – I										
S.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**CIE**	**SEE**	**TOTAL**
				L	**T**	**P**				
1	AIP001	Induction Program	-	-	-	-	-	-	-	-
THEORY										
2	AMA101	Matrices and Calculus	BS	3	1	0	4	40	60	100
3	AEC103	Basic Electrical and Electronics Engineering	ES	3	0	0	3	40	60	100
4	AME101	Engineering Graphics	PC	3	0	0	3	40	60	100
5	ACS102	Python Programming	ES	3	0	0	3	40	60	100
6	AMC101	Employment Enhancement Skills	MC	2	0	0	0	-	-	100
7	AMC102	Professional Ethics and Human Values	MC	2	0	0	0	-	-	100
PRACTICALS										
8	AEC302	Basic Electrical and Electronics Engineering Laboratory	ES	0	0	4	2	60	40	100
9	ACS301	Python Programming Laboratory	ES	0	0	4	2	60	40	100
10	AHS301	Communication Skills and Technical Writing	HS	0	0	2	1	60	40	100
11	AEEC301	Mini Project/Professional practices	EEC	0	0	2	1	60	40	100
			Total	16	1	10	19			

SEMESTER – II										
S.No	Course Code	Course Title	Category	Periods			Credits	CIE	SEE	TOTAL
				L	T	P				
THEORY										
1	AMA104	Transforms and Partial Differential Equations	BS	3	1	0	4	40	60	100
2	APH102	Engineering Materials and Metallurgy	BS	3	0	0	3	40	60	100
3	AAI101	Introduction to Data Science	ES	3	0	0	3	40	60	100
4	AME102	Engineering Mechanics	PC	3	0	0	3	40	60	100
5	ACS104	Fundamentals of Cloud Computing	ES	3	0	0	3	40	60	100
6	AHS101	Language Enhancement	HS	1	0	0	1	40	60	100
7	AMC103	Indian Constitution	MC	2	0	0	0	-	-	100
PRACTICALS										
8	AME301	Basic Civil & Mechanical Laboratory	ES	0	0	4	2	60	40	100
9	ACS302	Cloud Computing Laboratory	ES	0	0	4	2	60	40	100
10	AMC301	Yoga and Happy Living	MC	0	0	4	0	-	-	100
11	AEEC302	Mini Project/ Professional practices	EEC	0	0	2	1	60	40	100
			Total	18	1	8	22			

SEMESTER – III										
S.No	Course Code	Course Title	Category	Periods			Credits	CIE	SEE	TOTAL
				L	T	P				
THEORY										
1	AME103	Engineering Thermodynamics	PC	3	0	0	3	60	40	100
2	AME104	Fluid Mechanics and Machinery	PC	3	0	0	3	60	40	100
3	AME105	Strength of Materials	PC	3	0	0	3	40	60	100
4	AME106	Manufacturing Processes	PC	3	0	0	3	40	60	100
5	AMC104	Environmental Engineering & Sustainability	MC	2	0	0	0	-	-	100
PRACTICALS										

6	AME302	Fluid Mechanics and Machinery Laboratory	PC	0	0	4	2	60	40	100
7	AHS302	Soft Skills I	HS	0	0	2	0	-	-	100
8	AEEC303	Mini Project/ Professional practices	EEC	0	0	2	1	60	40	100
			Total	14	0	7	15			

SEMESTER – IV										
S.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**CIE**	**SEE**	**TOTAL**
				L	**T**	**P**				
THEORY										
1	AME107	Theory of Machines	PC	3	0	0	3	40	60	100
2	AME108	Metrology and Measurements	PC	3	0	0	3	40	60	100
3	AME109	Conventional & Unconventional Machining processes	PC	3	0	0	3	40	60	100
4	AMA106	Statistics and Numerical methods	BS	3	1	0	4	40	60	100
5	AME110	Thermal Engineering	PC	3	0	0	3	40	60	100
PRACTICALS										
6	AME303	Machine tools laboratory	PC	0	0	4	2	60	40	100
7	AME304	Strength of Materials Laboratory	PC	0	0	4	2	60	40	100
8	AHS303	Soft Skills II	HS	0	0	2	0	-	-	100
9	AEEC304	Mini Project/ Internship /Professional practices	EEC	0	0	2	1	60	40	100
			Total	15	1	10	21			

SEMESTER – V										
S.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**CIE**	**SEE**	**TOTAL**
				L	**T**	**P**				
THEORY										
1	AME111	Machine Design	PC	3	0	0	3	40	60	100
2	AME112	Automobile Engineering	PC	3	0	0	3	40	60	100
3		Professional Elective 1 - Manufacturing	PE	3	0	0	3	40	60	100
PRACTICALS										

4	AME305	Computer Aided Design Laboratory	PC	0	0	4	2	60	40	100
5	AME306	Metrology & Dynamics Laboratory	PC	0	0	4	2	60	40	100
6	AEEC305	Mini Project/ Professional practices	EEC	0	0	2	1	60	40	100
			Total	9	0	8	14			

SEMESTER – VI										
S.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**CIE**	**SEE**	**TOTAL**
				L	**T**	**P**				
THEORY										
1	AME113	Heat and Mass Transfer	PC	3	1	0	4	40	60	100
2	AME114	Finite Element analysis	PC	3	0	0	3	40	60	100
3		Open Elective 1	OE	3	0	0	3	40	60	100
PRACTICALS										
4	AME307	Computer Aided Manufacturing Laboratory	PC	0	0	4	2	60	40	100
5	AME308	Thermal Engineering Laboratory	PC	0	0	4	2	60	40	100
6	AEEC306	Mini Project / Internship /Professional Practices	EEC	0	0	2	1	60	40	100
			Total	9	1	8	15			

SEMESTER – VII										
S.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**CIE**	**SEE**	**TOTAL**
				L	**T**	**P**				
THEORY										
1	AME115	Robotics & Automation	PC	3	0	0	3	40	60	100
2		Professional Elective 2 – Design	PE	3	0	0	3	40	60	100
3		Professional Elective 3 – Thermal & Energy	PE	3	0	0	3	40	60	100
4		Open elective 2	OE	3	0	0	3	40	60	100
PRACTICALS										
5	AME309	Automation Laboratory	PC	0	0	4	2	60	40	100
6	AME310	Simulation and Analysis laboratory	PC	0	0	4	2	60	40	100

7	AEEC307	Internship /Professional Practices	EEC	0	0	2	1	60	40	100
			Total	12	0	8	17			

SEMESTER – VIII										
S.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**CIE**	**SEE**	**TOTAL**
				L	**T**	**P**				
THEORY										
1		Professional Elective 4 – Materials	PE	3	0	0	3	40	60	100
2		Open Elective 3	OE	3	0	0	3	40	60	100
PRACTICALS										
3	AEEC308	Internship/Professional Practices	EEC	0	0	2	1	60	40	100
4	AME311	Project	EEC	0	0	12	10	60	40	100
			Total	6	0	14	17			

PROFESSIONAL ELECTIVE 1 (MANUFACTURING)										
S.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**CIE**	**SEE**	**TOTAL**
				L	**T**	**P**				
THEORY										
1	AME501	Lean Manufacturing	PE	3	0	0	3	40	60	100
2	AME502	Process Planning & Cost Estimation	PE	3	0	0	3	40	60	100
3	AME503	Computer Integrated Manufacturing Systems	PE	3	0	0	3	40	60	100
4	AME504	Sustainable Manufacturing	PE	3	0	0	3	40	60	100
5	AME505	Precision Manufacturing	PE	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE 2 (DESIGN)										
S.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**CIE**	**SEE**	**TOTAL**
				L	**T**	**P**				
THEORY										
1	AME506	Ergonomics & Human Factors Engineering	PE	3	0	0	3	40	60	100
2	AME507	Computer Aided Design & Manufacturing	PE	3	0	0	3	40	60	100

3	AME508	Product Design and Development	PE	3	0	0	3	40	60	100
4	AME509	Design of Jigs and Fixtures	PE	3	0	0	3	40	60	100
5	AME510	Design for manufacturing and assembly	PE	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE 3 (THERMAL & ENERGY)										
S.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**CIE**	**SEE**	**TOTAL**
				L	**T**	**P**				
THEORY										
1	AME511	Power Plant Engineering	PE	3	0	0	3	40	60	100
2	AME512	Gas Dynamics and Jet Propulsion	PE	3	0	0	3	40	60	100
3	AME513	Refrigeration & Air Conditioning	PE	3	0	0	3	40	60	100
4	AME514	Modern IC Engines	PE	3	0	0	3	40	60	100
5	AME515	Renewable Energy Systems	PE	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE 4 (MATERIALS)										
S.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**CIE**	**SEE**	**TOTAL**
				L	**T**	**P**				
THEORY										
1	AME516	Non-Destructive Testing & Evaluation	PE	3	0	0	3	40	60	100
2	AME517	Testing of Materials	PE	3	0	0	3	40	60	100
3	AME518	Nano Materials and applications	PE	3	0	0	3	40	60	100
4	AME519	Composites materials and mechanics	PE	3	0	0	3	40	60	100
5	AME520	Mechanical behaviour of materials	PE	3	0	0	3	40	60	100

OPEN ELECTIVE										
S.No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**CIE**	**SEE**	**TOTAL**
				L	**T**	**P**				
THEORY										
1	AME701	Drone Technologies	OE	3	0	0	3	40	60	100
2	AME702	Additive Manufacturing	OE	3	0	0	3	40	60	100

3	AME703	Electric and Hybrid Vehicle Technology	OE	3	0	0	3	40	60	100
4	AEC701	Sensors and Actuators	OE	3	0	0	3	40	60	100
5	AEC702	Applied Design Thinking	OE	3	0	0	3	40	60	100
6	AEC703	Project Report Writing	OE	3	0	0	3	40	60	100
7	ACS701	System Engineering	OE	3	0	0	3	40	60	100
8	ACS702	Green Computing	OE	3	0	0	3	40	60	100
9	ACS703	Fintech Regulation	OE	3	0	0	3	40	60	100
10	AIT701	Network Essentials	OE	3	0	0	3	40	60	100
11	AIT702	Soft Computing Methodologies	OE	3	0	0	3	40	60	100
12	AIT703	Knowledge Engineering	OE	3	0	0	3	40	60	100
13	ACB701	Business Research Methods	OE	3	0	0	3	40	60	100
14	ACB702	Automation Testing Tools	OE	3	0	0	3	40	60	100
15	ACB703	Social Network Analysis	OE	3	0	0	3	40	60	100
16	AAI701	Drinking Water Supply and Treatment	OE	3	0	0	3	40	60	100
17	AAI702	Geographical Information System	OE	3	0	0	3	40	60	100
18	AAI703	IT in Agricultural System	OE	3	0	0	3	40	60	100
19	AMB701	Corporate Governance	OE	3	0	0	3	40	60	100
20	AMB702	Digital Marketing	OE	3	0	0	3	40	60	100
21	AMB703	Rural Marketing	OE	3	0	0	3	40	60	100

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AUTONOMOUS SYLLABUS R2024

CHOICE BASED CREDIT SYSTEM

SEM I

AMA101 MATRICES AND CALCULUS							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		1	**BS**	**3**	**1**	**0**	**4**
Preamble	The objective of the course is to ➢ introduce the matrix techniques and to explain the nature of the matrix. ➢ provide the necessary basic concepts of a few numerical methods and give procedures for solving numerically different kinds of problems occurring in Engineering and Technology. ➢ familiarize the students with differential calculus. ➢ understand techniques of calculus which are applied in the Engineering problems. ➢ acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications						
Unit 1	**MATRICES**						**9+3**
Matrices - Eigen values and eigenvectors - Diagonalization of matrices using orthogonal transformation – Cayley Hamilton Theorem (without proof) - Quadratic forms - Reduction to canonical form using orthogonal transformation							
Unit 2	**SOLUTION OF LINEAR SYSTEM OF EQUATIONS AND EIGENVALUE PROBLEMS**						**9+3**
Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Gauss Seidel iterative method - Matrix Inversion by Gauss Jordan method - Eigen values of a matrix by Power method – Jacobi method.							
Unit 3	**DIFFERENTIAL CALCULUS**						**9+3**
Limit of a function-Continuity-Derivatives-Differentiation rules (sum, product, quotient, chain rules)-Implicit Differentiation-Logarithmic Differentiation-Applications: Maxima and Minima of functions of one variable							
Unit 4	**INTEGRAL CALCULUS**						**9+3**
Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions – Improper integrals.							
Unit 5	**MULTIPLE INTEGRALS**						**9+3**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids –Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.							
							Total: 60

TEXTBOOKS	
1	Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2	Erwin Kreyszig ," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016
3	Grewal. B.S., and Grewal. J.S., Numerical methods in Engineering and Science, Khanna Publishers, 9th Edition, New Delhi, 2001.

REFERENCES	
1	Ramana. B.V., " Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
2	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Demonstrate the matrix techniques in solving the related problems in engineering and technology.	K4
CO2	Apply matrix methods to solve system of linear equations	K3
CO3	Apply differential calculus tools in solving various application problems	K3
CO4	Apply different methods of integration in solving practical problems.	K3
CO5	Evaluate multiple integrals to conduct investigations of complex problems	K5

CO-PO Mapping

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

AEC103 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		1	**ES**	**3**	**0**	**0**	**3**
Preamble	➢ This course provides the foundation for understanding various aspects of electrical and electronics engineering. From the basics of circuit theory to the intricacies of semiconductor devices, this subject delves into the heart of electrical and electronic systems.						
Unit 1	**ELECTRICAL CIRCUITS**						**9**
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only).							

Unit 2	ELECTRICAL MACHINES	9
Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor		
Unit 3	**ANALOG ELECTRONICS**	**9**
Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters		
Unit 4	**DIGITAL ELECTRONICS**	**9**
Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only).		
Unit 5	**MEASUREMENTS AND INSTRUMENTATION**	**9**
Functional elements of an instrument, Standards and calibration, Operating Principle, types -Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.		
		Total: 45

TEXTBOOKS	
1	Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, Second Edition, McGraw Hill Education, 2020
2	S.K.Bhattacharya “Basic Electrical and Electronics Engineering”, Pearson Education, Second Edition, 2011
3	Sedha R.S., “A textbook book of Applied Electronics”, S. Chand & Co., 2008
4	James A .Svoboda, Richard C. Dorf, “Dorf’s Introduction to Electric Circuits”, Wiley, 2018.
5	.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, DhanpatRai and Co, 2015.
REFERENCES	
1	Kothari DP and I.J Nagrath, “Basic Electrical Engineering”, Fourth Edition, McGraw Hill Education, 2019
2	Thomas L. Floyd, ‘Digital Fundamentals’, 11th Edition, Pearson Education, 2011
3	Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 1th edition, 2011
4	Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series, McGraw Hill.

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Compute the electric circuit parameters for simple problems.	K2
CO2	Explain the working principle and applications of electrical machines.	K2

CO3	Analyze the characteristics of analog electronic devices.	K2
CO4	Explain the basic concepts of digital electronics.	K2
CO5	Explain the operating principles of measuring instruments	K2

CO-PO Mapping

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

AME101 ENGINEERING GRAPHICS							
Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		1	**PC**	**3**	**0**	**0**	**3**
Preamble	➢ To develop in students, graphic skills for communication of concepts, ids and design of Engineering products. ➢ To expose them to existing national standards related to technical drawings.						
Unit 1	**PLANE CURVES AND FREE HAND SKETCHING**						**9**
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects.							
Unit 2	**PROJECTION OF POINTS, LINES AND PLANE SURFACES**						**9**
Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.							
Unit 3	**PROJECTION OF SOLIDS**						**9**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.							
Unit 4	**SECTION OF SOLIDS & DEVELOPMENT OF SURFACES**						**9**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes		
Unit 5	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**9**
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids, and cylinders by visual ray method.		
		Total: 45

TEXTBOOKS	
1	Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010
REFERENCES	
1	Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2001.
2	Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3	Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.
4	Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008
5	Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
6	Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Perform free hand sketching of basic geometrical constructions and multiple views of objects.	K3
CO2	Do orthographic projection of lines and plane surfaces.	K3
CO3	Draw projections and solids and development of surfaces.	K3
CO4	Prepare isometric and perspective sections of simple solids.	K3
CO5	Demonstrate computer aided drafting.	K3

CO-PO Mapping

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

ACS102 PYTHON PROGRAMMING							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		1	**ES**	**3**	**0**	**0**	**3**
Preamble	➢ To understand the basics of algorithmic problem solving. ➢ To learn to solve problems using Python conditionals and loops. ➢ To define Python functions and use function calls to solve problems. ➢ To use Python data structures - lists, tuples, dictionaries to represent complex data. ➢ To do input/output with files in Python.						
Unit 1	**BASICS OF PYTHON PROGRAMMING**						**9**
Overview of programming language- Python history-Interactive mode – script mode-Tokens: Literal-Keyword-Delimiter-Identifier-Data types: Integer-Floating-Complex-Boolean-String-Indentation-Input operation-Comments							
Unit 2	**CONTROL STRUCTURE, OPERATORS AND FUNCTIONS**						**9**
Statements: if, if-else, nested if, if –elif - Iterative statements: while, for, Nested loops, else in loops, break, continue and pass statements. Operators: Arithmetic-Membership-Identity-Bitwise Functions: Types, parameters, arguments: positional arguments, keyword arguments, parameters with default values, functions with arbitrary arguments, Scope of variables: Local and global scope, Recursion							
Unit 3	**COLLECTIONS, STRINGS AND REGULAR EXPRESSIONS**						**9**
List: Create Access, Negative Indices, Slicing, Splitting, List Methods, and comprehensions Tuples: Create, Indexing and Slicing, Operations on tuples. Dictionary: Create, add, traversing and replace values, operations on dictionaries. Sets: Create and operations on set. Strings: Formatting, Comparison, Slicing, Splitting, Stripping, Negative indices, String functions. Regular expression: Matching the patterns, Search and replace							
Unit 4	**FILE HANDLING AND EXCEPTIONS**						**9**
Files: Open, Read, Write, Append, Tell, Seek and Close. Errors and Exceptions: Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, Exception Chaining, Userdefined Exceptions, Defining Clean-Up actions							
Unit 5	**NUMPY, PANDAS, MATPLOTLIB**						**9**

Introduction - Basics of NumPy - N-dimensional Array in NumPy – Methods and Properties - Basics of SciPy - Broadcasting in NumPy Array Operations - Array Indexing in NumPy, Pandas - Introduction - Series - Data Frame - Matplotlib - Basics - Figures and Axes - Method subplot() - Axis container	
Total: 45	
TEXTBOOKS	
1	Ashok NamdevKamthane, Amit Ashok Kamthane "Programming and Problem Solving with Python" , 2nd edition , Mc Graw Hill
2	Dr,R,NageswaraRao, "Core Python Programming",3rd edition, Deamtech Publisher
REFERENCES	
1	Paul Dietel, Harvey Deitel, " Python for Programmers", Pearson
2	Reema Thareja," Problem Solving and programming with Python, Oxford University Press

COURSEOUTCOMES: At the end of the course, learners will be able to		**Bloom's Taxonomy Level**
CO1	Develop algorithmic solutions to simple computational problems.	K3
CO2	Develop and execute simple Python programs.	K3
CO3	Write simple Python programs using conditionals and loops for solving problems.	K2
CO4	Decompose a Python program into functions.	K3
CO5	Represent compound data using Python lists, tuples, dictionaries etc.	K3

CO-PO Mapping

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

AMC101 EMPLOYMENT ENCHANCEMENT SKILLS							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		1	**MC**	**2**	**0**	**0**	**0**
Preamble	This course is designed with an objective to equip students with skills to prepare a resume, face interviews, have professional work etiquette, organize events/ meetings, and make a presentation. This course aims at preparing the students						

	to be a better professional by imparting skills that a working professional is expected to possess.	
Unit 1	**RESUME WRITING**	**6**
Resume: Objective; Formats; Meticulous & Attention to Detail; Organizing Information; Highlight skills; Mistakes to avoid; Qualification & Skill; SWOT Analysis; Assignment – Draft Resume & Corrections		
Unit 2	**INTERVIEW SKILLS**	**6**
Types of Interviews; Preparation – Company, Role, Brush up Concepts, Technical Strengths; Strengths & Weakness; Importance of Grooming; Interview Questions – HR & Technical; Non Verbal Communication; Negotiation Skills; How to start/end an interview; Group Discussion; Assignment – Preparation for "Tell me about yourself", Mock Interviews.		
Unit 3	**PROFESSIONAL ETIQUETTES**	**6**
Workplace Etiquette – Global & Local; Culture Sensitivity; Gender Sensitivity; Communication Netiquettes – Phone, Email, Social Media; Avoid Gossip; How to be personable yet be professional. Meetings: Types of meetings; Agenda; Schedule & Participants; Materials required; Minutes of Meeting.		
Unit 4	**PRESENTATION SKILLS**	**6**
What is a Presentation; Develop an effective slide; Know your Slides; Know your Audience; Barriers in Presentation; Time Management; Listening to the silent audience; Question & Answer session; Feedback.		
Unit 5	**COMMUNICATION AT WORKPLACE**	**6**
Language & Communication; Types of Communication – Internal & External, Formal & Informal; Direction of Communication Flow – Downward, Upward, Lateral, Diagonal; Team Work; Emotional Intelligence		
		Total: 30

TEXTBOOKS	
1	"Soft Skills & Employability Skills" by Sabina Pillai&Agna Fernandez
2	"Soft Skills" by Meenakshi Raman &ShaliniUpadhyay
3	"Campus Recruitment" by Ramanadhan Ramesh Babu, Israel Battu, Akash R Bhutada&Vijaya Lakshmi Krishnan
REFERENCES	
1	"Personality Development & Soft Skills (Old Edition)" by Barun K Mitra
2	"Soft Skills Training: A Workbook to develop Skills for Employment" by Frederick H Wentz
3	"Ten Soft Skills You Need to Advance Your Career (Andre Keys Book 9)" by Lisa Smith
4	"Get Your First Job: A Companion For Getting Your First Job – A Guide to Employability Skills & Career Planning" by AJ Balasubramanian & Dr J Sadakkadulla.

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Understand the significance of being a professional.	K2
CO2	Apply employment skills in their environment.	K3

CO3	Employ skills that will enhance employability and ensure workplace and career success.	K3
CO4	Understand and apply appropriate behavior and attitude at workplace.	K5
CO5	Apply skills that will enhance their etiquettes to the standards expected in professional space.	K5

CO-PO Mapping

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

AMC102 PROFESSIONAL ETHICS AND HUMAN VALUES							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		1	**MC**	**2**	**0**	**0**	**0**
Preamble	➢ To create an awareness on Engineering Ethics and Human Values. ➢ To understand social responsibility of an engineer. ➢ To appreciate ethical dilemma while discharging duties in professional life.						
Unit 1	**HUMAN VALUES**						**2**
Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage –Empathy – Self-Confidence – Character							
Unit 2	**ENGINEERING ETHICS**						**4**
Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories. Valuing Time – Co-operation – Commitment							
Unit 3	**ENGINEERING AS SOCIAL EXPERIMENTATION**						**3**
Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study							
Unit 4	**SAFETY, RESPONSIBILITIES AND RIGHTS**						**3**
Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies							
Unit 5	**GLOBAL ISSUES**						**3**
Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership							
							Total: 15

TEXTBOOKS	
1	Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York 1996
2	Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004
REFERENCES	
1	Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint now available).
2	Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available).
3	John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
4	Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Understanding Core Human Values	K2
CO2	Applying Ethical Theories in Engineering	K3
CO3	Evaluating Engineering as Social Experimentation	K3
CO4	Assessing Safety, Risks, and Responsibilities	K5
CO5	Addressing Global Engineering Issues	K5

CO-PO Mapping

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

AEC302 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		1	**ES**	**0**	**0**	**4**	**2**

Preamble	➢ Soldering and testing simple electronic circuits; ➢ Assembling and testing simple electronic components on PCB. ➢ Study of basic electrical and digital equipment.

LIST OF EXPERIMENTS
1. Soldering simple electronic circuits and checking continuity.
2. Assembling and testing electronic components on a small PCB.
3. Study of electronic components and equipment's.
(a) Resistor Color coding using digital multi-meter.
(b) Assembling electronic components on breadboard.
4. Verification of Logic Gates
5. Verification of Half Adder and Full Adder
6. Measurement of electrical quantities-voltage current, power & power factor in RLC circuit
7. Verification of KVL, KCL
8. Verification of Thevenin, Norton, Superposition Theorem
9. Fluorescent lamp wiring
10. Stair case wiring
11. Study of iron box wiring and working
12. Assembly and dismantle of computer/ laptop
Total: 60

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.	K3
CO2	Demonstrate the wiring of various electrical joints in common household electrical wire work.	K3
CO3	Test the working of basic logic gates.	K3
CO4	Understand the working of basic electrical devices	K3
CO5	Apply basic electrical concepts to implement basic electrical circuits.	K3

CO-PO Mapping

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

ACS301 PYTHON PROGRAMMING LABORATORY							
Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		1	**ES**	**0**	**0**	**4**	**2**
Preamble	➢ To understand the problem-solving approaches. ➢ To learn the basic programming constructs in Python. ➢ To practice various computing strategies for Python-based solutions to real world problems. ➢ To use Python data structures - lists, tuples, dictionaries. ➢ To do input/output with files in Python.						

LIST OF EXPERIMENTS
1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3 Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4.Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5.Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7.Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8.Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9.Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10.Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11.Exploring Pygame tool. 12. Developing a game activity using Pygame like bouncing ball, car race etc.
Total: 60

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Develop algorithmic solutions to simple computational problems	K3
CO2	Develop and execute simple Python programs.	K3
CO3	Implement programs in Python using conditionals and loops for solving problems.	K3

CO4	Deploy functions to decompose a Python program.	K3
CO5	Process compound data using Python data structures.	K3

CO-PO Mapping

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

AHS301 COMMUNICATION SKILLS AND TECHNICAL WRITING							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		1	**HS**	**0**	**0**	**2**	**1**
Preamble	➢ Impart a thorough understanding of the principles underlying effective technical communication. ➢ Develop the skills necessary to tailor technical communication to diverse audience needs. ➢ Enhance proficiency in using language techniques and understanding genres related to technical communication. ➢ Equip students with the ability to utilize technological tools to improve technical communication practices. ➢ Foster an awareness of ethical considerations and global perspectives in technical communication.						
Unit 1	**PRINCIPLES OF TECHNICAL COMMUNICATION**						**12**
Listening -Brief video snippets of conversational moments from movies and short documentaries Speaking- Presenting oneself, introducing others, inviting people, and explaining places. Reading - Short passages that need understanding include inference and critical analysis. Writing-Finishing missing phrases and constructing suggestions based on supplied information. Grammar- Who-Questions and Yes/No Questions - Parts of Speech. Vocabulary development: prefixes, suffixes, articles, countable and uncountable nouns.							
Unit 2	**AUDIENCE-CENTERED COMMUNICATION**						**12**
Listening: Deep Listening - Talk Shows and Debates. Reading: In depth Reading: Scanning Passages Speaking: Describe current issues, happenings, etc. Writing: Instructions, Recommendations, Note Taking, and Paragraph Writing Grammar: Continuous tenses, prepositions and articles							

Vocabulary: Phrasal verbs and one-word substitutes		
Unit 3	**LANGUAGE TECHNIQUES AND GENRES IN TECHNICAL COMMUNICATION**	**12**
Listening: Listening to lectures, podcasts, audio books. Reading: Interpretation of Tables, Charts and Graphs Speaking: SWOT Analysis on oneself and Narrating incidents Writing: Formal Letter Writing, Covering Letter and Memos. Grammar: Perfect Tenses and Discourse Markers Vocabulary: Nouns, usage of keywords		
Unit 4	**TECHNOLOGICAL TOOLS USED IN COMMUNICATION**	**12**
Listening: Instructional videos, webinars on personal branding and networking and TED talks Reading: Manuals, Research papers or articles, Graphic narratives, AI tools used in reading Speaking: Participating in and conducting mock virtual meetings, focusing on presentation skills and etiquette. Mock networking events and Elevator Pitch Writing: E-Mails, drafting formal messages in social media handles, and Usage of AI prompts. Grammar: Adjectives, Verbs and Adverbs.		
Unit 5	**ETHICAL AND GLOBAL PERSPECTIVES IN TECHNICAL COMMUNICATION**	**12**
Listening: Podcasts, documentaries and webinars on digital ethics and cybersecurity. Reading: Articles on fundamental ethical principles and case studies. Speaking: Cultural sensitivity and representation ross-cultural communication strategies Mock meetings to practice global collaboration. Writing: Case study analysis reports on legal and ethical responsibilities. Proposals for implementing sustainable communication practices. Grammar: Reported Speech, Idioms and phrases and Loan words		
		Total: 60

TEXTBOOKS	
1	Effective Technical Communication by M. Ashraf Rizvi (Author) 2nd Edition Paperback 2017
2	Sylvan Barnet and Hugo Bedau, ‘Critical Thinking Reading and Writing’, Bedford/st. Martin’s: Fifth Edition (June 28, 2004)
3	Meenakshi Upadhyay, Arun Sharma – Verbal Ability and Reading Comprehension.
4	Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine Chuen Meng Goh, Cambridge.
REFERENCES	
1	Technical Communication: A Reader-Centered Approach" by Paul V. Anderson
2	"Technical Writing: Process and Product" by Sharon J. Gerson and Steven M. Gerson
3	"English for Engineers and Technologists: A Skill Approach" by Jeyanthi G. and Ramasamy P
4	"A Handbook for Technical Writers and Editors" by M. Ragunathan and M. Sundararajan

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	To create clear and successful technical publications, use core technical communication concepts.	K2
CO2	Modify technical communication to the requirements and expectations of various audiences.	K2
CO3	Use proper language and genres to effectively communicate technical knowledge.	K2
CO4	Use technology technologies to improve the generation, management, and dissemination of technical material.	K2
CO5	Navigate ethical quandaries and explore global views in technological communication methods.	K2

CO-PO Mapping

POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	1	1									
CO2	1	2	1	1	1	1									
CO3	1	1	2	2	1	2									
CO4	1	1	1	1	1	1									
CO5	2	1	1	1	1	1									

SEM II

AMA104 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		2	**BS**	**3**	**1**	**0**	**4**
Preamble	➢ Understand the applications of Fourier series in engineering apart from its uses in solving boundary value problems ➢ Understand the basic concepts of the Fourier transform techniques and its application in Engineering. ➢ Use the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.						
Unit 1	**PARTIAL DIFFERENTIAL EQUATIONS**						**9+3**
Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation – Linear homogeneous partial differential equations of second and higher order with constant coefficients.							
Unit 2	**FOURIER SERIES**						**9+3**
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Parseval's identity – Harmonic analysis.							
Unit 3	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**						**9+3**
Classification of PDE – Method of separation of variables - Solutions of one-dimensional wave equation using Fourier series – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Cartesian coordinates only).							
Unit 4	**FOURIER TRANSFORMS**						**9+3**
Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity							
Unit 5	**Z – TRANSFORMS**						**9+3**
Z- transforms - Elementary properties – Convolution theorem - Inverse Z - transform using partial and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.							
							Total: 60

TEXTBOOKS	
1	Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley India, 2011.
2	Grewal. B.S., Higher Engineering Mathematics, 42nd Edition, Khanna Publishers, Delhi, 2012.
3	Narayanan. S., Manickavachagam Pillay. T. K and Ramanaiah. G Advanced Mathematics for Engineering Students, Vol. II & III, S. Viswanathan Publishers Pvt. Ltd.1998.
REFERENCES	
1	Veerarajan. T., Transforms and Partial Differential Equation, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.

2	Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill Education Private Ltd., 9th Edition, New Delhi 2010
3	Michael Greenberg, Advanced Engineering Mathematics, 2nd Edition, Pearson Education, 2011

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Acquire problem solving skills to handle first order and higher order Partial differential equations.	K3
CO2	Demonstrate Fourier series to study the behaviour of periodic functions and their applications in engineering problems such as system communications, digital signal processing and field theory.	K3
CO3	Develop skills in classification, formulation, solution, and interpretation of PDE models.	K3
CO4	Develop the skill of conversion between time domain to frequency domain using the concept of Fourier Transforms.	K3
CO5	Use the effective mathematical tools for the solutions of partial differential equations by using Z-transform techniques for discrete time systems.	K4

CO-PO Mapping

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

APH102 ENGINEERING MATERIALS AND METALLURGY

Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		2	**BS**	**3**	**0**	**0**	**3**

Preamble	➢ To learn the constructing the phase diagram and using of iron-iron carbide phase diagram for ➢ microstructure formation. ➢ To learn selecting and applying various heat treatment processes and its microstructure formation.

	➢ To illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field. ➢ To illustrate the different polymer, ceramics and composites and their uses in engineering field. ➢ To learn the various testing procedures and failure mechanism in engineering field	
Unit 1	**CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS**	**9**
Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast-Iron microstructure, properties and application		
Unit 2	**MECHANICAL TESTING**	**9**
Testing of materials under tension, compression and shear loads, Hardness tests, fatigue and creep test. Impact testing, Fatigue testing, Fracture, Types, Fracture mechanics. Characteristics of creep curve & steady state creep. Fracture toughness & fatigue, Stress and temperature effects		
Unit 3	**HEAT TREATMENT**	**9**
Definition – Full annealing, stress relief, recrystallisation and spheroidising –normalizing, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram – continuous cooling Transformation (CCT) diagram – Austempering, Martempering – Hardenability, Jominy end quench test -case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening – Thermo-mechanical treatments.		
Unit 4	**FERROUS AND NON-FERROUS METALS**	**9**
Effect of alloying additions on steel – stainless and tool steels – HSLA - Maraging steels – Grey, white, malleable, spheroidal – alloy cast irons, Copper and its alloys – Brass, Bronze and Cupronickel – Aluminium and its alloys; Al-Cu – precipitation strengthening treatment – Titanium alloys, Mg-alloys, Ni-based super alloys – shape memory alloys- Properties and Applications – overview of materials standards		
Unit 5	**NON-METALLIC MATERIALS**	**9**
Polymers – types of polymers, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PAI, PPO, PPS, PEEK, PTFE, Thermoset polymers – Urea and Phenol formaldehydes –Nylon, Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON – intermetallic- Composites- Matrix and reinforcement Materials, applications of Composites - Nano composites.		
		Total: 45
TEXTBOOKS		
1	William D. Callister, Jr. (2020) “Materials Science and Engineering an Introduction”, 2nd Edition, John Wiley & Sons, Inc..	
2	V. Raghavan (2019), “Materials Science and Engineering”, Prentice – Hall of India Pvt. Ltd.	
3	A. Alavudeen, N. Venkateshwaran, and J. T. WinowlinJappes, A Textbook of Engineering Materials and Metallurgy, Laxmi Publications, 2006	
REFERENCES		

1	J.M. Shackelford (2014), Introduction to Materials Science for Engineers, 5thEdition, Prentice Hall, Inc.
2	Suryanarayana, A. V. K. (2020), Testing of Metallic Materials, Prentice Hall India, New Delhi
3	W. Bolton (2013), Engineering materials technology, 3 rd Edition, Butterworth &Heinemann

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classification.	K2
CO2	Explain the testing of mechanical properties.	K2
CO3	Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.	K2
CO4	Clarify the effect of alloying elements on ferrous and non-ferrous metals.	K2
CO5	Summarize the properties and applications of non-metallic materials	K"

CO-PO Mapping

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

AAI101 INTRODUCTION TO DATA SCIENCE							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		2	**ES**	**3**	**0**	**0**	**3**
Preamble	➢ To understand the data science fundamentals and process. ➢ To learn to describe the data for the data science process. ➢ To learn to describe the relationship between data. ➢ To utilize the Python libraries for Data Wrangling. ➢ To present and interpret data using visualization libraries in Python						
Unit 1	**INTRODUCTION**						**9**
Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model–presenting							

findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data		
Unit 2	**DESCRIBING DATA**	**9**
Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores		
Unit 3	**DESCRIBING RELATIONSHIPS**	**9**
Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula forcorrelation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean		
Unit 4	**PYTHON LIBRARIES FOR DATA WRANGLING**	**9**
Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, Boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets –aggregation and grouping – pivot tables		
Unit 5	**DATA VISUALIZATION**	**9**
Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.		
		Total: 45

TEXTBOOKS	
1	David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit I)
2	Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.(Units II and III
3	Jake Vander Plas, “Python Data Science Handbook”, O’Reilly, 2016. (Units IV and V)
REFERENCES	
1	Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014.

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Define the data science process	K1
CO2	Understand different types of data description for data science process	K2
CO3	Gain knowledge on relationships between data	K2
CO4	Use the Python Libraries for Data Wrangling	K3
CO5	Apply visualization Libraries in Python to interpret and explore data	K3

CO-PO Mapping

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

AME102 ENGINEERING MECHANICS							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		2	**PC**	**3**	**0**	**0**	**3**
Preamble	➢ To Learn the use scalar and vector analytical techniques for analysing forces in statically determinate structures ➢ To introduce the equilibrium of rigid bodies, vector methods and free body diagram o study and understand the distributed forces, surface, loading on beam and intensity. ➢ To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems. ➢ To develop basic dynamics concepts – force, momentum, work and energy.						
Unit 1	**BASICS AND STATICS OF PARTICLES**						**9**
Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces — Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility.							
Unit 2	**EQUILIBRIUM OF RIGID BODIES**						**9**
Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.							
Unit 3	**PROPERTIES OF SURFACES AND SOLIDS**						**9**
Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia-							

Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.		
Unit 4	**DYNAMICS OF PARTICLES**	**9**
Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.		
Unit 5	**FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS**	**9**
Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.		
		Total: 45

TEXTBOOKS	
1	Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2	Vela Murali, "Engineering Mechanics", Oxford University Press (2010).
3	Kumar, K.L., "Engineering Mechanics", 3rd Revised Edition, Tata McGraw-Hill Publishing company, New Delhi 2008.
REFERENCES	
1	Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
2	Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
3	Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
4	Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005
5	Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Illustrate the vector and scalar representation of forces and moments.	K2
CO2	Analyse the rigid body in equilibrium.	K4
CO3	Evaluate the properties of distributed forces.	K4
CO4	Determine the friction and the effects by the laws of friction.	K3
CO5	Calculate dynamic forces exerted in rigid body.	K4

CO-PO Mapping

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

ACS104 FUNDAMENTALS OF CLOUD COMPUTING							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		2	**ES**	**3**	**0**	**0**	**3**
Preamble	➢ To understand the principles of cloud architecture, models and infrastructure. ➢ To understand the concepts of virtualization and virtual machines. ➢ To gain knowledge about virtualization Infrastructure. ➢ To explore and experiment with various Cloud deployment environments. ➢ To learn about the security issues in the cloud environment.						
Unit 1	**BASIC CONCEPTS OF CLOUD COMPUTING**						**9**
Network-Based Systems- Concepts of Distributed Systems. Definition of Cloud, Concepts of Cloud Computing. Cloud Service Providers, NIST Cloud Computing, Cloud Characteristics							
Unit 2	**CLOUD INFRASTRUCTURE**						**9**
Cloud Pros and Cons. Layered Architectural Design, Cloud Delivery Models. Cloud Deployment Models, Architectural Design Challenges, Cloud Storage - Storage-as-a-Service – Advantages of Cloud Storage - Cloud Storage Providers - S3.							
Unit 3	**VIRTUALIZATION BASICS**						**9**
Virtual Machine and its architecture–VM primitive operations- Virtual Infrastructures- Data Center Virtualization for Cloud Computing–Levels of Virtualization Implementation – VMM Design Requirements, Virtualization Support at the OS Level, Physical versus Virtual Clusters. Live VM Migration Steps							
Unit 4	**BUILDING CLOUD NETWORKS**						**9**
Designing and Implementing a Data Center-Based Cloud Installing Open Source Cloud service. Virtual Box – Eucalyptus Public Cloud Platforms: Google App Engine, Amazon Web Services (AWS). Google Cloud Platform. Emerging Cloud Software Environments							
Unit 5	**CLOUD SECURITY AND APPLICATIONS**						**9**
Cloud Security Infrastructure Security Network level security- Host level security, Application level security- Data privacy and security Issues. Access Control and Authentication in cloud computing, IAM Security Standards							
							Total: 45
TEXTBOOKS							

1	Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things, Morgan Kaufmann Publishers, 2012.
2	Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi
REFERENCES	
1	Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
2	Krutz, R. L., Vines, R. D, “Cloud security. A Comprehensive Guide to Secure Cloud Computing”, Wiley Publishing, 2010

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Understand the design challenges in the cloud.	K2
CO2	Apply the concept of virtualization and its types.	K3
CO3	Experiment with virtualization of hardware resources.	K3
CO4	Develop and deploy services on the cloud and set up a cloud environment.	K3
CO5	Explain security challenges in the cloud environment.	K2

CO-PO Mapping

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

AHS101 தமிழர்மரபு							
Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		2	**HS**	**1**	**0**	**0**	**1**
Preamble	1. தமிழர் களின்வண் பாட் டினைறிதல் 2. அறத் தோடுவாழ் தல்						
அலகு I	**மொழிமற் றும் இலக் கியம்**						**3**
இந் தியமொழிக் குடும் பங் கதிராவிட மொழிகள்-தமிழ் ஒரு செம் மொழி தமிழ் செவ் விலக் கியங் -கால் கஇலக் கியத் தின்மையச் சார்பற் றதன் மை சங் க இலக் கியத் தில் பகிர் தறம் – திருக் குறளில் மேலாண் மைக்							

கருத் துக் கதமிழ் க் காப் பியங் கதமிழகத் தில் சமணபௌத் த சமயங் களின் தாக் கம்பக் தி இலக் கியம்ஆழ் வார் கள் மற் றும் நாயன் மார் கதிற் றிலக் கியங் -தமிழில் நவீன இலக் கியத் திவளர் ச் சி தமிழ் இலக் கியவளர் ச் சியிலரதியார் மற் றும்பாரதிதாசன் ஆகியோரின் பங் களிப். பு		
அலகு II	**மரபு –பாறை ஓவியங்கள் முதல் நவீ ன ஓவியங்கள் வரை சிற்பக்கலை**	**3**
நடுகல் முதல் நவீன சிற் பங் கள் – ஐம்பொன் சிலைகள்வாழங் குடியினர் மற் றும் அவர் கள் தயாரிக் கும் கைவினைப் பொருட்கள்கல்மகள் – தேர் செய் யும் கலைகூடுமண் சிற் பங் கள்தாட் டுப் புறத் தெய் வங்குகூரி முனையில் திருவள் ளுவர் சிலைஇசைக் கருவிகள் – மிருதங் கம், பறை, வீணை, யாழ், நாதஸ் வரம் – தமிழர் களின் சமூகபொருளாதார வாழ் வில் கோவில் களின் பங் கு		
அலகு III	**நாட்டுப் புறக்கலைகள் மற்றும் வீ ரவிளையாட்டுகள்**	**3**
தெருக் கூத்,தோகாட் டம் வில் லுப் பாட் டுதிணியான் கூத், துஓயிலாட் டம் தோல் பாவைக் கூத் துலம் பாட் டம்வளரி, புலியாட் டம் தமிழர் களின் விளையாட் டுகள்		
அலகு IV	**தமிழர்களின் திணைக் கோட்பாடுகள்**	**3**
தமிழகத் தின் தாவரங் களும்விலங் குகளும் – தொல் காப் பியம் மற் றும் சங் இலக் கியத் தில் அகம் மற் றும் புறக் கோட் பாடுதமிழர்கள் போற் றிய அறக் கோட் பாடு சங் ககாலத் தில் தமிழகத் தில் எழுத் தறிவுவியும் – சங் ககால நகரங் களும் துறைமுகங் களும்ககாலத் தில் ஏற் றுமதி மற் றும் இறக் குமதி கடல் கடந் த நாடுகளில் சோழர் களின் .வெற் றி		
அலகு V	**இந் திய தேசிய இயக் கம் மற் றும்திய பண் பாட் டிற் குத் தமிழர் களின் பங் களிப் பு**	**3**
இந் திய விடுதலைப் போரில் தமிழர் களின் பங் குந் தியாவின் பிறப் பகுதிகளில் தமிழ் ப் பண் பாட் டின் – தாக்கரிகம்பாதை இயக் கம் – இந் திய மருத் துவத் ,திலித் த மருத் துவத் தின் பங் குல் வெட் டுகள் கையெழுத் துப் படிகதமிழ் ப் புத் தகங் களின் அச் சுவரலாறு		
		Total: 15
TEXTBOOKS		
1	தமிழகவரலாறு – மக் களும் பண் பாடும்கே.கே. பிள் ளை (வெளியீடு:தமிழ் நாடு பாடநூல் மற் றும் கல் வியியல் பணிக கழகம்).	
2	கணினித் தமிழ்முனைவர் இலசுந் தரம்(விகடன் பிரசுரம்)	

3	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
REFERENCES	
1	கீழடி – வைகை நதிக் கரையில் சங் க கால நகர நாக((தொல் லியல் துறைவெளிய்டு
2	பொருநை ஆற் றங் கரைநாகரிகம். (தொல் லியல் துற வெளியீடு)
3	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

AHS101 HERITAGE OF TAMILS							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		2	**HS**	**1**	**0**	**0**	**1**
Preamble	1. To know the culture of Tamils 2. To live virtuously						
UNIT I	**LANGUAGE AND LITERATURE**						**3**
Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.							
UNIT II	**HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE**						**3**
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.							
UNIT III	**FOLK AND MARTIAL ARTS**						**3**
Therukoothu, Karagattam, VilluPattu, KaniyanKoothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.							
UNIT IV	**THINAI CONCEPT OF TAMILS**						**3**
Flora and Fauna of Tamils &Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas							
UNIT V	**CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**						**3**
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.							

	Total: 15
TEXTBOOKS	
1	தமிழகவரலாறு – மக் களும் பண் பாடும்கே.கே. பிள் ளை (வெளியீடு:தமிழ் நாடுபாடநூல் மற் றும்கல் வியியல்பணிகள் கழகம்).
2	கணினித் தமிழ் முனைவர் இலசுந் தரம்(விகடன் பிரசுரம்)
3	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
REFERENCES	
1	கீழடி – வைகை நதிக் கரையில் சங் க கால நகர நாகரிகம் (தொல் லியல் துறைவெளியீடு
2	பொருநை ஆற் றங் கரைநாகரிகம். (தொல் லியல் துறை வெளியீடு)
3	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

CO-PO Mapping

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

AMC103 INDIAN CONSTITUTION							
Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
		2	**MC**	**2**	**0**	**0**	**0**
Preamble	➢ This course intends to impart a comprehensive outlook about the nature of the Indian constitution; rights and duties of the citizens, Political Institutions of Central and State governments and its relationship with each other and the organization and functions of local government. ➢ A detailed analysis of the functions of the statutory bodies are incorporated in this course.						
Unit 1							**9**
Constitutional Assembly – Philosophy – Preamble – Salient Features of Indian Constitution							
Unit 2							**9**

Fundamental Rights – Directive Principles of State Policy – Fundamental Duties.		
Unit 3		**9**
Union Executive – President: Election – Powers and Functions – Council of Ministers – Prime Minister: Position and Powers – Relationship between Prime Minister and President. State Executive – Governor: Powers and functions – Chief Minister: Position and Powers – Relationship between Chief Minister and Governor.		
Unit 4		**9**
Union Legislature: Structure, Powers and Functions – Speaker: Power and Functions – Procedures of Constitutional Amendment – State Legislature: Structure, Powers and Functions.		
Unit 5		**9**
Judiciary – Supreme Court: Powers and Functions – High Court: Powers and Functions – Judicial Review		
		Total: 45

TEXTBOOKS	
1	Siwach, J.R, Dynamics of Indian Government and Politics, New Delhi: Sterling, 1985.
2	Narang, A.S., Indian Government and Politics New Delhi: Gitanjali ,1995
REFERENCES	
1	Thakur, R. The Government and Politics of India: London: Macmillan, 1995.
2	Gupta, D.C, Indian Government and Politic, New Delhi, 1996

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Understand the meaning and importance of Constitution, Fundamental rights and duties, union government, state and local governments, other statutory bodies.	K2
CO2	Create awareness about social responsibilities.	K3
CO3	To apply the functioning of Union, State and Local Governments in Indian federal system.	K3
CO4	To analyze election commission and amendment procedure for various statuary bodies.	K4
CO5	Understand the meaning and importance of Constitution, Fundamental rights and duties, union government, state and local governments, other statutory bodies.	K2

CO-PO Mapping

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

AME301 BASIC CIVIL AND MECHANICAL LABORATORY							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		2	**ES**	**0**	**0**	**4**	**2**
Preamble	➢ To provide exposure to the students with hands on experience on various basic engineering practices in Civil, and Mechanical Engineering						

LIST OF EXPERIMENTS

I CIVIL ENGINEERING PRACTICE

Buildings:

Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

1.Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

(b) Study of pipe connections requirements for pumps and turbines.

(c) Preparation of plumbing line sketches for water supply and sewage works.

(d) Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

2.Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.

(b) Hands-on-exercise:

Wood work, joints by sawing, planning and cutting

II MECHANICAL ENGINEERING PRACTICE

1.Welding:

(a) Preparation of arc welding of butt joints, lap joints and tee joints.

(b) Gas welding practice

2.Basic Machining:

(a) Simple Facing, Turning and Taper turning

(b) Drilling Practice

3.Sheet Metal Work:

(a) Forming & Bending:

(b) Model making – Trays, funnels, etc.

(c) Different type of joints.

4.Machine assembly practice:

(a) Study of centrifugal pump

(b) Study of air conditioner

5.Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.

(b) Foundry operations like mould preparation for gear and step cone pulley.

(c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.

		Total: 60
COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Fabricate carpentry components and pipe connections including plumbing works.	K3
CO2	Use welding equipments to join the structures.	K3
CO3	Carry out the basic machining operations.	K3
CO4	Make the models using sheet metal works.	K3
CO5	Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings.	K3

CO-PO Mapping

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

ACS302 CLOUD COMPUTING LABORATORY							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		2	**ES**	**0**	**0**	**4**	**2**
Preamble	➢ To learn the basics and types of Virtualization ➢ To understand the Hypervisors and its types ➢ To Explore the Virtualization Solutions ➢ To Experiment the virtualization platforms						
LIST OF EXPERIMENTS							
1. Create type 2 virtualization in VMWARE or any equivalent Open Source Tool. Allocate memory and storage space as per requirement. Install Guest OS on that VMWARE.							
2. Find a procedure for the following							
a. Shrink and extend virtual disk							
b. Create, Manage, Configure and schedule snapshots							
c. Create Spanned, Mirrored and Striped volume							
d. Create RAID 5 volume							
3. Desktop Virtualization using VNC and Chrome Remote Desktop							

4. Create type 2 virtualization on ESXI 6.5 server
5. Create a VLAN in CISCO packet tracer
6. Install KVM in Linux
7. Create Nested Virtual Machine (VM under another VM)
8. Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs
9. Install Google App Engine. Create a hello world app and other simple web applications using python/java.
10.Find a procedure to transfer the files from one virtual machine to another virtual machine
Total: 60

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Analyze the virtualization concepts and Hypervisor	K3
CO2	Apply the Virtualization for real-world applications	K3
CO3	Install & configure the different VM platforms	K3
CO4	Experiment with the VM with various software	K3

CO-PO Mapping

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

SEM – III

AME103 - ENGINEERING THERMODYNAMICS							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		3	**PC**	**3**	**0**	**0**	**3**
Preamble	➢ Impart knowledge on the basics and application of zeroth and first law of thermodynamics. ➢ Impart knowledge on the second law of thermodynamics in analysing the performance of thermal devices. ➢ Impart knowledge on availability and applications of second law of thermodynamics. ➢ Teach the various properties of steam through steam tables and Mollier chart. ➢ Impart knowledge on the macroscopic properties of ideal and real gases.						
Unit 1	**BASICS, ZEROTH AND FIRST LAW**						**9**
Review of Basics – Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes.							
Unit 2	**SECOND LAW AND AVAILABILITY ANALYSIS**						**9**
Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Second law and its corollaries - Clausius inequality - Concept of entropy, T-s diagram, Tds Equations, entropy change for - pure substance, ideal gases - different processes, principle of increase in entropy - Applications of II Law. Available and non-available energy of a source and finite body. Energy and irreversibility - Irreversibility I and II law Efficiency.							
Unit 3	**PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE**						**9**
Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Economizer, preheater, Binary and Combined cycle.							
Unit 4	**IDEAL AND REAL GASES, THEMODYNAMIC RELATIONS**						**9**
Properties of Ideal gas - Equations of state for ideal and real gases - Reduced properties. Compressibility factor - Principle of Corresponding states - Generalised Compressibility Chart and its use - Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes. Simple Calculations.							
Unit 5	**GAS MIXTURES AND PSYCHROMETRY**						**9**
Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Psychrometric terms - Psychrometric properties - Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – cooling load calculations - simple Applications							
							Total: 45
TEXTBOOKS							

1	Nag.P.K., “Engineering Thermodynamics”, 6th Edition, Tata McGraw Hill, 2017.
2	R.K.Rajput, “A Text Book Of Engineering Thermodynamics “, 5th Edition, 2017.
3	Rathakrishnan, E, “Fundamentals of Engineering Thermodynamics”, 2nd Edition, Prentice Hall of India Pvt Ltd, 2006.
4	Venkatesh A, “Basic Engineering Thermodynamics”, Universities Press (India) Limited, 2007.
REFERENCES	
1	Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,9th Edition, 2019.
2	Chattopadhyay, P, “Engineering Thermodynamics”, 2nd Edition Oxford University Press, 2016.
3	Claus Borgnakke and Richard E. Sonntag, “Fundamentals of Thermodynamics”, 10th Edition, Wiley Eastern, 2019.
4	Michael J. Moran, Howard N. Shapiro, “Fundamentals of Engineering Thermodynamics”, 8th Edition, 2014.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Apply the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems.	K3
CO2	Apply the second law of thermodynamics in analysing the performance of thermal devices through energy and entropy calculations.	K3
CO3	Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart.	K3
CO4	Apply the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations.	K3
CO5	Apply the properties of gas mixtures in calculating the properties of gas mixtures and applying various thermodynamic relations to calculate property changes.	K3

CO-PO Mapping

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

AME104 - FLUID MECHANICS AND MACHINERY							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		3	**PC**	**3**	**0**	**0**	**3**
Preamble	➢ To introduce the students about properties of the fluids, behaviour of fluids under static conditions. ➢ To impart basic knowledge of the dynamics of fluids and boundary layer concept. ➢ To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (laminar and turbulent) and c) forces on pipe bends. ➢ To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine. ➢ To impart a knowledge about centrifugal and reciprocating pumps.						
Unit 1	**FLUID PROPERTIES AND FLUID STATICS**						**8**
Introduction - properties of fluids - Types of fluid flows - Fluid pressure at a point - Pascal's law - pressure variation in a static fluid, absolute, gauge, atmospheric & vacuum pressures.							
Unit 2	**FLUID KINEMATICS AND DYNAMICS**						**9**
Fluid Kinematics: Introduction - Lagrangian and Eulerian Approach for fluid flow - Continuity equation Velocity and acceleration in a flow field - Potential and stream function. Fluid Dynamics: Introduction - Equation of motion, Euler's equation of motion - Bernoulli's equation derived from fundamental - Euler's equation. Fluid Flow measurements-Venturi meter - orifice meter - Pitot tube. Flow through Pipes - Major & Minor losses in pipe flow - Numerical exercise.							
Unit 3	**DIMENSIONAL ANALYSIS AND BOUNDARY LAYERS**						**9**
Introduction - Dimensional homogeneity –Buckingham theorem – Non-dimensional numbers – Model laws - Unit Quantities and Specific quantities, introduction to boundary layer theory –Laminar flow and Turbulent flow – Boundary layer thickness.							
Unit 4	**HYDRAULIC TURBINES**						**10**
Euler's Turbine equation - Classification of turbines – work done and efficiencies - Draft tube theory - Performance of hydraulic machines - unit and specific quantities - turbine governing.							
Unit 5	**PUMPS**						**9**
Classification - working, work done – manometric head - losses and efficiencies - specific speed - pumps in series and parallel - performance characteristic curves - discharge, slip.							
							Total: 45

TEXTBOOKS	
1	Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", 23rd Edition, Standard Book House, New Delhi 2019.
REFERENCES	
1	Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co, 9th Edition, 2017.
2	Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House Pvt Ltd., New Delhi 2006
3	Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics", 2018.
4	Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Understand the properties and behaviour in static conditions. Also, to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics.	K2
CO2	Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also, to understand the concept of boundary layer and its thickness on the flat solid surface.	K3
CO3	Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies.	K2
CO4	Explain the working principles of various turbines and design the various types of turbines.	K2
CO5	Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps.	K2

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

AME105 - STRENGTH OF MATERIALS							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		3	**PC**	**3**	**0**	**0**	**3**
Preamble	➢ To understand the concepts of stress, strain, and relationship between elastic constants. ➢ To understand the principal stresses and principal planes and to study the stresses and deformations induced in thin and thick shells. ➢ To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses. ➢ To determine stresses and deformation in circular shafts and helical spring due to torsion. ➢ To understand the concept of strain energy for various loading effects.						
Unit 1	**STRESS AND STRAIN**						**9**

Introduction, Properties of materials, Stress, Strain and Hooke's law, Stress strain diagram for brittle and ductile materials, True stress and strain, Shear stress and strain, Lateral strain and Poisson's ratio, Elastic constants and relations between them. Calculation of stresses in straight, Stepped and tapered sections, Composite sections, Stresses due to temperature change.		
Unit 2	**ANALYSIS OF STRESS AND STRAIN**	**9**
Compound Stresses: Principal stresses and maximum shear stress, Planes of Principal stress and Maximum Shear stress, Normal stress on the planes of maximum shear stress, Mohr's circle for plane stress conditions. Cylinders: Thin cylinder: Hoop's stress, maximum shear stress, circumferential and longitudinal strains, thin spherical Shell, thin cylinder with spherical ends. Thick cylinders: Lame's theory.		
Unit 3	**SHEAR FORCES AND BENDING MOMENT**	**9**
Shear Forces and Bending Moments: Type of beams, Loads and reactions, Relationship between loads, Shear force and bending moments of cantilever, simply supported and overhanging beams subjected to concentrated loads and uniformly distributed constant / varying loads. Stress in Beams: Bending Theory, Bending and shear stress distribution in rectangular, I and T section beams.		
Unit 4	**TORSION**	**9**
Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.		
Unit 5	**STRAIN ENERGY**	**9**
Strain Energy Strain Energy: Strain energy due to axial, shear, bending, torsion and impact load, Castigliano's theorem and their applications. Theories of Failure: Introduction, maximum principal stress theory, Maximum shearing stress theory, maximum principal strain theory, Maximum Strain energy theory and Maximum Shear Strain Energy Theory.		
		Total: 45

TEXTBOOKS	
1	Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2011
2	Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2012.
REFERENCES	
1	Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2001
2	Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2nd edition, 2010.
3	Hibbeler, R.C., "Mechanics of Materials", Pearson Education, 10th Edition, 2022.
4	Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 5th Edition, 2009.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Calculate stress and strain for different geometries under different loading conditions.	K2
CO2	Calculate the stresses and strains associated with thin and thick cylindrical pressure vessels under axial and circumferential loads.	K2

CO3	Construct shear force and bending moment diagrams for statically determinate beams.	K3
CO4	Calculate the shear stress for bodies subjected to torsion and bending stresses for columns.	K2
CO5	Discuss theories of failure as applied to materials.	K2

CO-PO Mapping

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

AME106 - MANUFACTURING PROCESSES

Programme & Branch	BE & MECH	Sem.	Category	L	T	P	C
		3	PC	3	0	0	3

Preamble	➢ To illustrate the working principles of various metal casting processes. ➢ To learn and apply the working principles of various metal joining processes. ➢ To analyse the working principles of bulk deformation of metals. ➢ To learn the working principles of sheet metal forming process. ➢ To study and practice the working principles of plastics molding.

Unit 1	**CASTING PROCESS**	**9**

Casting- Introduction, Advantages and applications; Principle of casting processes – Sand casting, Centrifugal casting, pressure die casting, Investment casting, stir casting, solidification of casting, Gating-Principles, requirements and types, Riser – Function, types, design, Defects in castings. Patterns – Types, making, materials and allowances.

Unit 2	**METAL FORMING**	**9**

Hot working & cold working, plastic deformation, yield criteria, strain hardening, recovery, recrystallization and grain growth. Rolling types & process, drawing types, sheet forming types & process, Extrusion process types, Forging Processes, classification & types- Power forging, Impression die forging, press forging, upset forging, defects in forging.

Unit 3	**WELDING PROCESS**	**9**

Welding process: Classification, morphology of fusion weld, working principle, Fusion welding: Arc welding- Gas Metal Arc Welding (MIG), Gas Tungsten Arc Welding (TIG), Shielded Metal Arc Welding (SMAW), plasma arc welding, oxyfuel gas welding, Resistance welding- spot, seam, projection, Solid state welding: Friction, friction stir welding, ultrasonic welding, forge welding, electromagnetic pulse welding, hot isostatic pressure welding, Laser welding, Electron beam welding, thermit welding.

Unit 4	**PROCESSING OF PLASTICS**	**9**

Classification of Polymers, Forms of raw plastic material, Types and characteristics of plastics, methods of processing plastics, moulding of thermoplastics – working principles and applications, compression moulding, Transfer Moulding, blow moulding, rotational moulding, Film blowing, Thermoforming.		
Unit 5	**SHEET METAL PROCESSES**	**9**
Sheet metal characteristics – shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes-Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning– Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming.		
		Total: 45

TEXTBOOKS	
1	Hajra Chouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2008
2	Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 7th edition, 2018.
REFERENCES	
1	Gowri P. Hariharan, A.Suresh Babu, "Manufacturing Technology I", Pearson Education, 2008.
2	Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" Eight Edition, Prentice – Hall of India, 2007.
3	Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 4th Edition, TMH - 2013
4	Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006
5	Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., Imprint, 2022.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Explain different metal casting processes, associated defects, merits and demerits.	K2
CO2	Compare different metal joining processes.	K2
CO3	Explain various welding processes.	K2
CO4	Distinguish various methods of manufacturing plastic components.	K2
CO5	Explain various sheet metal making processes.	K2

CO-PO Mapping

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

AMC104 - ENVIRONMENTAL ENGINEERING AND SUSTAINABILITY							
Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		3	**MC**	**2**	**0**	**0**	**0**
Preamble	➢ To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation. ➢ To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters. ➢ To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them. ➢ To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management. ➢ To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.						
Unit 1	**ENVIRONMENT AND BIODIVERSITY**						**6**
Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.							
Unit 2	**ENVIRONMENTAL POLLUTION**						**6**
Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.							
Unit 3	**RENEWABLE SOURCES OF ENERGY**						**6**
Energy management and conservation, New Energy Sources: Need of new sources. Different types of new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.							
Unit 4	**SUSTAINABILITY AND MANAGEMENT**						**6**
Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.							
Unit 5	**SUSTAINABILITY PRACTICES**						**6**
Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy							

efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles - carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio economic and technological change.	
	Total: 30
TEXTBOOKS	
1	Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2	Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3	Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5	Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6	Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7	Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.
REFERENCES	
1	R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . Edition 2010.
2	Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3	Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4	Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5	Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.	K2
CO2	To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.	K2
CO3	To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.	K2
CO4	To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.	K2

CO5	To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.	K2

CO-PO Mapping

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

AME302 - FLUID MECHANICS AND MACHINERY LABORATORY							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		3	**PC**	**0**	**0**	**4**	**2**
Preamble	Upon Completion of this subject, the students can be able to have hands on experience in flow measurements using different devices and also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.,						
LIST OF EXPERIMENTS							
1. Determination of the Coefficient of discharge of given Orifice meter.							
2. Determination of the Coefficient of discharge of given Venturi meter.							
3. Calculation of the rate of flow using Rota meter.							
4. Determination of friction factor for a given set of pipes.							
5. Conducting experiments and drawing the characteristic curves of centrifugal pump/ submergible pump							
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.							
7. Conducting experiments and drawing the characteristic curves of Gear pump.							
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.							
9. Conducting experiments and drawing the characteristics curves of Francis turbine.							
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.							
Total: 60							

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Ability to use measurement equipment for flow measurement.	K2
CO2	Analyze the coefficient of discharge in the orifice meter, venturi meter and rotameter.	K3
CO3	Visualize the flow net and verify the 57ernoulli's equation.	K2

CO4	Determine the losses in flow through pipes	K2
CO5	Analyze the performance characteristic curves of turbines and pumps	K3

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

SEM – IV

AME107 - THEORY OF MACHINES							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		4	**PC**	**3**	**0**	**0**	**3**
Preamble	➢ To understand the basic components and layout of linkages in the assembly of a system machine. ➢ To understand the principles in analysing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism. ➢ To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms. ➢ To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism. ➢ To design cam mechanisms for specified output motions and understand the principles in mechanisms used for speed and stability control.						
Unit 1	**BASICS OF MECHANISM**						**9**
Mechanisms – Terminology and definitions – Degrees of freedom, Grubler's criterion - kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms - Quick return motion Mechanisms - Straight line motion mechanisms - Intermittent Motion mechanisms - Toggle mechanism, Universal Hooke's Joint.							
Unit 2	**KINEMATICS OF LINKAGE MECHANISM**						**9**
Velocity and acceleration analysis of Four Bar mechanism, slider crank mechanism. Relative velocity and acceleration of particles in a common link and coincident Particles on separate links- Coriolis component of acceleration. Velocity Analysis by Instantaneous Center Method. Klein's Construction: Analysis of velocity and acceleration of single slider crank mechanism.							
Unit 3	**FORCE ANALYSIS**						**9**
Dynamic force analysis – Inertia force and Inertia torque – D Alembert's principle – Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels.							
Unit 4	**BALANCING & VIBRATION**						**9**
Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing.							
Unit 5	**MECHANISMS**						**9**
Cams and followers. Development of cam profile for various types of followers and its different motion. Governors: Types – characteristics - force analysis. Gyroscope: Vector representation of angular motion. Gyroscopic couple, effect of gyroscopic couple on ship, plane disc, aero plane. Gear and Gear trains – law of toothed gearing - epicyclic gear train.							
							Total: 45
TEXTBOOKS							
1	F. B. Sayyad, "Dynamics of Machinery", McMillan Publishers India Ltd., Tech-Max Educational resources, 2023.						
2	Rattan, S.S, "Theory of Machines", 5th Edition, Tata McGraw-Hill, 2023.						

3	Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 6th Edition, Oxford University Press, 2023.
REFERENCES	
1	Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2016
2	Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006.
3	Rao.J.S. and Dukkipati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
4	Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2017.
5	V.Ramamurthi, "Mechanics of Machines", Narosa Publishing House, 2002.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Discuss the fundamentals of various mechanisms and its inversion.	K2
CO2	Perform velocity and acceleration analysis of a particle in each system and angular velocity of rigid bodies that are in plane motion.	K3
CO3	Solve the problems related to balancing the parts in rotating and reciprocating systems.	K4
CO4	Apply the principles of balancing of masses to various systems and engines.	K4
CO5	Construct the cam profile for a desired motion. Recognize the fundamentals of governor and gyroscope.	K4

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

AME108 - METROLOGY AND MEASUREMENTS							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		4	**PC**	**3**	**0**	**0**	**3**
Preamble	➢ To learn basic concepts of the metrology and importance of measurements.						

	➢ To teach measurement of linear and angular dimensions assembly and transmission elements. ➢ To study the tolerance analysis in manufacturing. ➢ To develop the fundamentals of GD & T and surface metrology. ➢ To provide the knowledge of the advanced measurements for quality control in manufacturing industries.	
Unit 1	**MEASUREMENT SYSTEMS AND PERFORMANCE**	**9**
Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types of standards.		
Unit 2	**LINEAR, ANGULAR AND FORM MEASUREMENTS**	**9**
Linear Measuring Instruments – Vernier calliper, Micrometre, Vernier height gauge, Depth Micrometre, bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector - Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope. Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.		
Unit 3	**TOLERANCE ANALYSIS**	**9**
Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.		
Unit 4	**METROLOGY OF SURFACES**	**9**
Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.		
Unit 5	**ADVANCES IN METROLOGY**	**9**
Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers – Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multi sensor CMMs. Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in process monitoring in production - Computed tomography – White light Scanners.		
		Total: 45
TEXTBOOKS		
1	Dotson Connie, “Dimensional Metrology”, Cengage Learning, 6th, 2016.	
2	Mark Curtis, Francis T. Farago, “Handbook of Dimensional Measurement”, Industrial Press, 5th edition, 2013.	
3	Beckwith Marangoni and Lienhard, “Mechanical Measurements”, Pearson Education, 6th Edition, 2013.	
4	R.K. Jain, “Engineering Metrology”, Khanna Publishers, 22nd edition, 2022.	
REFERENCES		

1	Ammar Grous J, “Applied Metrology for Manufacturing Engineering”, Wiley-ISTE, 2013.
2	Galyer, J.F.W. Charles Reginald Shot bolt, “Metrology for Engineers”, Cengage Learning EMEA; 5th revised edition, 1990.
3	National Physical Laboratory Guide No. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131.
4	Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013.
5	Venkateshan, S. P., “Mechanical Measurements”, Second edition, John Wiley &Sons, 2015.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Discuss the concepts of measurements to apply in various metrological instruments.	K2
CO2	Apply the principle and applications of linear and angular measuring instruments, assembly, and transmission elements.	K2
CO3	Apply the tolerance symbols and tolerance analysis for industrial applications.	K2
CO4	Apply the principles and methods of form and surface metrology.	K2
CO5	Apply the advances in measurements for quality control in manufacturing Industries.	K2

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

AME109 - CONVENTIONAL AND UNCONVENTIONAL MACHINING PROCESSES							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		4	**PC**	**3**	**0**	**0**	**3**
Preamble	➢ To study the concepts and basic mechanics of metal cutting and the factors affecting machinability ➢ To learn working of basic and advanced turning machines. ➢ To teach the basics of special purpose machines with reciprocating and rotating motions and abrasive finishing processes. ➢ To study the basic concepts of CNC of machine tools and CNC programming.						

	➢ To learn the concepts of unconventional machining processes.	
Unit 1	**THEORY OF METAL CUTTING**	**9**
Mechanics of chip formation, single point cutting tool, forces in machining, Types of chips, cutting tools–nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.		
Unit 2	**TURNING MACHINES**	**9**
Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type.		
Unit 3	**SPECIAL PURPOSE MACHINES**	**9**
Shaper, Drilling, reaming, boring, Tapping. Milling operations-types of milling cutter. Gear cutting – gear milling, hobbing and gear shaping processes. Abrasive processes: grinding wheel – specifications and selection, types of grinding process–cylindrical, surface, centreless and internal grinding. Broaching machines: broach construction – push, pull, surface & continuous machines.		
Unit 4	**CNC MACHINE AND PROGRAMMING**	**9**
Computer Numerical Control machine tools, construction, special features – Drives, Recirculating ball screws, tool changers; Control systems – Turning and machining centres – Work holding methods, Coolant systems - Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes, Manual part programming – Fixed cycles, Loops and subroutines.		
Unit 5	**UNCONVENTIONAL MACHINING PROCESSES**	**9**
Introduction – Need for non-traditional machining process – Classification - Mechanical energy based process – Electrical based process – Chemical and electro chemical energy based process – Thermal energy based process – equipment - effect of process parameters – applications.		
		Total: 45

TEXTBOOKS	
1	Hajra Choudhury, “Elements of Workshop Technology”, Vol.II., Media Promoters 2023.
2	Rao. P.N “Manufacturing Technology – Metal Cutting and Machine Tools”, 3rd Edition, Tata McGraw-Hill, New Delhi, 2017.
3	Jagadeesha T, “Non-Traditional Machining Processes”, I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017.
REFERENCES	
1	Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J. White “Machine Tool Practices”, Prentice Hall of India, 2011.
2	Geofrey Boothroyd, “Fundamentals of Metal Machining and Machine Tools”, Mc Graw Hill, 2005.
3	HMT, “Production Technology”, Tata McGraw Hill, 2017.
4	Roy. A. Lindberg, “Process and Materials of Manufacture,” Fourth Edition, PHI/Pearson Education 2015.

COURSE OUTCOMES: **At the end of the course, learners will be able to**	**Bloom’s Taxonomy Level**

CO1	Explain the mechanism of material removal processes.	K2
CO2	Describe the constructional and operational features of centre lathe and other special purpose lathes.	K2
CO3	Describe the constructional and operational features of shaper, planner, milling, drilling, sawing and broaching machines.	K2
CO4	Summarize numerical control of machine tools and write a part program.	K2
CO5	Explain the various unconventional machining processes and the influence of process parameters.	K2

CO-PO Mapping

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

AMA106 - STATISTICS AND NUMERICAL METHODS							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		4	**BS**	**3**	**1**	**0**	**4**
Preamble	➢ This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology. ➢ To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems. ➢ To introduce the basic concepts of solving algebraic and transcendental equations. ➢ To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines. ➢ To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.						
Unit 1	**TESTING OF HYPOTHESIS**						**9+3**
Sampling distributions – Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.							
Unit 2	**DESIGN OF EXPERIMENTS**						**9+3**

One way and two way classifications – Completely randomized design – Randomized block design – Latin square design – 2 2 factorial design.		
Unit 3	**SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS**	**9+3**
Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method- Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.		
Unit 4	**INTERPOLATION, NUMERICAL DIFFERENTATION AND NUMERICAL INTEGRATION**	**9+3**
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.		
Unit 5	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**9+3**
Single step methods: Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order differential equations – Multi step methods: Milne's and Adams – Bash forth predictor corrector methods for solving first order differential equations.		
		Total: 60

TEXTBOOKS	
1	Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
3	Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
REFERENCES	
1	Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2	Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 9th Edition, 2016.
3	Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012.
5	Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2016.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Apply the concept of testing of hypothesis for small and large samples in real life problems.	K2
CO2	Apply the basic concepts of classifications of design of experiments in the field of agriculture.	K3

CO3	Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.	K2
CO4	Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.	K4
CO5	Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.	K3

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

AME110 - THERMAL ENGINEERING

Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		4	**PC**	**3**	**0**	**0**	**3**

Preamble	➢ To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes ➢ To apply the thermodynamic concepts into various thermal application like Steam Turbines, Compressors and Refrigeration and Air conditioning.

Unit 1	**GAS POWER CYCLES**	**9**

Air standard Otto, Diesel and Dual cycles -Air standard Brayton cycle –Calculation of mean effective pressure and air standard efficiency, effect of reheat, regeneration and intercooling.

Unit 2	**STEAM NOZZLES AND INJECTOR**	**9**

Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow.

Unit 3	**STEAM AND GAS TURBINES**	**9**

Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing. Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combination.

Unit 4	**AIR COMPRESSOR**	**9**

Reciprocating compressors, Effect of clearance and volumetric efficiency. Adiabatic, Isothermal and Mechanical efficiencies, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Unit 5	REFRIGERATION & AIR CONDITIONING	9
Refrigerants and their desirable properties- COP - Vapor compression refrigeration system – Vapor absorption refrigeration system – Ammonia refrigeration system – Li-Br Refrigeration system – Cascaded refrigeration system – Air conditioning – Summer, winter, year around, window, split – Split Airconditioning		
		Total: 45

TEXTBOOKS	
1	R. K. Rajput, "Thermal Engineering", 11th Edition, Laxmi Publication, 2020.
2	M. Mahesh Rathore, "Thermal Engineering", Edition: 1, Mcgraw Hill edition, 2012
3	Kothandaraman.C.P, S,Domkundwar. A.V, "A course in thermal Engineering", 5th Edition, Dhanpat Rai & sons, 2016.
REFERENCES	
1	Sarkar, B.K, "Thermal Engineering", Tata McGraw-Hill Publishers, 2017.
2	Ramalingam. K.K, "Thermal Engineering", SCITECH Publications (India) Pvt Ltd, 2nd Edition, 2018.
3	Rudramoorthy R, "Thermal Engineering", 3rd Edition, Tata McGraw Hill Publishers, 2017
4	Arora.C.P, "Refrigeration and Air Conditioning", 3rd edition, Tata McGraw-Hill Publishers, 2017.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Apply thermodynamic concepts to different air standard cycles and solve problems.	K3
CO2	To solve problems in steam nozzle and calculate critical pressure ratio.	K2
CO3	Explain the flow in steam turbines, draw velocity diagrams, flow in Gas turbines and solve problems.	K3
CO4	Analyse and acquire solutions to the problems involved in the air compressors.	K3
CO5	Apply the basics of thermodynamics on Refrigeration and Air conditioning.	K3

CO-PO Mapping

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

AME303 - MACHINE TOOLS LABORATORY							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		4	**PC**	**0**	**0**	**4**	**2**
Preamble	➢ To Select appropriate tools, equipment's and machines to complete a given job. ➢ To Study and acquire knowledge on various basic machining operations in special purpose machines and its applications in real life manufacture of components in the industry.						

LIST OF EXPERIMENTS
1. Taper Turning and Eccentric Turning on circular parts using lathe machine.
2. Knurling, external and internal thread cutting on circular parts using lathe machine.
3. Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
4. Drilling and Reaming using vertical drilling machine.
5. Milling contours on plates using vertical milling machine.
6. Cutting spur and helical gear using milling machine.
7. Generating gears using gear hobbing machine.
8. Generating gears using gear shaping machine.
9. Grinding components using cylindrical and centerless grinding machine.
10. Grinding components using surface grinding machine.
11. Cutting force calculation using dynamometer in lathe & milling machine
12. Tool angle grinding with tool and Cutter Grinder.
Total: 60

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Demonstrate the safety precautions exercised in the mechanical workshop.	K3
CO2	The students able to make the work piece as per given shape and size using machining process such as rolling, drawing, turning, shaping, drilling and milling.	K3
CO3	The students become make the gears using gear making machines and analyze the defects in the cast and machined components.	K3

CO-PO Mapping

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

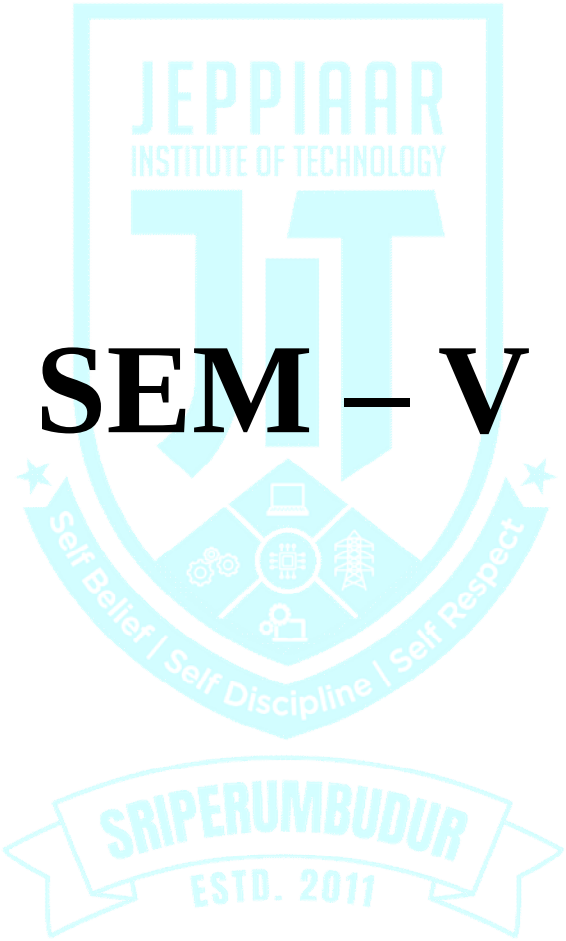
AME304 - STRENGTH OF MATERIALS LABORATORY							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		4	**PC**	**0**	**0**	**4**	**2**
Preamble	To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads.						

LIST OF EXPERIMENTS
1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals – Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison (i) Unhardened specimen, (ii) Quenched Specimen and, (iii) Quenched and tempered specimen.
11. Microscopic Examination of (i) Hardened samples and (ii) Hardened and tempered samples.
Total: 60

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Determine the compression and hardness test on different materials.	K3
CO2	Analyze the tension and double shear test with mild steel.	K3
CO3	Apply the deflection test on various types of beams.	K3
CO4	Analyse the impact test for different materials.	K3
CO5	Determine the torsional characteristics for the given materials.	K3

CO-PO Mapping

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


JEPPIAAR
INSTITUTE OF TECHNOLOGY
Self Belief | Self Discipline | Self Respect
SRIPERUMBUDUR
ESTD. 2011

SEM – V

AME111 - MACHINE DESIGN							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		5	**PC**	**3**	**0**	**0**	**3**
Preamble	➢ To Learn designing shafts and couplings for various applications. ➢ To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components. ➢ To understand the standard procedure available for Design of Transmission of Mechanical elements spur, helical & bevel gears. ➢ To learn the concepts of design multi and variable speed gear box for machine tool applications. ➢ To Learn designing and select sliding and rolling contact bearings, seals and gaskets. (Use of PSG Design Data book is permitted)						
Unit 1	**DESIGN OF SHAFTS AND COUPLINGS**						**9**
Shafts and Axles – Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and splines – Rigid and flexible couplings.							
Unit 2	**DESIGN OF FLEXIBLE ELEMENTS**						**9**
Design of Flat belts and pulleys – Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.							
Unit 3	**SPUR, HELICAL AND BEVEL GEARS**						**9**
Speed ratios and number of teeth-Force analysis -Tooth stresses – Dynamic effects – Fatigue strength – Factor of safety – Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane-Equivalent number of teeth-forces for helical gears. Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears.							
Unit 4	**GEAR BOX DESIGN**						**9**
Geometric progression – Standard step ratio – Ray diagram, kinematics layout -Design of sliding mesh gear box – Design of multi speed gear box for machine tool applications – Constant mesh gear box – Speed reducer unit. – Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.							
Unit 5	**DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS**						**9**
Sliding contact and rolling contact bearings – Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs, -- Selection of Rolling Contact bearings –Design of Seals and Gaskets.							
							Total: 45
TEXTBOOKS							
1	Bhandari V B, “Design of Machine Elements”, 5th Edition , Tata McGraw-Hill Book Co, 2020.						
2	Joseph Shigley, Richard G. Budynas and J. Keith Nisbett “Mechanical Engineering Design”, 11th Edition, Tata McGraw-Hill , 2020.						
3	Prabhu. T.J, “Design of Transmission Elements”, Mani Offset, Chennai, 2000.						
REFERENCES							

1	Ansel C Ugural, “Mechanical Design – An Integral Approach”, 1st Edition, Tata McGraw-Hill Book Co, 2004.
2	Merhyle Franklin Spotts, Terry E. Shoup, and Lee Emrey Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2004.
3	Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine component Design”,7th Edition, Wiley, 2019.
4	Sundararajamoorthy T. V. and Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2003.
5	E. Shoup, “Design of Machine Elements”, 8th Edition, Pearson Publications, 2019.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Apply the concepts design to shafts, key and couplings.	K3
CO2	Apply the concepts of design to belts, chains and rope drives.	K3
CO3	Apply the concepts of design to spur, helical and bevel gears.	K3
CO4	Apply the concepts of design to gear boxes.	K3
CO5	Apply the concepts of design and select sliding and rolling contact bearings, seals and gaskets.	K3

CO-PO Mapping

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

AME112 - AUTOMOBILE ENGINEERING							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		4	**PC**	**3**	**0**	**0**	**3**
Preamble	➢ To understand the construction and working principle of various parts of an automobile. ➢ To have the practice for assembling and dismantling of engine parts and transmission system.						
Unit 1	**VEHICLE STRUCTURE AND ENGINES**						**9**

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines –components-functions and materials, variable valve timing (VVT).		
Unit 2	**ENGINE AUXILIARY SYSTEMS**	**9**
Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).		
Unit 3	**TRANSMISSION SYSTEMS**	**9**
Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.		
Unit 4	**STEERING, BRAKES AND SUSPENSION SYSTEMS**	**9**
Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.		
Unit 5	**ALTERNATIVE ENERGY SOURCES**	**9**
Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles - Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels – Electric and Hybrid Vehicles, Fuel Cell.		
		Total: 45

TEXTBOOKS	
1	Jain K.K. and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2017.
2	Kirpal Singh, “Automobile Engineering”, Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2021.
REFERENCES	
1	Ganesan V. “Internal Combustion Engines”, Third Edition, Tata McGraw-Hill, 2017.
2	Heinz Heisler, “Advanced Engine Technology”, SAE International Publications USA, 1998.
3	Joseph Heitner, “Automotive Mechanics”, Second Edition, East-West Press, 1999.
4	S K Gupta, “A Textbook of Automobile Engineering”, S Chand Publications, 2nd Edition, 2020.
5	Newton, Steeds and Garet, “Motor Vehicles”, Butterworth Publishers,1989.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Recognize the various parts of the automobile and their functions and materials.	K2
CO2	Discuss the engine auxiliary systems and engine emission control.	K2
CO3	Distinguish the working of different types of transmission systems.	K2

CO4	Explain the Steering, Brakes and Suspension Systems.	K2
CO5	Predict possible alternate sources of energy for IC Engines.	K3

CO-PO Mapping

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

AME305 - COMPUTER AIDED DESIGN LABORATORY

Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		5	**PC**	**0**	**0**	**4**	**2**

Preamble	To gain practical experience in handling 2D drafting and 3D modelling software systems.

LIST OF EXPERIMENTS

1. Introduction of 3D Modelling software

Creation of 3D assembly model of following machine elements using 3D Modelling software

2. Flange Coupling
3. Plummer Block
4. Screw Jack
5. Lathe Tailstock
6. Universal Joint
7. Machine Vice
8. Stuffing box
9. Crosshead
10. Safety Valves
11. Non-return valves
12. Connecting rod
13. Piston
14. Crankshaft

* Students may also be trained in manual drawing of some of the above components

Total: 60

COURSE OUTCOMES: **At the end of the course, learners will be able to**	**Bloom's Taxonomy Level**

CO1	Design experience in handling 2D drafting and 3D modelling software systems.	K3
CO2	Design 3-Dimensional geometric model of parts, sub-assemblies, assemblies and export it to drawing.	K3

CO-PO Mapping

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

AME306 - METROLOGY & DYNAMICS LABORATORY							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		5	**PC**	**0**	**0**	**4**	**2**
Preamble	➢ To study the different measurement equipment and use of this industry for quality inspection. ➢ To supplements the principles learnt in dynamics of machinery. ➢ To understand how certain measuring devices are used for dynamic testing.						
LIST OF EXPERIMENTS – METROLOGY							
1. Calibration and use of linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge, depth micrometer, bore gauge, telescopic gauge, Comparators.							
2. Measurement of angles using bevel protractor, sine bar, autocollimator, precision level.							
3. Measurement of assembly and transmission elements – screw thread parameters – Screw thread Micrometers, three wire method, Toolmaker's microscope.							
4. Measurement of gear parameters – Micrometers, Vernier caliper..							
5. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM), Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components.							
6. Non-contact (Optical) measurement using Measuring microscope / Profile projector and Video measurement system.							
7. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus-based instruments.							
LIST OF EXPERIMENTS – DYNAMICS							
1. Study of gear parameters.							
2. Epicycle gear Train.							
3. Determination of moment of inertia of flywheel and axle system.							
4. Determination of mass moment of inertia of a body about its axis of symmetry.							
5. Undamped free vibrations of a single degree freedom spring-mass system.							
6. Torsional Vibration (Undamped) of single rotor shaft system.							
7. Dynamic analysis of cam mechanism.							
8. Experiments on Governors							

9. Experiment on motorized gyroscope.	
10. Determination of critical speed of shafts.	
Total: 60	

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	The students able to measure the gear tooth dimensions, angle using sine bar, straightness.	K3
CO2	Determine mass moment of inertia of mechanical element, governor effort and range of sensitivity.	K3
CO3	Determine the natural frequency and damping coefficient, critical speeds of shafts.	K3

CO-PO Mapping

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

SEM – VI

AME113 - HEAT AND MASS TRANSFER							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		6	**PC**	**3**	**1**	**0**	**4**
Preamble	➢ To Learn the principal mechanism of heat transfer under steady state and transient conditions. ➢ To learn the fundamental concept and principles in convective heat transfer. ➢ To learn the theory of phase change heat transfer and design of heat exchangers. ➢ To study the fundamental concept and principles in radiation heat transfer. ➢ To study the basic concept of mass transfer and electronic cooling.						
Unit 1	**CONDUCTION**						**9+3**
Modes of heat transfer – Fundamental Laws – Applications – Thermal contact resistance; Overall heat transfer coefficient. One dimensional steady state conduction in simple geometries – General equation of heat conduction in Cartesian, cylindrical and spherical coordinates – Conduction in plane wall, cylindrical and spherical shells; Electrical analogy; Conduction in composite walls and shells; Critical thickness of insulation; Heat transfer through fins; Unsteady state heat transfer – Systems with negligible internal resistance -lumped heat capacity analysis; Infinite bodies; Semi-infinite bodies.							
Unit 2	**CONVECTION**						**9+3**
Mechanism of convection – classification – Types of Flow – non-dimensional numbers in heat transfer; Boundary layer concepts for flow over a flat plate and flow through circular pipes; Forced convection – External flow over flat plate, cylinder, sphere and bank of tubes; Internal flow through circular pipes; Natural convection: Steady one-dimensional flow over vertical, horizontal plates, horizontal cylinders and spheres; combined free and forced convection.							
Unit 3	**CONVECTIVE PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**						**9+3**
Condensation and boiling – boiling modes, correlations, forced convection boiling, laminar film condensation on a vertical plate, turbulent film condensation; Heat exchangers – design procedure for heat exchanger – LMTD and NTU analysis, fouling factor, effectiveness.							
Unit 4	**RADIATION**						**9+3**
Thermal Radiation – Black body and real surface radiation; Radiation properties and governing laws; Radiation heat transfer – view factor and its relations – Radiation heat exchange between black and grey surfaces, Radiosity – Radiation shields and the radiation effects.							
Unit 5	**MASS TRANSFER AND COOLING OF ELECTRONIC EQUIPMENTS**						**9+3**
Mass transfer – Fick's law of diffusion, diffusion mass transfer, forced convective mass transfer, heat and mass transfer analogies; Cooling of electronic equipment; Conduction in Cooling – Chip Carriers – PCB – TCM; Air cooling in forced and Natural convection.							
							Total: 60
TEXTBOOKS							
1	Yunus A. Cengel, Afshin J. Ghajar, "Heat and Mass Transfer: Fundamentals and Applications", Tata Mc Graw Hill publications, 6th Edition 2020.						

2	Sachdeva, R. C, "Fundamentals of Engineering Heat and Mass Transfer", New Age International Publishers, 6th Edition, 2022.
REFERENCES	
1	Frank, P., Incropera and David, P. D, "Fundamentals of Heat and Mass Transfer", John Wiley publication, 7th Edition, 2017.
2	Rajput, R. K, "A Textbook of Heat and Mass Transfer", S. Chand Publication, 7th edition, 2019.
3	Holman, J.P, "Heat and Mass Transfer", Tata McGraw-Hill,10th edition, 2011.
4.	Kothandaraman C.P and Subramanyan S, "Fundamentals of Heat and Mass Transfer", New Age International, 10th edition, 2022.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Apply and interpret the radical concepts on steady and transient state heat conduction problems.	K3
CO2	Solve free and forced convection problems using correlations and perform experimentation.	K4
CO3	Investigate the phenomenon of boiling, condensation and heat exchanger equipment design.	K4
CO4	Conduct and investigate the basic occurrence of radiational concepts.	K4
CO5	Interpret the fundamental concepts on mass transfer and cooling of electronic equipment.	K4

CO-PO Mapping

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

AME114 - FINITE ELEMENT ANALYSIS							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		6	**PC**	**3**	**0**	**0**	**3**
Preamble	➢ To introduce the concepts of Mathematical Modeling of Engineering Problems. ➢ To appreciate the use of FEM to a range of Engineering Problems.						
Unit 1	**INTRODUCTION**						**9**
Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted							

Residual Methods – Variational Formulation of Boundary Value Problems – RitzTechnique – Basic concepts of the Finite Element Method.		
Unit 2	**ONE DIMENSIONAL PROBLEMS**	**9**
One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.		
Unit 3	**TWO-DIMENSIONAL SCALAR VARIABLE PROBLEMS**	**9**
Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.		
Unit 4	**TWO-DIMENSIONAL VECTOR VARIABLE PROBLEMS**	**9**
Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.		
Unit 5	**ISOPARAMETRIC FORMULATION**	**9**
Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.		
		Total: 45

TEXTBOOKS	
1	Reddy J.N, “An Introduction to the Finite Element Method”, 4th Edition, Tata McGraw-Hill, 2020.
2	Seshu P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
REFERENCES	
1	Rao, S.S, “The Finite Element Method in Engineering”, Butterworth Heinemann, 6th Edition, 2017.
2	Logan, D.L, “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd, 6th Edition, 2016.
3	Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and Applications of Finite Element Analysis”, 4th Edition, Wiley Student Edition, 2002.
4.	Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, 5th Edition, Cambridge University Press, 2021.
5.	Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Summarize the basics of finite element formulation.	K2

CO2	Apply finite element formulations to solve one dimensional Problems.	K3
CO3	Apply finite element formulations to solve two dimensional scalar Problems.	K3
CO4	Apply finite element method to solve two dimensional Vector problems.	K3
CO5	Apply finite element method to solve problems on iso parametric element and dynamic problems.	K3

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

AME307 - COMPUTER AIDED MANUFACTURING LABORATORY

Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		5	**PC**	**0**	**0**	**4**	**2**

Preamble

- To study the features of CNC Machine Tool.
- To expose students to modern control systems (Fanuc, Siemens etc.,)
- To know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre, CNC EDM and CNC wire-cut and studying of Rapid prototyping.

LIST OF EXPERIMENTS

Manual Part Programming.

(i) Part Programming – CNC Machining Centre

a) Linear Cutting, b) Circular cutting, c) Cutter Radius Compensation, d) Canned Cycle Operations.

(ii) Part Programming – CNC Turning Centre

a) Straight, Taper and Radius Turning, b) Thread Cutting, c) Rough and Finish Turning Cycle, d) Drilling and Tapping Cycle.

(iii) Computer Aided Part Programming

a) CL Data and Post process generation using CAM packages, b) Application of CAPP in Machining and Turning Centre.

Total: 60

COURSE OUTCOMES: **At the end of the course, learners will be able to**	**Bloom's Taxonomy Level**

CO1	Demonstrate manual part programming with G and M codes using CAM.	K3

CO-PO Mapping

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

AME308 - THERMAL ENGINEERING LABORATORY							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		6	**PC**	**0**	**0**	**4**	**2**
Preamble	➢ To study the value timing-V diagram and performance of IC Engines ➢ To Study the characteristics of fuels/Lubricates used in IC Engines ➢ To study the Performance of steam generator/ turbine ➢ To study the heat transfer phenomena, predict the relevant coefficient using implementation ➢ To study the performance of refrigeration cycle / components						
LIST OF EXPERIMENTS – IC ENGINES LAB							
1. Valve Timing and Port Timing diagrams.							
2. Actual p-v diagrams of IC engines.							
3. Performance Test on 4 – stroke Diesel Engine.							
4. Heat Balance Test on 4 – stroke Diesel Engine.							
5. Morse Test on Multi-cylinder Petrol Engine.							
6. Retardation Test on a Diesel Engine.							
7. Determination of Flash Point and Fire Point of various fuels / lubricants							
8. Performance test on a reciprocating air compressor.							
LIST OF EXPERIMENTS – HEAT TRANFER LAB							
1. Thermal conductivity measurement using guarded plate apparatus.							
2. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.							
3. Determination of heat transfer coefficient under natural convection from a vertical cylinder.							
4. Determination of heat transfer coefficient under forced convection from a tube.							
5. Determination of Thermal conductivity of composite wall.							
6. Determination of Thermal conductivity of insulating powder.							
7. Heat transfer from pin-fin apparatus (natural & forced convection modes)							
8. Determination of Stefan – Boltzmann constant.							
9. Determination of emissivity of a grey surface.							
10. Effectiveness of Parallel / counter flow heat exchanger.							
LIST OF EXPERIMENTS – STEAM LAB							
1. Study on Steam Generators and Turbines							
LIST OF EXPERIMENTS – REFRIGERATION AND AIR CONDITIOING LAB							

1. Determination of COP of a refrigeration system
2. Determination of COP of air conditioning test rig
3. Performance test in a fluidized Bed Cooling Tower
Total: 60

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Conduct performance and retardation tests on internal combustion engines.	K4
CO2	Conduct tests on natural and forced convective heat transfer apparatus and evaluate heat transfer coefficient.	K4
CO3	Conduct tests on radiative heat transfer apparatus and evaluate Stefan Boltzmann constant and emissivity.	K4
CO4	Conduct tests to evaluate the performance of parallel/counter flow heat exchanger apparatus and reciprocating air compressor.	K4
CO5	Conduct tests to evaluate the performance of refrigeration and air conditioning test rigs.	K4

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					1			1	1	1	1
CO2	2	2	1	1					1			1	1	1	1
CO3	2	2	1	1					1			1	1	1	1
CO4	2	2	1	1					1			1	1	1	1
CO5	2	2	1	1					1			1	1	1	1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SEM – VII

AME115 - ROBOTICS & AUTOMATION							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		7	**PC**	**3**	**0**	**0**	**3**
Preamble	➢ To study the kinematics, drive systems and programming of robots. ➢ To study the basics of robot laws and transmission systems. ➢ To familiarize students with the concepts and techniques of robot manipulator, its kinematics. ➢ To familiarize students with the various Programming and Machine Vision application in robots. ➢ To build confidence among students to evaluate, choose and incorporate robots in engineering systems.						
Unit 1	**FUNDAMENTALS OF ROBOT**						**9**
Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications.							
Unit 2	**ROBOT KINEMATICS**						**9**
Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.							
Unit 3	**ROBOT DRIVE SYSTEMS AND END EFFECTORS**						**9**
Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper							
Unit 4	**SENSORS IN ROBOTS**						**9**
Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.							
Unit 5	**PROGRAMMING AND APPLICATIONS OF ROBOT**						**9**
Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.							
							Total: 45
TEXTBOOKS							
1	Ganesh S. Hedge, “A textbook of Industrial Robotics”, Lakshmi Publications, 2nd Edition, 2015.						

2	Mikell P Groover, “Industrial Robotics – Technology, Programming and applications”, McGraw Hill, 2nd edition 2012.
REFERENCES	
1	Fu K.S. Gonalz R.C. and Ice C.S.G, “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill book co. 2007.
2	Yoram Koren, “Robotics for Engineers”, McGraw Hill Book, Co., 2002.
3	Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill 2005.
4	John. J. Craig, “Introduction to Robotics: Mechanics and Control” 2nd Edition, 2002.
5	Jazar, “Theory of Applied Robotics: Kinematics, Dynamics and Control”, Springer India reprint, 2010.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Interpret the features of robots and technology involved in the control.	K2
CO2	Apply the basic engineering knowledge and laws for the design of robotics.	K2
CO3	Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots.	K2
CO4	Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.	K2
CO5	Demonstrate the image processing and image analysis techniques by machine vision system.	K2

CO-PO Mapping

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

AME309 - AUTOMATION LABORATORY							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		7	**PC**	**0**	**0**	**4**	**2**
Preamble	To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept of mechatronics.						
LIST OF EXPERIMENTS							

1. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – Code Conversion.
2. Stepper motor interface.
3. Traffic light interface.
4. Speed control of DC motor.
5. Study of various types of transducers.
6. Study of hydraulic, pneumatic and electro-pneumatic circuits.
7. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software.
8. Study of PLC and its applications.
9. Study of image processing technique.
Total: 60

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Demonstrate the functioning of mechatronics systems with various pneumatic, hydraulic and electrical systems.	K3
CO2	Demonstrate the microcontroller and PLC as controllers in automation systems by executing proper interfacing of I/O devices and programming.	K3
CO3	Demonstrate the functioning of Image processing.	K3

CO-PO Mapping

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

AME310 - SIMULATION AND ANALYSIS LABORATORY							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		7	**PC**	**0**	**0**	**4**	**2**
Preamble	➢ To give exposure to software tools needed to analyze engineering problems. ➢ To expose the students to different applications of simulation and analysis tools.						
LIST OF EXPERIMENTS – SIMULATION							
1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables							
2. Use of Matlab to solve simple problems in vibration							
3. Mechanism Simulation using Multibody Dynamic software							
LIST OF EXPERIMENTS – ANALYSIS							
1. Force and Stress analysis using link elements in Trusses, cables etc.							
2. Stress and deflection analysis in beams with different support conditions.							

3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi – symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.
Total: 60

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Simulate the working principle of air conditioning system, hydraulic and pneumatic cylinder and cam follower mechanisms using MATLAB.	K3
CO2	Analyze the stresses and strains induced in plates, brackets and beams and heat transfer problems.	K4
CO3	Calculate the natural frequency and mode shape analysis of 2D components and beams.	K3

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

SEM – VIII

AME311 - PROJECT WORK							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		8	**EEC**	**0**	**0**	**12**	**10**
Preamble	➢ To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination. ➢ The students in a group of 4 in maximum and 1in minimum works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.						
							Total: 300

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Improve their understating more towards real problem.	K3
CO2	Solve the subjective problem using latest available technology.	K4
CO3	Understand different perspective of problem-solving using software tools.	K2
CO4	Prepare documentation for the solution.	K2

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

PROFESSIONAL ELECTIVES – MANUFACTURING

AME501 - LEAN MANUFACTURING							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		5	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To introduce the basics of 6 SIGMA ➢ To learning about the lean manufacturing tools. ➢ To study about the deeper understanding methodologies of Lean manufacturing. ➢ To study the lean concepts and its elements. ➢ To learn implementation and challenges of lean manufacturing.						
Unit 1	**BASICS OF 6 SIGMA**						**9**
Introduction to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, value for the enterprise, Variation, and sources of variation, Mean and moving the mean, Various quality costs, cost of poor quality.							
Unit 2	**INTRODUCTION TO LEAN MANUFACTURING TOOLS**						**9**
Process Capability Indices, Cause and Effect diagram, Control Charts, Introduction to FMEA, APQP, PPAP. 3 foundational 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process creation, DMAIC for process improvement and PDCA for sustaining improvements.							
Unit 3	**LEAN ELEMENTS**						**9**
Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, Cost. Building Zero defect capabilities, Cultural and Organizational aspects							
Unit 4	**DEEPER UNDERSTANDING METHODOLOGIES**						**9**
What is a process, Why Process management, Keys to process management, Difference between process management and 6 Sigma, Introduction to Deming cycle, PDCA, DMAIC and continuous improvement, DMEDI for creation process, DMAIC Vs DMEDI with examples, Introduction to Toyota Production System, Six Sigma and Production System integration							
Unit 5	**IMPLEMENTATION AND CHALLENGES**						**9**
Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.							
							Total: 45

TEXTBOOKS	
1	J M Juran & F M Gryna, “Quality Planning and Analysis”, Tata Mc Graw Hill
2	Akhilesh N. Singh, “Lean Manufacturing: Principles to Practice”, Bibliophile South Asia
3	The Toyota Way: 14 Management Principles
4	Gemba, “Kaizen: A Commonsense Approach to a Continuous Improvement Strategy”
REFERENCES	
1	Quality Council of India https://qcin.org/ & its library. https://qcin.org/nbqp/knowledge_bank/
2	International Society of Six Sigma Professionals: https://isssp.org/about-us/
3	Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones

4	Older / Previous editions of AIAG manuals on APQP, FMEA and PPAP. These are great sources of information on Quality Planning and has basics of Project Management and required skills.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Discuss the basics of 6 SIGMA.	K2
CO2	Elaborate the lean manufacturing tools.	K2
CO3	Discuss lean concepts and its elements.	K2
CO4	Illustrate about the deeper understanding methodologies of Lean manufacturing.	K2
CO5	Describe the implementation and challenges of lean manufacturing.	K2

CO-PO Mapping

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

AME502 - PROCESS PLANNING AND COST ESTIMATION

Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		5	**PE**	**3**	**0**	**0**	**3**

Preamble	To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.	
Unit 1	**INTRODUCTION**	**9**
Introduction of Process Planning- methods of process planning, drawing interpretation. Material evaluation, steps in process selection, production equipment and tooling selection.		
Unit 2	**PROCESS PLANNNING ACTIVITIES**	**9**
Process planning activities- process parameter calculation for various production processes, selection of jigs and fixtures. selection of quality assurance methods, documents for process planning, economics of process planning, case studies		
Unit 3	**INTRODUCTION TO COST ESTIMATION**	**9**

Introduction to cost estimation- importance of costing and estimation, methods of costing, elements of cost estimation. types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost.		
Unit 4	**MACHINING TIME CALCULATIONS**	**9**
Machining time estimation- importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations. Machining time calculation for Milling, Shaping, Planning and Grinding.		
Unit 5	**PRODUCTION COST ESTIMATIONS**	**9**
Production costs- different production processes for different jobs, estimation of forging cost, estimation of welding cost, estimation of foundry cost, estimation of machining cost		
		Total: 45

TEXTBOOKS	
1	Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.
2	Sinha B.P, “Mechanical Estimating and Costing”, Tata-McGraw Hill publishing co, 1995.
REFERENCES	
1	Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002.
2	Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9 th Edition, John Wiley, 1998.
3	Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.
4	Mikell P. Groover, “Automation, Production, Systems and Computer Integrated Manufacturing”, Pearson Education 2001.
5	K.C. Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers 1990.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Select the process, equipment and tools for various industrial products.	K2
CO2	Prepare process planning activity chart.	K3
CO3	Explain the concept of cost estimation.	K2
CO4	Calculate the machining time for various machining operations.	K4
CO5	Compute the job order cost for different type of shop floor.	K4

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

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

AME503 - COMPUTER INTEGRATED MANUFACTURING SYSTEMS							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		5	**PE**	**3**	**0**	**0**	**3**
Preamble	To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.						
Unit 1	**INRODUCTION**						**9**
Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system – Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.							
Unit 2	**PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING**						**9**
Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.							
Unit 3	**CELLULAR MANUFACTURING**						**9**
Group Technology (GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.							
Unit 4	**FLEXIBLE MANUFACTURING SYSTEM AND AUTOMATED GUIDED VEHICLE SYSTEM**						**9**
Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control – Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.							
Unit 5	**INDUSTRIAL ROBOTICS**						**9**
Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.							
							Total: 45
TEXTBOOKS							
1	Mikell P Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008.						

2	Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.
REFERENCES	
1	Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995.
2	Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India.
3	Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Explain the basic concepts of CAD, CAM and computer integrated manufacturing systems.	K2
CO2	Summarize the production planning and control and computerized process planning.	K2
CO3	Differentiate the different coding systems used in group technology.	K2
CO4	Explain the concepts of flexible manufacturing system (FMS) and automated guided vehicle (AGV) system.	K2
CO5	Classification of robots used in industrial applications.	K1

CO-PO Mapping

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

AME504 - SUSTAINABLE MANUFACTURING							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		5	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To be acquainted with sustainability in manufacturing and its evaluation. ➢ To provide knowledge in environment and social sustainability. ➢ To provide the student with the knowledge of strategy to achieve sustainability. ➢ To familiarize with trends in sustainable operations. ➢ To create awareness in current sustainable practices in manufacturing industry.						
Unit 1	**ECONOMIC SUSTAINABILITY**						**9**

Industrial Revolution-Economic sustainability: globalization and international issues Sustainability status - Emerging issues- Innovative products- Reconfiguration manufacturing enterprises - Competitive manufacturing strategies - Performance evaluation- Management for sustainability - Assessments of economic sustainability		
Unit 2	**SOCIAL AND ENVIRONMENTAL SUSTAINABILITY**	**9**
Social sustainability – Introduction-Work management -Human rights - Societal commitment - Customers -Business practices -Modelling and assessing social sustainability. Environmental issues pertaining to the manufacturing sector: Pollution - Use of resources -Pressure to reduce costs - Environmental management: Processes that minimize negative environmental impacts - environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability		
Unit 3	**SUSTAINABILITY PRACTICES**	**9**
Sustainability awareness - Measuring Industry Awareness-Drivers and barriers -Availability of sustainability indicators -Analysis of sustainability practicing -Modeling and assessment of sustainable practicing -Sustainability awareness -Sustainability drivers and barriers - Availability of sustainability indicators- Designing questionnaires- Optimizing Sustainability Indexes-Elements – Cost and time model.		
Unit 4	**MANUFACTURING STRATEGY FOR SUSTAINABILITY**	**9**
Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.		
Unit 5	**TRENDS IN SUSTAINABLE OPERATIONS**	**9**
Principles of sustainable operations - Life cycle assessment manufacturing and service activities - influence of product design on operations - Process analysis – Capacity management - Quality management -Inventory management - Just-In-Time systems - Resource efficient design - Consumerism and sustainable well-being.		
		Total: 45

TEXTBOOKS

1	Ibrahim Garbie, “Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0”, Springer International Publishing., United States, 2016, ISBN-13: 978-3319293042.
2	Davim J.P., “Sustainable Manufacturing”, John Wiley & Sons., United States, 2010, ISBN: 978-1-848-21212-1.

REFERENCES

1	Jovane F, Ęmper, W.E. and Williams, D.J., “The ManuFuture Road: Towards Competitive and Sustainable High-Adding-Value Manufacturing”, Springer,2009, United States, ISBN 978-3-540-77011-4.
2	Kutz M., “Environmentally Conscious Mechanical Design”, John Wiley & Sons., United States, 2007, ISBN: 978-0-471-72636-4.
3	Seliger G., “Sustainable Manufacturing: Shaping Global Value Creation”, Springer, United States, 2012, ISBN 978-3-642-27289-9.

COURSE OUTCOMES: At the end of the course, learners will be able to		Bloom's Taxonomy Level
CO1	Discuss the importance of economic sustainability.	K2
CO2	Describe the importance of sustainable practices.	K2
CO3	Identify drivers and barriers for the given conditions.	K2
CO4	Formulate strategy in sustainable manufacturing.	K2
CO5	Plan for sustainable operation of industry with environmental, cost consciousness.	K2

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

AME505 - PRECISION MANUFACTURING							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		5	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To study the need, significance and progress of precision manufacturing and the different levels of manufacturing. ➢ To study the principle and working of different methods of precision machining. ➢ To study the special construction requirements of precision machine tools. ➢ To study the errors involved in precision machine tools and calculate the error budgets for a given situation. ➢ To study the Selecting a suitable measurement solution to measure and characterize precision machined features.						
Unit 1	**PRECISION ENGINEEERING**						**9**
Introduction to Precision Engineering, Need for precision manufacturing, Taniguchi diagram, Four Classes of Achievable Machining Accuracy – Normal, Precision, High-precision, Ultra-precision Processes and Nanotechnology.							
Unit 2	**PRECISION MACHINING**						**9**

Overview of Micro- and Nanomachining, Conventional micro machining techniques - micro-turning, micro milling, micro-grinding, Ultra-precision diamond turning, Non-conventional micromachining techniques – AJM, WJM, USM, EDM, PCM, ECM, LBM, EBM, FIBM, etc.		
Unit 3	**MACHINE DESIGN FOR PRECISION MANUFACTURING**	**9**
Philosophy of precision machine design, Ultra-Precision Machine Elements: Guide- ways, Drive Systems, Friction Drive, Linear Motor Drive, Spindle Drive. Bearings: Applications of Rolling, Hydrodynamic, Hydrostatic, Aerostatic and Magnetic bearings.		
Unit 4	**MECHANICAL AND THERMAL ERRORS**	**9**
Sources of error, Principles of measurement, Errors due to machine elements, bearings, spindles, Kinematic design, Structural compliance. Vibration, Thermal errors – background, thermal effects, Environmental control of precision machinery. Error mapping and error budgets.		
Unit 5	**MEASUREMENT AND CHARACTERISATION**	**9**
Optical dimensional metrology of precision features – Machine vision, multi-sensor coordinate metrology, Laser Tracking Systems, Laser scanners, White-Light Interference 3D Microscopes, Focus-Based Optical Metrology- Fringe projection method, Measurement of Typical Nano features. Surface metrology - 3D surface topography – Chromatic confocal Microscopy, Interferometry, Non-optical Scanning Microscopy – SEM, SPM, Parameters for characterizing 3D surface topography.		
		Total: 45

TEXTBOOKS

1	Jain, V.K., “Introduction to micromachining”, Narosa publishers, 2018
2	Venktesh V.C., SudinIzman, “Precision Engineering”, Tata McGraw Hill Publishing Company, New Delhi 2007.

REFERENCES

1	David Dornfeld, Dae-Eun Lee, “Precision Manufacturing”, Springer, 2008.
2	Jain, V.K., “Micro manufacturing Processes”, CRC Press, 2012.
3	Joseph McGeough, “Micromachining of Engineered Materials”, Marcel Dekker Inc., 2002.
4	Kevin Harding, “Handbook of Optical Dimensional Metrology, Series: Series in Optics and optoelectronics”, Taylor & Francis, 2013.
5	Murty, R.L., “Precision Engineering in Manufacturing”, New Age publishers, 2005

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Explain the need, significance and progress of precision manufacturing and the different levels of manufacturing.	K2
CO2	Explain the principle and working of different methods of precision machining.	K2
CO3	Explain the special construction requirements of precision machine tools.	K2
CO4	Explain the errors involved in precision machine tools and calculate the error budgets for a given situation.	K2
CO5	Select a suitable measurement solution to measure and characterize precision machined features.	K3

CO-PO Mapping

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

PROFESSIONAL ELECTIVES – DESIGN

AME506 - ERGONOMICS & HUMAN FACTORS ENGINEERING							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		7	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To understand the concepts in Human factors and Ergonomics including human perception, cognition, motor control etc ➢ To consider ergonomics concept in manufacturing ➢ To apply ergonomics in design of controls and display ➢ To apply environmental factors in ergonomics design. ➢ To develop aesthetics applicable to manufacturing and product						
Unit 1	**FUNDAMENTALS OF ERGONOMICS AND HUMAN FACTORS ENGINEERING**						**9**
Human Biological- Ergonomic and psychological capabilities and limitations-Concepts of human factors engineering and Ergonomics-Man-Machine system and Design philosophy-Physical work and energy expenditure: Manual lifting-Work posture-Repetitive motion- Provision of energy for muscular work-Heat stress-Role of oxygen physical exertion, -Measurement of energy expenditure-Respiration-Pulse rate and blood pressure during physical work-Physical work capacity and its evaluation.							
Unit 2	**ANTHROPOMETRY AND ERGONOMIC DESIGN**						**9**
Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Workstation Design, Chair Design. Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt's perceptions – Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form.							
Unit 3	**DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS**						**9**
Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, check readings, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple displays Controls: Design considerations, Controls with little efforts – Push button, Switches, rotating Knobs. Controls with muscular effort – Hand wheel, Crank, Heavy lever, Pedals. Design of controls in automobiles, Machine Tools.							
Unit 4	**ENVIRONMENTAL FACTORS**						**9**
Colour: Colour and light, Colour and objects, Colour and the eye – after Image, Colour blindness, Colour constancy, Colour terms – Colour circles, Munsel colour notation, reactions to colour and colour combination – colour on engineering equipment, Colour coding, psychological effects, colour and machine form, colour and style.							
Unit 5	**AESTHETIC CONCEPTS**						**9**
Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions – Symmetry, Balance, Contrast, Continuity, Proportion. Style – The components of style, House style, Style in capital good. Introduction to Ergonomic and plant layout software's, total layout design.							
							Total: 45
TEXTBOOKS							
1	Marcelo M. Soares , Francisco Rebelo , "Ergonomics in Design: Methods and Techniques (Human Factors and Ergonomics)"						

2	"Ergonomics in Product Design", Send points Publishing Co. Ltd
REFERENCES	
1	Benjamin W.Niebel, "Motion and Time Study", Richard D. Irwin Inc., 7th Edition, 2002
2	Brain Shakel, "Applied Ergonomics Handbook", Butterworth Scientific London 1988.
3	Bridger, R.C., "Introduction to Ergonomics", McGraw Hill Publications, 2nd Edition, 2003.
4	Martin Helander, "A Guide to human factors and Ergonomics", Taylor and Francis, 2006
5	Mayall W.H. "Industrial design for Engineers", London Hiffee books Ltd., 1988.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Appreciate ergonomics need in the industrial design.	K2
CO2	Apply ergonomics in creation of manufacturing system	K3
CO3	Discuss on design of controls and display.	K2
CO4	Consider environmental factors in ergonomics design.	K2
CO5	Report on importance of aesthetics to manufacturing system and product.	K2

CO-PO Mapping

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

AME507 - COMUTER AIDED DESIGN & MANUFACTURING

Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		7	**PE**	**3**	**0**	**0**	**3**

Preamble	➢ To provide an overview of how computers are being used in mechanical component design. ➢ To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.	
Unit 1	**INTRODUCTION**	**9**

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - Line drawing -Clipping- viewing transformation-Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM –CAD/CAM concepts —Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance.		
Unit 2	**GEOMETRIC MODELING**	**9**
Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modelling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modelling techniques- CSG and B-rep.		
Unit 3	**STANDARDS OF CAD**	**9**
Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards**.**		
Unit 4	**FUNDAMENTAL OF CNC AND PART PROGRAMMING**	**9**
Introduction to NC systems and CNC - Machine axis and Co-ordinate system- CNC machine tools- Principle of operation CNC- Construction features including structure- Drives and CNC controllers- 2D and 3D machining on CNC- Introduction of Part Programming, types - Detailed Manual part programming on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.		
Unit 5	**FLEXIBLE MANUFACTURING SYSTEM (FMS) AND CELLULAR MANUFACTURING**	**9**
Group Technology(GT),Part Families–Parts Classification and coding–Simple Problems in Opitz Part Coding system–Production flow Analysis–Cellular Manufacturing–Composite part concept–Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control–Quantitative analysis in FMS		
		Total: 45
TEXTBOOKS		
1	Ibrahim Zeid, “Mastering CAD CAM”, Tata McGraw-Hill Publishing Co, 2007	
2	Mikell P Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008.	
3	Radhakrishnan P, Subramanyan S and Raju V, “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.	
REFERENCES		
1	Chris McMahon and Jimmie Browne “CAD/CAM Principles", "Practice and Manufacturing management”, 2nd Edition, Pearson Education, 1999.	
2	Donald Hearn and M. Pauline Baker, “Computer Graphics”, Prentice Hall, Inc,1992.	
3	Foley, Wan Dam, Feiner and Hughes, “Computer graphics principles & practice”, Pearson Education, 2003.	
4	William M Neumann and Robert F Sproul, “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.	

COURSE OUTCOMES: At the end of the course, learners will be able to		Bloom's Taxonomy Level
CO1	Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics.	K2
CO2	Explain the fundamentals of parametric curves, surfaces and Solids	K2
CO3	Summarize the different types of Standard systems used in CAD	K2
CO4	Apply NC & CNC programming concepts to develop part programme for Lathe & Milling Machines	K3
CO5	Summarize the different types of techniques used in Cellular Manufacturing and FMS.	K2

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

AME508 - PRODUCT DESIGN AND DEVELOPMENT							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		7	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To introduce the fundamental concepts of the new product development. ➢ To develop material specifications, analysis and process. ➢ To Learn the Feasibility Studies & reporting of new product development. ➢ To study the New product qualification and Market Survey on similar products of new product development. ➢ To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model.						
Unit 1	**FUNDAMENTALS OF PRODUCT DEVELOPMENT**						**9**
Introduction – Reading of Drawing – Grid reading, Revisions, ECN (Engg. Change Note), Component-material grade, Specifications, customer specific requirements – Basics of monitoring of NPD applying-Gantt chart, Critical path analysis – Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing-BOM. Basics of MIS software and their application in industries like SAP, MS Dynamics, Oracle ERP Cloud– QFD**.**							
Unit 2	**MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS**						**9**

Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.		
Unit 3	**ESSENTIALS OF PRODUCT DEVELOPMENT**	**9**
Request of Quotation Processing – Feasibility Studies & reporting – Cross Function Team discussion on new product and reporting – Concept design, Machine selection for tool making, Machining– Manufacturing Process selection, Machining Planning, cutting tool selection – Various Inspection methods– Manual measuring, CMM – Geometric Optical Measuring, Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programming. Tool assembly and shop floor trials. Initial sample submission with PPAP documents.		
Unit 4	**CRITERIONS OF PRODUCT DEVELOPMENT**	**9**
New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.		
Unit 5	**REPORTING & FORWARD THINKING OF PRODUCT DEVELOPMENT**	**9**
Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering - Cloud points generation, converting cloud data to 3D model, Concurrent Engineering – Basics, Application and its advantages in NPD.		
		Total: 45

TEXTBOOKS	
1	Product Development – Sten Jonsson
2	Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger
REFERENCES	
1	Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark
2	Toyota Product Development System – James Morgan & Jeffrey K. Liker
3	Product Design & Value Engineering – Dr. M.A. Bulsara &Dr. H.R. Thakkar
4	Winning at New Products – Robert Brands 3rd Edition.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Discuss fundamental concepts and customer specific requirements of the New Product Development.	K2
CO2	Discuss the Material specification standards, analysis and fabrication, manufacturing process.	K2
CO3	Develop Feasibility Studies & reporting of New Product development.	K4

CO4	Analyzing the New product qualification and Market Survey on similar products of new product development.	K4
CO5	Develop Reverse Engineering, Cloud points generation, converting cloud data to 3D model.	K4

CO-PO Mapping

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

AME509 - DESIGN OF JIGS AND FIXTURES							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		7	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To understand the functions and design principles of Jigs, fixtures and press tools. ➢ To gain proficiency in the development of required views of the final design						
Unit 1	**LOCATING AND CLAMPING PRINCIPLES**						**9**
Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.							
Unit 2	**JIGS AND FIXTURES**						**9**
Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.							
Unit 3	**PRESS WORKING AND ELEMENTS OF CUTTING DIES**						**9**
Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.							
Unit 4	**BENDING AND DRAWING DIES**						**9**
Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design							

and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.		
Unit 5	**FORMING TECHNIQUES AND EVALUATION**	**9**
Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke**.**		
		Total: 45

TEXTBOOKS	
1	Joshi, P.H. “Jigs and Fixtures”, 2nd Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.
2	Joshi P.H “Press tools - Design and Construction”, wheels publishing, 1996
3	Venkataraman. K, “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 2005.
REFERENCES	
1	ASTME Fundamentals of Tool Design Prentice Hall of India.
2	Design Data Handbook, PSG College of Technology, Coimbatore.
3	Donaldson, Lecain and Goold “Tool Design”, 5th Edition, Tata McGraw Hill, 2017.
4	Hoffman “Jigs and Fixture Design”, Thomson Delmar Learning, Singapore, 2004.
5	Kempster, “Jigs and Fixture Design”, Third Edition, Hoddes and Stoughton, 1974.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Summarize the different methods of Locating Jigs and Fixtures and Clamping principles.	K2
CO2	Design and develop jigs and fixtures for given component.	K4
CO3	Discuss the press working terminologies and elements of cutting dies.	K2
CO4	Distinguish between Bending and Drawing dies.	K2
CO5	Discuss the different types of forming techniques.	K2

CO-PO Mapping

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

AME510 - DESIGN FOR MANUFACTURING & ASSEMBLY							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		7	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To introduce economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products. ➢ To learn design consideration principles of forming in the design of extruded, stamped, and forged products. ➢ To learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products. ➢ To learn design consideration principles of welding in the design of welded products. ➢ To learn design consideration principles of assembly in the design of assembled products.						
Unit 1	**INTRODUCTION AND CASTING**						**9**
Introduction - Economics of process selection - General design principles for manufacturability; Design considerations for: Sand cast – Die cast – Permanent mold cast parts.							
Unit 2	**FORMING**						**9**
Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts –Forged parts.							
Unit 3	**MACHINING**						**9**
Design considerations for: Turned parts – Drilled parts – Milled, planed, shaped and slotted parts– Ground parts.							
Unit 4	**WELDING**						**9**
Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment & heat treatment. Resistance welding – Design considerations for: Spot – Seam – Projection – Flash & Upset weldment.							
Unit 5	**ASSEMBLY**						**9**
Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic assembly.							
							Total: 45
TEXTBOOKS							
1	James G. Bralla, “Handbook of Product Design for Manufacture”, McGraw Hill, 1986.						
2	O. M olloy, E.A. Warman, S. Tilley, “Design for Manufacturing and Assembly: Concepts, Architectures and Implementation”, Springer, 1998.						
REFERENCES							
1	Corrado Poli, “Design for Manufacturing: A Structured Approach”, Elsevier, 2001.						

2	Da vid M. Anderson, “Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production”, CIM Press, 2004.
3	Eri k Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, “Manufacturing and Design: Understanding the Principles of How Things Are Made”, Elsevier, 2014.
4	Henry Peck, “Designing for Manufacture”, Sir Isaac Pitman & Sons Ltd., 1973.
5	Matousek, “Engineering Design”, Blackie & Sons, 1956

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Discuss the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.	K2
CO2	Explain design consideration principles of forming in the design of extruded, stamped, and forged products.	K2
CO3	Explain design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.	K2
CO4	Explain design consideration principles of welding in the design of welded products.	K2
CO5	Explain design consideration principles of assembly in the design of assembled products.	K2

CO-PO Mapping

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

PROFESSIONAL ELECTIVES – THERMAL & ENERGY

AME511 - POWER PLANT ENGINEERING							
Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		7	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To study coal based thermal power plants. ➢ To study diesel, gas turbine and combined cycle power plants. ➢ To learn the basics of nuclear engineering and power plants. ➢ To learn the power from renewable energy ➢ To study energy, economic and environmental issues of power plants.						
Unit 1	**COAL BASED POWER PLANT**						**9**
Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary cycles and cogeneration systems							
Unit 2	**DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS**						**9**
Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimization, Components of Diesel and Gas Turbine power plants, Combined Cycle Power Plants, Integrated Gasifier based Combined Cycle systems.							
Unit 3	**NUCLEAR POWER PLANT**						**9**
Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors, Safety measures for Nuclear Power plants.							
Unit 4	**POWER FROM RENEWABLE ENERGY**						**9**
Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.							
Unit 5	**ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANT**						**9**
Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.							
							Total: 45

TEXTBOOKS	
1	Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008
2	A Textbook of Power Plant Engineering by R.K. Rajput, 2016.
REFERENCES	
1	El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010
2	Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004

3	Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering Second Edition, Standard Handbook of McGraw – Hill, 1998.
4	Power Plant Engineering by B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar | 1 November 2019
5	Power Plant Engineering, As per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al. | 1 January 2019

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Explain the layout, construction and working of the components inside a thermal power plant.	K2
CO2	Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.	K2
CO3	Explain the layout, construction and working of the components inside nuclear power plants.	K2
CO4	Explain the layout, construction and working of the components inside Renewable energy power plants.	K2
CO5	Explain the applications of power plants while extending their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.	K2

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

AME512 - GAS DYNAMICS AND JET PROPULSION

Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		7	**PE**	**3**	**0**	**0**	**3**

Preamble	➢ To study the fundamentals of compressible flow concepts and the use of gas tables. ➢ To learn the compressible flow behavior in constant area ducts. ➢ To study the development of shock waves and its effects. ➢ To study the types of jet engines and their performance parameters. ➢ To learn the types of rocket engines and their performance parameters.

Unit 1	BASIC CONCEPTS AND ISENTROPIC FLOWS	9
Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers		
Unit 2	**FLOW THROUGH DUCTS**	**9**
Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties		
Unit 3	**NORMAL AND OBLIQUE SHOCKS**	**9**
Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications		
Unit 4	**JET PROPULSION**	**9**
Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines		
Unit 5	**SPACE PROPULSION**	**9**
Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights		
		Total: 45

TEXTBOOKS	
1	And erson, J.D., “Modern Compressible flow”, Third Edition, McGraw Hill, 2003.
2	M Yahya, “Fundamentals of Compressible Flow with Aircraft and Rocket propulsion”, New Age International (P) Limited, 4th Edition, 2012
REFERENCES	
1	R. D. Zucker and O Biblarz, “Fundamentals of Gas Dynamics”, 2nd edition, Wiley, 2011
2	Balachandran, P., “Fundamentals of Compressible Fluid Dynamics”, Prentice-Hall of India, 2007
3	Radhakrishnan, E., “Gas Dynamics”, Printice Hall of India, 2006.
4	Hill and Peterson, “Mechanics and Thermodynamics of Propulsion”, Addison – Wesley, 1965.
5	Babu, V., “Fundamentals of Compressible Flow”, CRC Press, 1st Edition, 2008

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Apply the fundamentals of compressible flow concepts and the use of gas tables.	K3
CO2	Analyze the compressible flow behaviour in constant area ducts.	K4
CO3	Analyze the development of shock waves and their effects.	K4
CO4	Explain the types of jet engines and their performance parameters.	K2

CO5	Explain the types of rocket engines and their performance parameters.	K2

CO-PO Mapping

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

AME513 - REFRIGERATION AND AIR CONDITIONING							
Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		7	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To introduce the underlying principles of operations in different Refrigeration & Air conditioning systems and components. ➢ To provide knowledge on design aspects of Refrigeration & Air conditioning systems. ➢ To study the vapour absorption and air refrigeration systems. ➢ To learn the psychrometric properties and processes. ➢ To study the air conditioning systems and load estimation						
Unit 1	**VAPOUR COMPRESSION REFRIGERATION SYSTEM**						**9**
Refrigerants Desirable properties – Classification - Nomenclature - Vapour compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – sub cooling and super heating- effects of condenser and evaporator pressure on COP-multi pressure system -low temperature refrigeration - Cascade systems – problems. Equipment's: Type of Compressors, Condensers, Expansion devices, Evaporators.							
Unit 2	**OTHER REFRIGERATION SYSTEMS**						**9**
Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic- Vortex and Pulse tube refrigeration systems							
Unit 3	**PSYCHROMETRIC PROPERTIES AND PROCESSES**						**9**
Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.							
Unit 4	**AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION**						**9**

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.		
Unit 5	**CRYOGENIC ENGINEERING**	**9**
Introduction to cryogenics – difference between refrigeration & cryogenics – simple cryogenic cycle – Linde Hampson refrigeration cycle – modified Linde Hampson cryogenic cycle – cascaded systems – boiling point of various gases in ambient air – cryo vessel – cryostat – inversion curve – Joule Thomson effect – positive & negative zone – Liquid Oxygen cryogenics - Liquid Nitrogen cryogenics - Liquid Helium cryogenics.		
		Total: 45

TEXTBOOKS	
1	Arora, C.P., “Refrigeration and Air Conditioning”, 3rd edition, McGraw Hill, New Delhi, 2010
2	R.S.Khurmi, “Textbook of Refrigeration and Air-Conditioning”, S Chand Publications, 2019.
3	Mamata Mukhopadhyay, “Fundamentals of cryogenic engineering”, PHI Learning, 2014.
REFERENCES	
1	ASHRAE Handbook, Fundamentals, 2010
2	JonesW.P., “Air conditioning engineering” 5th edition, Elsevier Butterworth-Heinemann, 2007
3	Roy J. Dossat, “Principles of Refrigeration”, 4th edition, Pearson Education Asia, 2009.
4	Stoecker W.F and Jones J.W, “Refrigeration and Air Conditioning”, McGraw Hill, NewDelhi,1986
5	R.K.Rajput, “A Textbook of Refrigeration and Air-Conditioning”, 2019.

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Explain the Vapor compression Refrigeration systems and to solve problems.	K2
CO2	Discuss the various types of Refrigeration systems.	K2
CO3	Calculate the Psychrometric properties and its use in psychrometric processes.	K4
CO4	Explain the concepts of Air conditioning and to solve problems.	K2
CO5	Explains the concept of cryogenics and its functioning.	K2

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

AME514 - MODERN IC ENGINES							
Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		7	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To study the working of Gasoline fuel injection systems and SI combustion. ➢ To study the working of Diesel fuel injection systems and CI combustion. ➢ To Identifying the source and measure it; explain the mechanism of emission formation and control methods. ➢ To study the Selecting alternative fuel resources and their utilization techniques in IC engines. ➢ To study the advanced combustion modes and future power train systems.						
Unit 1	**SPARK IGNITION ENGINES**						**9**
Mixture requirements – Fuel injection systems – Mono point, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion – Knock - Factors affecting knock – Combustion chambers – Hydrogen utilization in spark engines – digital twin based spark ignition technology.							
Unit 2	**COMPRESSION IGNITION ENGINES**						**9**
Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Introduction to Turbo charging – Electronic engine management.							
Unit 3	**POLLUTANT FORMATION AND CONTROL**						**9**
Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.							
Unit 4	**ALTERNATE FUELS**						**9**
Alcohol Fuels, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits – Utilisation Methods - Engine Modifications							
Unit 5	**RECENT TRENDS IN IC ENGINES**						**9**
Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems - Hybrid Electric Vehicles – NOx Adsorbers - Onboard Diagnostics							
							Total: 45
TEXTBOOKS							

1	V. Ganesan, “Internal Combustion Engines”, V Edition, Tata McGraw Hill, 2012.
2	John B. Heywood, “Internal Combustion Engines Fundamentals”, McGraw-Hill, 1988.
REFERENCES	
1	B.P . Pundir, “IC Engines Combustion & Emission”, Narosa Publishing House, 2014
2	Duffy Smith, “Auto Fuel Systems”, The Good Heart Wilcox Company, Inc., 2003.
3	EranSher, “Handbook of Air Pollution from Internal Combustion Engines: Pollutant Formation and Control”, Academic Press, 1998.
4	K.K.Ramalingam, “Internal Combustion Engine Fundamentals”, SciTech Publications, 2011.
5	R.B.Mathur and R.P. Sharma, “Internal Combustion Engines”, Dhanpat Rai& Sons, 2007

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Explain the working of Gasoline fuel injection systems and SI combustion.	K2
CO2	Explain the working of Diesel fuel injection systems and CI combustion.	K2
CO3	Identify the source and measure it; explain the mechanism of emission formation and control methods.	K3
CO4	Select alternative fuel resources and its utilization techniques in IC engines.	K3
CO5	Explain advanced combustion modes and future power train systems	K2

CO-PO Mapping

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

AME515 - RENEWABLE ENERGY SYSTEMS							
Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		7	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To Provide knowledge about various renewable energy technologies ➢ To enable students to understand solar power and design a PV system.						

	➢ To provide knowledge about wind energy system. ➢ To Provide knowledge about various possible hybrid energy systems ➢ To gain knowledge about application of various renewable energy technologies	
Unit 1	**INTRODUCTION**	**9**
Primary energy sources - renewable vs. non-renewable primary energy sources - renewable energy resources in India - Current usage of renewable energy sources in India - future potential of renewable energy in power production and development of renewable energy technologies		
Unit 2	**SOLAR ENERGY**	**9**
Solar Radiation and its measurements, Solar Thermal Energy Conversion - plate Solar Collectors - Concentrating Collectors - Efficiency and performance of collectors. Direct Solar Electricity Conversion from Photovoltaic - types of solar cells - applications. Recent Advances in PV Applications: Building Integrated PV, Grid Connected PV Systems,		
Unit 3	**WIND ENERGY**	**9**
Wind energy principles, wind site and its resource assessment, wind assessment, Factors influencing wind, wind turbine components, wind energy conversion systems (WECS), Classification of WECS devices, wind electric generating and control systems, characteristics and applications		
Unit 4	**BIO ENERGY**	**9**
Energy from biomass - Principle of biomass conversion technologies/process - classification, Bio gas generation, types of biogas plants, selection of site for biogas plant, classification of biogas plants, Advantage and disadvantages of biogas generation, thermal gasification of biomass, biomass gasifier, Application of biomass and biogas plants and their economics		
Unit 5	**OTHER TYPES OF ENERGY**	**9**
Energy conversion from Hydrogen and Fuel cells, Geothermal energy - resources, types of wells, methods of harnessing the energy - potential in India. OTEC - Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini hydel power plants and their economics.		
		Total: 45

TEXTBOOKS	
1	Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, McGraw Hill; 1st edition 2020.
2	Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited, 2nd edition, 2011.
3	D Yogi Goswami, “Principles of Solar Engineering”, CRC Press, 2022.
REFERENCES	
1	Twidell & Wier, “Renewable Energy Resources”, CRC Press (Taylor & Francis).
2	Tiwari and Ghosal/ Narosa, “Renewable energy resources”.
3	D.P.Kothari, K.C.Singhal, “Renewable energy sources and emerging technologies”, P.H.I. Publishers, 2015.
4	D.S.Chauhan, S.K. Srivastava, ‘Non – Conventional Energy Resources’, New Age Publishers, 2006
5	H.Khan, ‘Non – Conventional Energy Resources’, Tata Mc Graw Hill, 2006.

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Attained knowledge about various renewable energy technologies	K2
CO2	Ability to understand and design a PV system.	K2
CO3	Understand the concept of various wind energy system.	K2
CO4	Gain knowledge about various possible hybrid energy systems	K2
CO5	Attained knowledge about various application of renewable energy technologies	K2

CO-PO Mapping

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

PROFESSIONAL ELECTIVES – MATERIALS

AME516 - NON-DESTRUCTIVE TESTING AND EVALUATION							
Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		8	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To provide a basic understanding with case studies on different NDT & E techniques. ➢ Impart knowledge on inspecting materials with industry specifications and standards. ➢ To provide a basic understanding on different NDT & E testing. ➢ Understand Eddy current testing ➢ To get knowledge about the advanced NDT techniques						
Unit 1	**INTRODUCTION OF NDT**						**9**
Fundamentals of characterisation studies, Codes, Standards and Specifications, Defects in Materials due to various processing, Visual Testing – vision certification, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes– light sources and special lighting–calibration							
Unit 2	**SURFACE INSPECTIN TECHNIQUES AND ULTRASONIC TESTING**						**9**
Dye penetrant testing – visible, fluorescent method, Selection of penetrant method – Theory of magnetism and Principle of Magnetic Particle Testing - Wet Magnetic Particle Testing and Dry Magnetic Particle Testing. Ultrasonic transducers, Inspection techniques, Flaw characterization, Material properties characterization, Immersion testing, Applications.							
Unit 3	**ACOUSTIC EMISSION TESTING AND RADIOGRAPHY TESTING**						**9**
AE sources, Wave propagation in metals and alloys, AE signal intensity in attenuation media, AE equipment, Signal features, Data collection and analysis, source location, Applications. Introduction to Radiography – radiography sources - Film Radiography - Film handling and storage - Effect of film processing on film characteristics - Radiographic Image Quality and Radiographic Techniques							
Unit 4	**EDDY CURRENT TESTING**						**9**
Generation of eddy currents – effect of change of impedance on instrumentation – properties of eddy currents – eddy current sensing elements, probes, type of coil arrangement – absolute, differential, lift off, operation–Through encircling coils, type of arrangements – absolute, differential fill factor, operation - Factors affecting sensing elements and coil impedance - test part and test system– Applicable codes and standards.							
Unit 5	**ADVANCED NON-DESTRUCTIVE TESTING**						**9**
Leak testing, Hydro testing, Holography, Thermography, Magnetic Barkhausen Effect, and In-situ metallography. Industrial applications of flaw detection probability, Wave propagation in guided wave modes in isotropic and composite plate structures, Mode conversion, diffraction and scattering of ultrasonic waves in isotropic and anisotropic media, Pulsed eddy, current NDT, Electromagnetic acoustic technique (EMAT). Scanning Acoustic Microscopy (SAM) and Scanning Laser Acoustic Microscopy.							
							Total: 45
TEXTBOOKS							

1	Wong B. Stephen, “Non-Destructive Testing - Theory, Practice and Industrial Applications”, 2015, 1st edition, Lambert Academic Publishing, USA
REFERENCES	
1	Prasad, J C. G. Krishnadas Nair, “Non-Destructive Test and Evaluation of Materials”, 2017, 2nd edition, McGraw Hill Education (India) Private Limited
2	Raviprakash, “Non-Destructive Testing Techniques”, 2010, 1st edition, New Age International Private Limited Published.
3	Baldev Raj, M. Thavasimuthu, and Jayakumar T, “Practical Non-Destructive Testing”, 3rd edition, Narosa publications, 2009.

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Infer the knowledge of various NDT techniques.	K2
CO2	Apply the NDT techniques to identify surface defects of engineering components.	K3
CO3	Use the subsurface NDT techniques to identify the defects.	K2
CO4	Examine and quantify closed discontinuities to assess the structural integrity of engineering components.	K3
CO5	Analyse the outputs of the acquired data from NDT techniques	K4

CO-PO Mapping

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

AME517 - TESTING OF MATERIALS							
Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		8	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To provide a basic understanding of testing of materials ➢ To get knowledge about the different Mechanical Testing ➢ Impart knowledge onNon Destructive testing ➢ To get knowledge about the Characterization Techniques ➢ To gain knowledge in Advanced testing methods						
Unit 1	**INTRODUCTION TO MECHANICAL TESTING**						**9**

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing		
Unit 2	**TRADITIONAL MECHANICAL TESTING**	**9**
Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.		
Unit 3	**NON-DESTRUCTIVE TESTING AND APPLICATIONS**	**9**
Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications		
Unit 4	**MECHANICAL CHARACTERIZATION TECHNIQUES**	**9**
Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications		
Unit 5	**ADVANCED TESTING**	**9**
Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo- mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.		
		Total: 45

TEXTBOOKS	
1	Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2	Cullity, B. D., “Elements of X-ray diffraction”, 3rd Edition, Addison-Wesley Company Inc., New York, 2000
3	P. Field Foster, “The Mechanical Testing of Metals and Alloys” 7th Edition, Cousens Press, 2007
REFERENCES	
1	Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978
2	ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA
3	Brandon D.G., “Modern Techniques in Metallography”, Von Nostrand Inc. NJ, USA, 1986

COURSEOUTCOMES: **At the end of the course, learners will be able to**	**Bloom’s Taxonomy Level**

CO1	Identify suitable testing technique to inspect industrial component.	K1
CO2	Ability to use the different technique and know its applications and limitations.	K2
CO3	Obtain the knowledge of Non-destructive testing and its applications.	K2
CO4	To gain knowledge in Mechanical Characterization Techniques.	K2
CO5	Attain Knowledge in Advanced Testing of materials.	K2

CO-PO Mapping

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

AME518 - NANO MATERIALS AND APPLICATIONS							
Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		8	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To provide a basic understanding of Nanomaterials. ➢ To get knowledge about the Nano sensors ➢ Impart knowledge on Nanotechnology Enabled devises ➢ To get knowledge about the Diffraction analysis ➢ To gain knowledge in Surface imaging						
Unit 1	**SYNTHESIS AND PREPARATION OF NANOMATERIALS**						**9**
Synthesis of bulk nanostructured materials - Sol Gel processing- bulk and nano composite materials - Grinding - high energy ball milling – injection moulding - extrusion - melt quenching and annealing							
Unit 2	**NANOSENSORS**						**9**
Introduction to sensors. Characteristics and terminology - static and dynamic characteristics. Micro and nano-sensors, Fundamentals of sensors, biosensor, micro fluids, Packaging and characterization of sensors, Sensors for aerospace and defence. Organic and inorganic nanosensors							
Unit 3	**NANO TECHNOLOGY ENABLED DEVICES**						**9**
Nanomaterials and nanostructured films, Nanoscale electronic and ionic transport. Sensor for bio-medical applications. Bioelectronics, Nanoparticle biomaterial hybrid systems for sensing applications. Gas sensor							
Unit 4	**DIFFRACTION ANALYSIS**						**9**

X-ray diffraction, powder diffraction, lattice parameters, structure analyses, strain analyses, phase identification, particle size analyses using - Scherer`s formula - X-ray photoelectron spectroscopy (XPS)- Auger electron spectroscopy (AES)		
Unit 5	**SURFACE IMAGING**	**9**
Scanning Electron Microscope (SEM) – Field Emission Scanning Electron Microscope (FESEM)- Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM)– Transmission Electron Microscopy (TEM)		
		Total: 45

TEXTBOOKS	
1	W. Gaddand, D. Brenner, S. Lysherski and G. J. Infrate, “Handbook of nanoscience, Engineering and Technology”, CRC Press, 2002
2	G. Cao, “Naostructures and Nanomaterials: Synthesis, properties and applications”, Imperical College Press, 2004.
3	J. George, “Preparation of thin films”, Marcel Dekker, InC., New York, 2005.
4	C. N. R. Rao, A. Muller, A. K. Cheetham, “The chemistry of nanomaterials: Synthesis, properties and applications”, Wiley VCH Verlag Gmbh & Co, Weinheim, 2004.
REFERENCES	
1	A. H. Cottrell, “The Mechanical Properties of Matter”, John Wiley, New York-London, 1964.
2	R. Asthana, A. Kumar and N. Dahotre, “Materials Science in Manufacturing” Butterworth Heinemann, Elsevier 2006
3	G. E. Dieter, adapted by D Bacon, “Mechanical Metallurgy”, SI Metric edition, McGraw Hill, Singapore, 1988
4	K. A. Padmanabhan, “Mechanical Properties of Nanostructured Materials”, Materials Science and Engineering, A 304-306 (2001) 200-205
5	H. Gleiter, “Nanocrystalline Materials”, Progress in Materials Science Vol. 33, 1989
6	C. Koch, “Nanostructured Materials: Processing, Properties and Applications”, 2nd Edition, Ed.: 2007

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Infer the knowledge of various Nanomaterials.	K2
CO2	Obtain the knowledge of nano sensors.	K2
CO3	Use the enabled devices to identify the nano particles.	K2
CO4	Analyze the outputs of the acquired data from Diffraction analyses.	K4
CO5	Analyze the outputs of the acquired data from Surface Imaging	K4

CO-PO Mapping

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

AME519 - COMPOSITE MATERIALS AND MECHANICS							
Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		8	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ Study of different composite materials and finding its mechanical strength ➢ Fabrication of FRP and other composites by different manufacturing methods ➢ Stress analysis of fiber reinforced Laminates for different combinations of plies with different orientations of the fiber. ➢ Calculation of stresses in the lamina of the laminate using different failure theories. ➢ Calculation of residual stresses in different types of laminates under thermo-mechanical load using the Classical Laminate Theory						
Unit 1	**INTRODUCTION TO COMPOSITE MATERIALS**						**9**
Definition-Matrix materials-polymers-metals-ceramics - Reinforcements: Particles, whiskers, inorganic fibers, metal filaments-ceramic fibers-fiber fabrication-natural composite wood, Jute Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate-Reinforced composite Materials, Dispersion-Strengthened composite, Fiber-reinforced composites Rule of mixtures-Characteristics of fiber-Reinforced composites, Manufacturing fiber and composites.							
Unit 2	**MANUFACTURING OF COMPOSITES**						**9**
Manufacturing of Polymer Matrix Composites (PMCs)-hand lay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM)-,bag moulding, injection moulding, Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) - Solid state, liquid state, vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs)–hot pressing reaction bonding process-infiltration technique, direct oxidation-interfaces							
Unit 3	**LAMINA CONSTITUTIVE EQUATIONS**						**9**
Lamina Constitutive Equations: Lamina Assumptions–Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, CrossPly Laminates. Laminate Structural							

Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates		
Unit 4	**LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATE FLAT PLATES**	**9**
Introduction- Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations– Natural Frequencies		
Unit 5	**THERMO STRUCTURAL ANALYSIS**	**9**
Fabrication stresses / Residual stresses in FRP laminated composites-Co-efficient of Thermal Expansion (C.T.E.) - Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's -Stress and Moment Resultants due cooling of the laminates during fabrication-Calculations for thermo-mechanical stresses in FRP laminates Case studies: Implementation of CLT for evaluating residual stresses in the components made with different isotropic layers such as electronic packages etc.		
		Total: 45

TEXTBOOKS	
1	Agarwal BD and Broutman LJ, "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York,1990.
2	Gibson RF, Principles of Composite Material Mechanics, CRC press,4th Edition,2015.
REFERENCES	
1	Hyer MW and Scott R White, "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill,1998
2	Issac M Daniel and OriIshai, "Engineering Mechanics of Composite Materials", OxfordUniversityPress-2006, First Indian Edition-2007
3	Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press (India) Pvt Ltd, Hyderabad, 2004 (Reprinted 2008)
4	Mallick PK, Fiber – Reinforced Composites: Materials, Manufacturing and Design, CRC Press, 3rd Edition, 2007

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Infer the knowledge of various NDT techniques.	K2
CO2	Calculate for mechanical strength of the composite material	K4
CO3	Fabricate the FRP and other composites by different manufacturing methods	K4
CO4	Analyze fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.	K4

CO5	Evaluate the stresses in the lamina of the laminate using different failure theories	K5

CO-PO Mapping

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

AME520 - MECHANICAL BEHAVIOR OF MATERIALS							
Programme & Branch	**BE& MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		8	**PE**	**3**	**0**	**0**	**3**
Preamble	➢ To learn the concepts of theory of elasticity in three-dimensional stress system. ➢ To study the shear centre of various cross-sections and deflections in beams subjected to unsymmetrical bending. ➢ To learn the stresses in flat plates and curved members. ➢ To study torsional stress of non-circular sections. ➢ To learn the stresses in rotating members, contact stresses in point and line contact applications						
Unit 1	**ELASTICITY**						**9**
Stress-Strain relations and general equations of elasticity in Cartesian, Polar and curvilinear coordinates, differential equations of equilibrium – compatibility - boundary conditions - representation of three - dimensional stress of a tension generalized hook's law - St. Venant's principle - planes tress - Airy's stress function. Energy methods							
Unit 2	**SHEAR CENTRE AND UNSYMMETRICAL BENDING**						**9**
Location of shear centre for various thin sections - shear flows. Stresses and Deflections in beams subjected to unsymmetrical loading-kern of a section							
Unit 3	**STRESSES IN FLAT PLATES AND CURVED MEMBERS**						**9**
Circumference and radial stresses – deflections - curved beam with restrained ends - closed ring subjected to concentrated load and uniform load - chain links and crane hooks. Solution of rectangular plates – pure bending of plates – deflection – uniformly distributed load – various end conditions							
Unit 4	**TORSION OF NON-CIRCULAR SECTIONS**						**9**
Torsion of rectangular cross section - St.Venants theory - elastic membrane analogy - Prandtl's stress function - torsional stress in hollow thin walled tubes							

Unit 5	STRESSES IN ROTATING MEMBERS AND CONTACT STRESSES	9
Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Methods of computing contact stress-deflection of bodies in point and line contact applications		
		Total: 45

TEXTBOOKS	
1	Arthur P Boresi, Richard J.Schmidt, “Advanced Mechanics of Materials”, Wiley India Pvt. Ltd., 2009.
2	Hibbeler. R.C., “Mechanics of Materials”, Prentice-Hall, 2018.York, 2000.
REFERENCES	
1	1.Robert D.Cook, Warren C.Young, "Advanced Mechanics of Materials", Prentice Hall,1999.
2	Srinath. L.S., “Advanced Mechanics of Solids”, Tata McGraw Hill, 2009
3	Timoshenko and Goodier, "Theory of Elasticity", Tata McGraw Hill, 2010.

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Apply the concepts of theory of elasticity in three-dimensional stress system.	K3
CO2	Determine the shear centre of various cross-sections and deflections in beams	K4
CO3	Appreciate the unsymmetrical bending.	K2
CO4	Evaluate the stresses in flat plates and curved members.	K5
CO5	Calculate torsional stress of non-circular sections.	K4

CO-PO Mapping

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

OPEN ELECTIVES

AME701 - DRONE TECHNOLOGIES							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
			OE	**3**	**0**	**0**	**3**
Preamble	➢ To understand the basics of drone concepts. ➢ To learn and understand the fundaments of design, fabrication and programming of drone. ➢ To impart the knowledge of a flying and operation of drone. ➢ To know about the various applications of drone. ➢ To understand the safety risks and guidelines of fly safely.						
Unit 1	**INTRODUCTION TO DRONE TECHNOLOGY**						**9**
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability							
Unit 2	**DRONE DESIGN, FABRICATION AND PROGRAMMING**						**9**
Classifications of the UAV -Overview of the main drone parts- Technical characteristics - Function of the components -Assembling a drone- The energy sources- Level of autonomy- Drones configurations - The methods of programming drone- Download program -Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.							
Unit 3	**DRONE FLYING AND OPERATION**						**9**
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment. Drone controls Flight operations –management tool –Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications.							
Unit 4	**DRONE COMMERCIAL APPLICATIONS**						**9**
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing.							
Unit 5	**FUTURE DRONES AND SAFETY**						**9**
The safety risks- Guidelines to fly safely - Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms.							
							Total: 45

TEXTBOOKS

1	Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, John Wiley & Sons, Inc, 2021.
2	Terry Kilby and Belinda Kilby, “Make: Getting Started with Drones “, Maker Media, 1st Edition, 2016.

REFERENCES

1	John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016
2	Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Know about a various type of drone technology, drone fabrication and programming.	K2
CO2	Execute the suitable operating procedures for functioning a drone.	K3
CO3	Select appropriate sensors and actuators for Drones.	K3
CO4	Develop a drone mechanism for specific applications.	K4
CO5	Create the programs for various drones.	K6

CO-PO Mapping

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

AME702 - ADDITIVE MANUFACTURING							
Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
			OE	**3**	**0**	**0**	**3**
Preamble	➢ To introduce the development, capabilities, applications, of Additive Manufacturing (AM), and its business opportunities. ➢ To be acquainted with vat polymerization and material extrusion processes ➢ To be familiar with powder bed fusion and binder jetting processes. ➢ To gain knowledge on applications of direct energy deposition, and material jetting processes. ➢ To impart knowledge on sheet lamination and direct write technologies.						
Unit 1	**INTRODUCTION**						**9**
Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping - Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain - ASTM/ISO 52900 Classification - Benefits - AM File formats: STL, AMF – Applications - Business Opportunities in AM.							
Unit 2	**VAT POLYMERIZATION AND MATERIAL EXTRUSION**						**9**
Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process - top down and bottom-up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process -							

Advantages - Applications. Material Extrusion: Fused Deposition Modeling - Process-Materials - Applications and Limitations.		
Unit 3	**POWDER BED FUSION AND BINDER JETTING**	**9**
Powder Bed Fusion: Selective Laser Sintering: Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting, Electron Beam Melting: Materials - Process - Advantages and Applications. Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits - Limitations -Applications.		
Unit 4	**MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION**	**9**
Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Directed Energy Deposition: Laser Engineered Net Shaping - Process – Material Delivery - Materials -Benefits - Applications.		
Unit 5	**SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY**	**9**
Sheet Lamination: Laminated Object Manufacturing - Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding - Materials - Application and Limitation. Ink-Based Direct Writing: Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW.		
		Total: 45

TEXTBOOKS

1	Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani, “Additive manufacturing technologies”, Springer Cham, 3rd edition, 2021.
2	Andreas Gebhardt and Jan-Steffen Hotter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, 2016.

REFERENCES

1	Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, 1st Edition, 2012.
2	Milan Brandt, “Laser Additive Manufacturing: Materials, Design, Technologies, and Applications”, Woodhead Publishing, 1st Edition, 2016.
3	Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 2nd Edition, CRC Press, 2021.
4	Kamrani A.K. and Nasr E.A, “Rapid Prototyping: Theory and practice”, Springer, 2006.
5	Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A toolbox for prototype development”, CRC Press, 2019.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.	K2
CO2	Acquire knowledge on process vat polymerization and material extrusion processes and its applications.	K2
CO3	Elaborate the process and applications of powder bed fusion and binder jetting.	K2

CO4	Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.	K2
CO5	Acquire knowledge on sheet lamination and direct write technology.	K2

CO-PO Mapping

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

AME703 - ELECTRIC AND HYBRID VEHICLE TECHNOLOGY

Programme & Branch	**BE & MECH**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
			OE	**3**	**0**	**0**	**3**

Preamble	➢ To introduce the concept of hybrid and electric drive trains. ➢ To elaborate on the types and utilisation of hybrid and electric drive trains. ➢ To expose on different types of AC and DC drives for electric vehicles. ➢ To learn and utilise different types of energy storage systems. ➢ To introduce concept of energy management strategies and drive sizing.

Unit 1	**INTRODUCTION**	**9**
Basics of vehicle performance, vehicle power source characterization, transmission characteristics, History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drivetrains on energy supplies.		
Unit 2	**HYBRID ELECTRIC DRIVE TRAINS**	**9**
Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drivetrains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.		
Unit 3	**CONTROL OF AC & DC DRIVES**	**9**
Introduction to electric components used in hybrid and electric vehicles, Configuration, and control - DC Motor drives, Induction Motor drives, Permanent Magnet Motor drive, and Switch Reluctance Motor drives, drive system efficiency.		
Unit 4	**ENERGY STORAGE**	**9**
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Energy storage and its analysis - Battery based, Fuel Cell based, and Super Capacitor based, Hybridization of different energy storage devices.		
Unit 5	**DRIVE SIZING AND ENERGY MANAGEMENT STRATEGIES**	**9**

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selection of appropriate energy storage technology, Energy Management Strategies: Energy management strategies used in hybrid and electric vehicles, classification, and comparison of energy management strategies, Implementation issues.	
Total: 45	
TEXTBOOKS	
1	Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", Routledge publications, 3rd Edition, 2021
2	James Larminie and John Lowry, "Electric Vehicle Technology Explained", Wiley, 2nd Edition, 2012.
REFERENCES	
1	Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 3rd Edition 2018.
2	Rand D.A.J, Woods, R & Ronald Dell, "Batteries for Electric vehicles", John Wiley & Sons, 1998.
3	Jack Erjavec, "Hybrid, Electric and Fuel-Cell Vehicles", Delmar Cengage Learning, 2nd Edition, 2012.
4	Christian Paar, "Energy Management in Hybrid Electric Vehicles using Co-Simulation", VDM Verlag, 2011.
5	Yangsheng Xu, Jingyu Yan, Huihuan Qian and Tin Lun Lam, "Hybrid Electric Vehicle Design and Control: Intelligent Omnidirectional Hybrids", McGraw Hill Eductaion, 1st Edition, 2014.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Discuss, categorize and configure hybrid drivetrains requirement for a vehicle.	K2
CO2	Design and apply appropriate hybrid and electric drive trains in a vehicle.	K5
CO3	Design and install suitable AC and DC drives for electric vehicles.	K5
CO4	Discuss arrive at a suitable energy storage system for a hybrid / electric vehicle.	K2
CO5	Apply energy management strategies to ensure better economy and efficiency.	K3

CO-PO Mapping

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

AEC701 - SENSORS AND ACTUATORS							
Programme & Branch	**BE & ECE**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		-	**OE**	**3**	**0**	**0**	**3**

Preamble	The course is to make the students to list common types of sensor and actuators used in automotive vehicles.	
Unit – I	**INTRODUCTION TO MEASUREMENTS AND SENSORS**	**9**
Sensors: Functions- Classifications- Main technical requirement and trends Units and standards Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error Propagation of error- Odds and uncertainty- principle of transduction-Classification. Static characteristics- mathematical model of transducers- Zero, First and Second order transducers Dynamic characteristics of first and second order transducers for standard test		
Unit – II	**VARIABLE RESISTANCE AND INDUTANCE SENSORS**	**9**
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers: - EI pick up and LVDT		
Unit – III	**VARIABLE AND OTHER SPECIAL SENSORS**	**9**
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magneto strictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.		
Unit – IV	**AUTOMOTIVE ACTUATORS**	**9**
Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines. Working principles, construction and location of actuators viz. Solenoid, relay, stepper motor etc.		
Unit – V	**AUTOMATIC TEMPERATURE CONTROL ACTUATORS**	**9**
Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.		
		Total:45

TEXTBOOK:

1.	Doebelin's Measurement Systems: 7th Edition (SIE), Ernest O. Doebelin DhaneshN.Manik McGraw Hill Publishers, 2019.
2.	Robert Brandy, “Automotive Electronics and Computer System”, Prentice Hall,2001
3.	William Kimberley,” Bosch Automotive Handbook”, 6th Edition, Robert Bosch GmbH, 2004.
4.	Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978-3-658-01783-5

REFERENCES:	
1.	James D Halderman, “Automotive Electrical and Electronics” , Prentice Hall, USA, 2013
2.	Tom Denton, “Automotive Electrical and Electronics Systems,” Third Edition, 2004, SAE International.
3.	Patranabis.D, “Sensors and Transducers”, 2nd Edition, Prentice Hall India Ltd,2003
4.	William Ribbens, "Understanding Automotive Electronics -An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012

COURSE OUTCOMES: At the end of the course, learners will be able to		Bloom’s Taxonomy Level
CO1	List common types of sensor and actuators used in vehicles	K2
CO2	Design measuring equipment’s for the measurement of pressure force, temperature and flow	K4
CO3	Generate new ideas in designing the sensors and actuators for automotive application.	K3
CO4	Understand the operation of the sensors, actuators and electronic control.	K2
CO5	Design temperature control actuators for vehicles.	K4

CO-PO Mapping

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

AEC702 - APPLIED DESIGN THINKING

Programme & Branch	BE & ECE	Sem.	Category	L	T	P	C
		-	OE	3	0	0	3

Preamble	➢ This course aims to provide to make the students Introduce tools & techniques of design thinking for innovative product, development. ➢ Illustrate customer-centric product innovation using simple, use cases. ➢ Demonstrate development of Minimum usable Prototypes, Outline principles of solution concepts & their evaluation. ➢ Describe system thinking principles as applied to complex systems

Unit – I	**DESIGN THINKING PRINCIPLES**	**9**
Exploring Human-centered Design - Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy-building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] - Case studies		
Unit – II	**ENDUSER-CENTRIC INNOVATION**	**9**
Importance of customer-centric innovation - Problem Validation and Customer Discovery - Understanding problem significance and problem incidence - Customer Validation. Target user, User persona & user stories. Activity: Customer development process - Customer interviews and field visit		
Unit – III	**APPLIED DESIGN THINKING TOOLS**	**9**
Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design		
Unit – IV	**CONCEPT GENERATION**	**9**
Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts		
Unit – V	**SYSTEM THINKING**	**9**
System Thinking, Understanding Systems, Examples and Understandings, Complex Systems.		
		Total:45

TEXTBOOK:

1.	Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
2.	Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
3.	Proposition Design: How to Create Products and Services Customers Want, Wiley
4.	Donella H. Meadows, (2015), “Thinking in Systems -A Primer”, Sustainability Institute
5.	Tim Brown, (2012) “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Business.

REFERENCES:

1.	https://www.ideou.com/pages/design-thinking#process
2.	https://blog.forgeforward.in/valuation-risk-versus-validation-risk-in-product-innovations49f253ca86 24
3.	https://blog.forgefor ward.in/product-innovation-rubric-adf5ebdfd356 4. https
4.	https://blog.forgefor ward.in/evaluating-product-innovations-e8178e58b86e
5.	https://blog.forgeforward.in/user-guide-for-product-innovation-rubric-857181b253dd
6.	https://blog.forgeforward.in/startup-failure-is-like-true-lie-7812cdfe9b85

COURSE OUTCOMES: **At the end of the course, learners will be able to**	**Bloom’s Taxonomy Level**

CO1	Define & test various hypotheses to mitigate the inherent risks in product innovations	K2
CO2	Design the solution concept based on the proposed value by exploring alternate solutions to achieve value-price fit.	K4
CO3	Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching	K4
CO4	Develop skills in storytelling & pitching	K3
CO5	Apply system thinking in a real-world scenario	K3

CO-PO Mapping

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

AEC703 - PROJECT REPORT WRITING

Programme & Branch	**BE & ECE**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
		-	**OE**	**3**	**0**	**0**	**3**

Preamble	➢ This course aims to provide essentials of project writing, Perceive the difference between general writing and technical writing. ➢ Assimilate the fundamental features of report writing, Learn the structure of a technical and project report.

Unit – I	**9**
Writing Skills – Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing.	
Unit – II	**9**
Project Report – Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism – Report Writing in STEM fields – Experiment – Statistical Analysis.	
Unit – III	**9**
Structure of the Project Report: (Part 1) Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.	
Unit – IV	**9**
Structure of the Project Report: (Part 2) – Literature Review, Research Design, Methods of Data Collection - Tools and Procedures - Data Analysis - Interpretation - Findings –Limitations - Recommendations – Conclusion – Bibliography.	

Unit – V		**9**
Proof reading a report – Avoiding Typographical Errors – Bibliography in required Format – Font – Spacing – Checking Tables and Illustrations – Presenting a Report Orally – Techniques.		
		Total:45

REFERENCES:

1.	Gerson and Gerson - Technical Communication: Process and Product, 7th Edition, Prentice Hall(2012)
2.	Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance(2012)
3.	Daniel Riordan - Technical Report Writing Today (1998) Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers.

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Write effective project reports.	K2
CO2	Use statistical tools with confidence	K2
CO3	Explain the purpose and intension of the proposed project coherently and with clarity.	K2
CO4	Create writing texts to suit achieve the intended purpose.	K2
CO5	Master the art of writing winning proposals and projects.	K2

CO-PO Mapping

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

ACS701 - SYSTEMS ENGINEERING							
Programme & Branch	**B.E &CSE**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
			PE	**3**	**0**	**0**	**3**
Preamble	To introduce system engineering concepts to design the manufacturing system for optimum utilization of source for effective functioning.						
Unit 1	**INTRODUCTION**					**9**	
Definitions of Systems Engineering, Systems Engineering Knowledge, Life cycles, Life-cycle phases, logical steps of systems engineering, Frame works for systems engineering.							
Unit 2	**SYSTEMS ENGINEERING PROCESSES**					**9**	
Formulation of issues with a case study, Value system design, Functional analysis, Business Process Reengineering, Quality function deployment, System synthesis, Approaches for generation of alternatives.							
Unit 3	**ANALYSIS OF ALTERNATIVES- I**					**9**	
Cross-impact analysis, Structural modeling tools, System Dynamics models with case studies, Economic models: present value analysis – NPV, Benefits and costs over time, ROI, IRR; Work and Cost breakdown structure.							
Unit 4	**ANALYSIS OF ALTERNATIVES–II**					**9**	
Reliability, Availability, Maintainability, and Supportability models; Stochastic networks and Markov models, Queuing network optimization, Time series and Regression models, Evaluation of large scale models.							
Unit 5	**DECISION ASSESSMENT**					**9**	
Decision assessment types, Five types of decision assessment efforts, Utility theory, Group decision making and Voting approaches, Social welfare function; Systems Engineering methods for Systems Engineering Management.							
						Total: 45	
TEXTBOOKS							
1	Andrew P. Sage, James E. Armstrong Jr. “Introduction to Systems Engineering”, John Wiley and Sons, Inc,2000.						
COURSEOUTCOMES: **At the end of the course, learners will be able to**						**Bloom’s Taxonomy Level**	
CO1	The Student must be able to apply systems engineering principles to make decision for optimization.					K2	
CO2	Hence an understanding of the systems engineering discipline and be able to use the core principles and processes for designing effective system.					K2	
CO3	Analyze the various method to impact on system engineering					K2	
CO4	Decision capabilities identified with various analysis.					K2	

CO5	Management the system based on decision results.	K2

CO-PO Mapping

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

ACS702- GREEN COMPUTING						
Programme & Branch	**B.E & CSE**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
			OE	**3**	**0**	**0**	**3**
Preamble	➢ To learn the fundamentals of Green Computing. ➢ To analyze the Green computing Grid Framework. ➢ To understand the issues related with Green compliance. ➢ To study and develop various case studies.						
Unit 1	**FUNDAMENTALS**						**9**
Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot print, scoop on power – Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.							
Unit 2	**GREEN ASSETS AND MODELING**						**9**
Green Assets: Buildings, Data Centers, Networks, and Devices – Green Business Process Management: Modeling, Optimization, and Collaboration – Green Enterprise Architecture – Environmental Intelligence – Green Supply Chains – Green Information Systems: Design and Development Models							
Unit 3	**GRID FRAMEWORK**						**9**
Virtualization of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center – Green Grid framework.							
Unit 4	**GREEN COMPLIANCE**						**9**
Socio-cultural aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, and Audits – Emergent Carbon Issues: Technologies and Future. .							
Unit 5	**CASE STUDIES**						**9**
The Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies – Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.							
							Total: 45
TEXTBOOKS							

1	Bhuvan Unhelkar, “Green IT Strategies and Applications-Using Environmental Intelligence”, CRC Press, June 2014
2	Woody Leonhard, Katherine Murray, “Green Home computing for dummies”, August 2012.
REFERENCES	
1	Alin Gales, Michael Schaefer, Mike Ebbers, “Green Data Center: steps for the Journey”, Shroff/IBM rebook, 2011.
2	John Lamb, “The Greening of IT”, Pearson Education, 2009.
3	Jason Harris, “Green Computing and Green IT- Best Practices on regulations & industry”, Lulu.com, 2008
4	.Carl speshocky, “Empowering Green Initiatives with IT”, John Wiley & Sons, 2010. 5. Wu Chun Feng (editor), “Green computing: Large Scale energy efficiency”, CRC Press

COURSEOUTCOMES: **At the end of the course, learners will be able to**		**Bloom’s Taxonomy Level**
CO1	Acquire knowledge to adopt green computing practices to minimize negative impacts on the environment	K2
CO2	Enhance the skill in energy saving practices in their use of hardware.	K2
CO3	Evaluate technology tools that can reduce paper waste and carbon footprint by the stakeholders.	K2
CO4	Understand the ways to minimize equipment disposal requirements.	K2
CO5	Discuss briefly about the use cases in various applications.	K2

CO-PO Mapping

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

ACS703 - FINTECH REGULATION							
Programme & Branch	**B.E & CSE**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
			OE	**3**	**0**	**0**	**3**
Preamble	➢ To learn about Laws and Regulation						

	➢ To acquire the knowledge of Regulations of Fintech firm and their role in Market	
Unit 1	**INTRODUCTION**	**9**
The Role of the Regulators, Equal Treatment and Competition, Need for a regulatory assessment of Fintech, India Regulations, The Risks to Consider, Regtech and SupTech, The rise of TechFins, Regulatory sandboxes, compliance and whistle blowing		
Unit 2	**INNOVATION AND REGULATION**	**9**
The technology, market and the law, Regulation and Innovation in Banking and Finance, Regulations of Fintech Firms and their role in Market-Based Chains, Current Regulatory Approach, Fintech Innovations in Banking, Asset Management, Insurance, Pensions and Healthcare Schemes, Patentability of FinTech inventions.		
Unit 3	**CROWDFUNDING AND DIGITAL ASSETS**	**9**
Types of crowd funding, The Jobs Act, Regulation crowd funding, Regulation A+, Regulation D crowd funding, Intrastate offerings, Digital Assets – Three uses of Digital Assets, A world of Altcoins, Stablecoins, Digital Asset Forks, Initial Coin Offerings, Regulatory Framework for Digital and Crypto Assets, Central Bank Digital Currencies		
Unit 4	**MARKETPLACE LENDING AND MOBILE PAYMENTS**	**9**
Online Lending Business Models, Payday Loans, Consumer Protection Laws, Debt Collection, Equal Credit Opportunity Act, Contract Formation and the E-Sign Act, Military Lending Act, Securities Laws Considerations, Mobile Devices, Payment Cards and the Law, Truth in Lending Act and Regulation Z, Card Act, Electronic Fund Transfer Act and Regulation E, Fair Credit Reporting Act, Federal Bank Secrecy Act, State Money Transmitter Laws.		
Unit 5	**ANTI-MONEY LAUNDERING AND CYBERSECURITY**	**9**
Reporting requirements under the Bank Secrecy Act, Patriot Act, Panalties for violating the BSA, Virtual currencies and the Bank Secrecy Act, Cybersecurity Frameworks, Cybersecurity Act of 2015, Contractual and Self Regulatory obligations		
		Total: 45

REFERENCES

1	Jelena Madir, FinTech – Law and Regulation, Edward Elgar Publishing Limited, 2019
2	Valerio Lemma, Fintech Regulation: Exploring New Challenges of the Capital Markets Union, Palgrave Macmillan, 2020
3	Chris Brummer, Fintech Law in a Nutshell, West Academic Publishing, 2020
4	Bernardo Nicoletti, The Future of Fintech, Integrating Finance and Technology in Financial Services, Springer Nature, 2017
5	Kevin C. Taylor, FinTech Law: A Guide to Technology Law in the Financial Services Industry, BNA Books, 2014
6	Lee Reiners, FinTech Law and Policy, 2018

COURSEOUTCOMES: **At the end of the course, learners will be able to**	**Bloom's Taxonomy Level**

CO1	Understand the role that financial regulation plays in key FinTech developments such as mobile payments, crowdfunding, crypto assets, private digital currencies, and decentralized finance.	K2
CO2	Know the role that law and technology play in facilitating international transactions such as syndicated lending and international bond issues.	K2
CO3	Be able to critically engage with the major theoretical legal debates surrounding international financing, financial markets and financial technology.	K2
CO4	Be able to deal with policy arguments on international financing, financial markets and financial technology law	K2
CO5	Demonstrate ability to apply critical and contextual approaches to the developing legal issues emanating from international financing, regulation of financial markets and financial technology.	K2

CO-PO Mapping

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

AIT701 - NETWORKING ESSENTIALS							
Programme & Branch	**B.Tech & IT**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
			OE	**3**	**0**	**0**	**3**
Preamble	➢ Understand the division of network functionalities into layers. ➢ Be familiar with the components required to build different types of networks ➢ Be exposed to the required functionality at each layer ➢ Learn the flow control and congestion control algorithms. ➢ Learn the Classify the various soft computing frame works						
Unit1	**FUNDAMENTALS & LINK LAYER**						**9**
Building a network – Requirements – Layering and protocols – Internet Architecture – Network software – Performance ; Link layer Services – Framing – Error Detection – Flow control							
Unit 2	**MEDIA ACCESS & INTERNETWORKING**						**9**
Media access control – Ethernet (802.3) – Wireless LANs – 802.11 – Bluetooth – Switching and bridging – Basic Internetworking (IP, CIDR, ARP, DHCP, ICMP)							
Unit 3	**ROUTING**						**9**

Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM), Unicast Routing Algorithms		
Unit 4	**TRANSPORT LAYER**	**9**
Overview of Transport layer – UDP – Reliable byte stream (TCP) – Connection management – Flow control – Retransmission – TCP Congestion control – Congestion avoidance (DECbit, RED) – QoS – Application requirements		
Unit 5	**APPLICATION LAYER**	**9**
Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS – SNMP, Telnet –SSH		
		Total: 45

TEXTBOOKS	
1	Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.
2	Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.
REFERENCES	
1	James F. Kurose, Keith W. Ross, "Computer Networking – A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009
2	Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010
3	Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach",McGraw Hill Publisher, 2011
4	Behrouz A. Forouzan, "Data communication and Networking", Fourth Edition, Tata McGraw – Hill, 2011.

COURSEOUTCOMES:

At the end of the course, learners will be able to		**Bloom's Taxonomy Level**
CO1	Identify the components required to build different types of networks	K2
CO2	Choose the required functionality at each layer for given application	K3
CO3	Identify solution for each functionality a t each layer	K1
CO4	Trace the flow of information from one node to another node in the network.	K2
CO5	Design protocols for various functions in the network and understand the working of various application layer protocols	K2

CO-PO Mapping

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

AIT702 - SOFT COMPUTING METHODOLOGIES							
Programme & Branch	**B.Tech & IT**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
			OE	**3**	**0**	**0**	**3**
Preamble	➢ Classify the various soft computing frame works ➢ Be familiar with the design of neural networks, fuzzy logic and fuzzy systems ➢ Learn mathematical background for optimized genetic programming ➢ Be exposed to neuro-fuzzy hybrid systems and its applications						
Unit 1	**INTRODUCTION TO SOFT COMPUTING**						**9**
Soft Computing Constituents-From Conventional AI To Computational Intelligence- Artificial Neural Network: Introduction, Characteristics- Evolution Of Neural Networks - Basic Models - Important Technologies - Applications. Fuzzy Logic: Introduction - Crisp Sets- Fuzzy Sets - Crisp Relations And Fuzzy Relations: Cartesian Product Of Relation - Classical Relation, Fuzzy Relations, Tolerance And Equivalence Relations. Genetic Algorithm-Introduction - Biological Background - Traditional Optimization And Search Techniques – Genetic Basic Concepts.							
Unit 2	**NEURAL NETWORKS**						**9**
Mcculloch-Pitts Neuron - Linear Separability - Hebb Network - Supervised Learning Network: Perceptron Networks - Adaptive Linear Neuron, Multiple Adaptive Linear Neuron, BPN, RBF - Associative Memory Network: Auto- Associative Memory Network, Hetero-Associative Memory Network, Hopfield Networks, Iterative Auto Associative Memory Network – Unsupervised Learning Networks: Kohonen Self-Organizing Feature Maps, LVQ – CP Networks, ART Network.							
Unit 3	**FUZZY LOGIC**						**9**
Membership Functions: Features, Fuzzification, Methods Of Membership Value Assignments- Defuzzification: Lambda Cuts - Methods - Fuzzy Arithmetic And Fuzzy Measures: Fuzzy Arithmetic - Extension Principle - Fuzzy Measures - Measures Of Fuzziness -Fuzzy Integrals - Fuzzy Rule Base And Approximate Reasoning : Truth Values And Tables, Fuzzy Propositions, Formation Of Rules- Decomposition Of Rules, Aggregation Of Fuzzy Rules, Fuzzy Reasoning-Fuzzy Inference Systems Overview Of Fuzzy Expert System- Fuzzy Decision Making							
Unit 4	**GENETIC ALGORITHM**						**9**
Genetic Algorithm- Operators – Encoding Scheme – Fitness Evaluation –Crossover - Mutation – Classification Of Gnetic Algorithms- Genetic Programming – Advances In GA .							
Unit 5	**HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS**						**9**
Neuro-Fuzzy Hybrid Systems - Genetic Neuro Hybrid Systems - Genetic Fuzzy Hybrid And Fuzzy Genetic Hybrid Systems - Simplified Fuzzy ARTMAP - Applications: A Fusion Approach Of Multispectral Images With SAR, Optimization Of Traveling Salesman Problem Using Genetic Algorithm Approach, Soft Computing Based Hybrid Fuzzy Controllers.							
							Total: 45

TEXTBOOKS	
1	S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd, 2011
2	J.S.R.Jang, C.T. Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI
REFERENCES	
1	S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.

2	George J. Klir, Ute St. Clair, Bo Yuan, "Fuzzy Set Theory: Foundations and Applications" Prentice Hall, 1997.
3	David E. Goldberg, "Genetic Algorithm in Search Optimization and Machine Learning" Pearson Education India, 2013.
4	James A. Freeman, David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India, 1991.

COURSEOUTCOMES:

At the end of the course, learners will be able to		**Bloom's Taxonomy Level**
CO1	Apply various soft computing concepts for practical applications	K2
CO2	Choose and design suitable neural network for real time problems	K2
CO3	Use fuzzy rules and reasoning to develop decision making and expert system	K2
CO4	Explain the importance of optimization techniques and genetic programming	K2
CO5	Review the various hybrid soft computing techniques and apply in real time problems	K2

CO-PO Mapping

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

AIT703 - KNOWLEDGE ENGINEERING

Programme & Branch	**B.Tech & IT**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
			OE	**3**	**0**	**0**	**3**

Preamble	➢ To understand the basics of Knowledge Engineering. ➢ To discuss methodologies and modeling for Agent Design and Development. ➢ To design and develop ontologies. ➢ To apply reasoning with ontologies and rules. ➢ To understand learning and rule learning

UNIT I	**REASONING UNDER UNCERTAINTY**	**9**

Introduction – Abductive reasoning – Probabilistic reasoning: Enumerative Probabilities – Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability – Uncertainty methods - Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning-Knowledge Engineering.

Unit 2	METHODOLOGY AND MODELING	9
Conventional Design and Development – Development tools and Reusable Ontologies – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios.		
Unit 3	**ONTOLOGIES – DESIGN AND DEVELOPMENT**	**9**
Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching. Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification.		
Unit 4	**REASONING WITH ONTOLOGIES AND RULES**	**9**
Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge.		
Unit 5	**LEARNING AND RULE LEARNING**	**9**
Machine Learning – Concepts – Generalization and Specialization Rules – Types – Formal definition of Generalization. Modelling, Learning and Problem Solving – Rule learning and Refinement – Overview – Rule Generation and Analysis – Hypothesis Learning		
		Total: 45

TEXTBOOKS

1	Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016. (Unit 1 – Chapter 1 / Unit 2 – Chapter 3,4 / Unit 3 – Chapter 5, 6 / Unit 4 - 7 , Unit 5 Chapter 8, 9)
2	Jiawei Han and MichelineKamber, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012.

REFERENCES

1	Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2	Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.
3	Behrouz A. Forouzan, “Data communication and Networking”, Fourth Edition, Tata McGraw – Hill, 2011.
4	Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition,2001

COURSEOUTCOMES:

At the end of the course, learners will be able to		**Bloom’s Taxonomy Level**
CO1	Understand the basics of Knowledge Engineering.	K2
CO2	Apply methodologies and modelling for Agent Design and Development.	K3
CO3	Design and develop ontologies.	K3
CO4	Apply reasoning with ontologies and rules.	K3

CO5	Understand learning and rule learning.	K2

CO-PO Mapping

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

ACB701 - BUSINESS RESEARCH METHODS							
Programme & Branch	**B.TECH & CSBS**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
Prerequisites			**OE**	**3**	**0**	**0**	**3**
Preamble	➢ To make the students of tourism understand the principles of scientific methodology in business enquiry, develop analytical skills of business research and to prepare scientific business reports.						
UNIT I	**INTRODUCTION**						**9**
Business Research – Definition and Significance – the research process – Types of Research – Exploratory and causal Research – Theoretical and empirical Research – Cross –Sectional and time – series Research – Research questions / Problems – Research objectives – Research hypotheses – characteristics – Research in an evolutionary perspective – the role of theory in research.							
UNIT II	**RESEARCH DESIGN AND MEASUREMENT**						**9**
Research design – Definition – types of research design – exploratory and causal research design – Descriptive and experimental design – different types of experimental design – Validity of findings – internal and external validity – Variables in Research – Measurement and scaling – Different scales – Construction of instrument – Validity and Reliability of instrument.							
UNIT III	**DATA COLLECTION**						**9**
Types of data – Primary Vs Secondary data – Methods of primary data collection – Survey Vs Observation – Experiments – Construction of questionnaire and instrument – Types of Validity – Sampling plan – Sample size – determinants optimal sample size – sampling techniques – Sampling methods							
UNIT IV	**DATA PREPARATION AND ANALYSIS**						**9**
Data Preparation – editing – Coding –Data entry – Validity of data – Qualitative Vs Quantitative data analyses – Applications of Bivariate and Multivariate statistical techniques, Factor analysis, Discriminant analysis, Cluster analysis, Multiple regression and Correlation, Multidimensional scaling – Conjoint Analysis – Application of statistical software for data analysis.							
UNIT V	**REPORT DESIGN, WRITING AND ETHICS IN BUSINESS RESEARCH**						**9**
Research report –Types – Contents of report – need for executive summary – chapterization – contents of chapter – report writing – the role of audience – readability – comprehension –tone – final proof – report format – title of the report – ethics in research – Ethics in research Subjectivity and Objectivity in research.							

	Total:45 Periods
TEXTBOOK:	
1.	Donald R. Cooper, Pamela S. Schindler and J K Sharma, Business Research methods,11th Edition, Tata Mc Graw Hill, New Delhi, 2012.
REFERENCES:	
1.	Alan Bryman and Emma Bell, Business Research methods, 3rd Edition, Oxford University Press, New Delhi, 2011.
2.	Uma Sekaran and Roger Bougie, Research methods for Business, 5th Edition, Wiley India, New Delhi, 2012.
3	William G Zikmund, Barry J Babin, Jon C.Carr, AtanuAdhikari,Mitch Griffin, Business Research methods, A South Asian Perspective, 8th Edition, Cengage Learning, New Delhi, 2012.
4	Panneerselvam. R, Research Methodology, 2nd Edition, PHI Learning, 2014.

COURSE OUTCOMES: **Upon successful completion of the course the student will be able to**		**Bloom's Taxonomy Level**
CO1	Understand and appreciate the scientific inquiry	K2
CO2	Undertake a systematic outlook towards business situations for the purpose of objective decision making.	K3
CO3	Ability to conduct a scientific inquiry to solve organizational problems	K3
CO4	Analyze data and find solutions to the problems.	K3
CO5	Prepare research reports	K4

CO-PO Mapping

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

ACB702 - AUTOMATION TESTING TOOLS							
Programme & Branch	**B.TECH & CSBS**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
Prerequisites			**OE**	**3**	**0**	**0**	**3**

Preamble	➢ To understand the basics of software testing and test planning ➢ To build test cases and execute them ➢ To focus on automation testing using selenium ➢ To automate the testing using TestNG ➢ To get an insight about test automation using Cucumber	
UNIT I	**INTRODUCTION TO SOFTWARE TESTING AND TEST PLANNING**	**9**

Why do we test Software?, Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing-Performance Testing-The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.		
UNIT II	**TEST DESIGN AND EXECUTION**	**9**
Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.		
UNIT III	**SELENIUM**	**9**
me browsers, Identifying Web Elements using id, name, linkname, class, xpath, tagname- Handling Input box/buttons, list/selection/drop down boxes, radio buttons, check boxes- Extracting links and other Web-Elements-Extracting Data from WebTable-Capturing screenshots-Handling pop-ups, frames, and windows- Exceptions in Selenium - Data driving from csv and excel using Java APIs-Debugging Tests-Page Object Model		
UNIT IV	**TESTNG**	**9**
Introduction to TestNg-Advantages over Junit-Annotations in TestNg-Understand and Read TestNg Reports-Testng and its configuration-Grouping the testcases, Exclusion of groups, Partial Groups - TestSuite.xml/Suite creation-Types of parameterization-Parameter from TestNg.xml (pass value at Suite and Test level) - Assertion, Verification		
UNIT V	**CUCUMBER**	**9**
Introduction to Behavior Driven Development(BDD)-BDD framework using Cucumber-Preparing selenium and cucumber environment -creating a feature files using Gherkins and Gherkin syntax-writing features and scenario, Given – When -Then structure -Writing glue code -Cucumber and Java step definitions-writing step definition/ implementing scenarios steps-Cucumber data driven testing		
		Total:45 Periods

TEXTBOOK:

1.	Yogesh Singh, “Software Testing”, Cambridge University Press, 2012
2.	Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018

REFERENCES:

1.	Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc.
2.	Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing
3	Paul C. Jorgensen, Software Testing: A Craftsman’s Approach, Fourth Edition, 2014, Taylor & Francis Group.
4	Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing

COURSE OUTCOMES: **Upon successful completion of the course the student will be able to**	**Bloom’s Taxonomy Level**

CO1	Understand the basic concepts of software testing and test planning. Understand	K2
CO2	Design effective test cases that can uncover critical defects in the application.	K3
CO3	Automate the software testing using Selenium Apply	K3
CO4	Automate the software testing using TestNG Apply	K3
CO5	Automate the software testing using Cucumber	K3

CO-PO Mapping

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

ACB703 - SOCIAL NETWORK ANALYSIS							
Programme & Branch	**B.TECH & CSBS**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
Prerequisites		**-**	**OE**	**3**	**0**	**0**	**3**

Preamble	➢ To understand the concept of semantic web and related applications. ➢ To learn knowledge representation using ontology. ➢ To understand human behaviour in social web and related communities. ➢ To learn visualization of social networks.

UNIT I	**INTRODUCTION**	**9**

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web -Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

UNIT II	**MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION**	**9**

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations

UNIT III	**EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS**	**9**

Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and

mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.		
UNIT IV	**PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES**	**9**
Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.		
UNIT V	**VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS**	**9**
Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks.		
		Total:45 Periods

TEXTBOOK:

1.	Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer 2007.
2.	Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010.

REFERENCES:

1.	Guandong Xu ,Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", First Edition, Springer, 2011.
2.	Dion Goh and Schubert Foo, "Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008.
3	Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling", IGI Global Snippet, 2009.
4.	John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web", Springer, 2009

COURSE OUTCOMES: **Upon successful completion of the course the student will be able to**		**Bloom's Taxonomy Level**
CO1	Develop semantic web related applications.	K4
CO2	Represent knowledge using ontology.	K3
CO3	Predict human behaviour in social web and related communities.	K4
CO4	Visualize social networks.	K3

CO-PO Mapping

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

AAI701 - DRINKING WATER SUPPLY AND TREATMENT							
Programme &Branch	**B.TECH & AIDS**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
Prerequisites			**OE**	**3**	**0**	**0**	**3**
Preamble	To equip the students with the principles and design of water treatment units and distribution system.						
UNIT I	**SOURCES OF WATER**						**9**
Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards.							
UNIT II	**CONVEYANCE FROM THE SOURCE**						**9**
Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.							
UNIT III	**WATER TREATMENT**						**9**
Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation –- sand filters - Disinfection –– Construction, Operation and Maintenance aspects							
UNIT IV	**ADVANCED WATER TREATMENT**						**9**
Water softening – Desalination- R.O. Plant – demineralization – Adsorption - Ion exchange– Membrane Systems - Iron and Manganese removal - Defluoridation - Construction and Operation and Maintenance aspects.							
UNIT V	**WATER DISTRIBUTION AND SUPPLY**						**9**
Requirements of water distribution – Components – Selection of pipe material – Service reservoirs - Functions – Network design – Economics - Computer applications – Appurtenances – Leak detection - Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing.							
							Total:45Periods
TEXTBOOK:							
1.	Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2008.						
2.	Punmia B.C, Arun K.Jain, Ashok K.Jain, “ Water supply Engineering” Lakshmi publication private limited, New Delhi, 2016						

3.	Rangwala "Water Supply and Sanitary Engineering", February 2022 4. Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 2018
REFERENCES:	
1.	Fair. G.M., Geyer.J.C., "Water Supply and Wastewater Disposal", John Wiley and Sons, 1954.
2.	Babbit.H.E, and Donald.J.J, "Water Supply Engineering" , McGraw Hill book Co, 1984.
3	Steel. E.W.et al., "Water Supply Engineering" , Mc Graw Hill International book Co, 1984.
4	Duggal. K.N., “Elememts of public Health Engineering”, S.Chand and Company Ltd, New Delhi, 1998.

COURSEOUTCOMES: Upon successful completion of the course the student will be able to		**Bloom’s Taxonomy Level**
CO1	An understanding of water quality criteria and standards, and their relation to public health	K2
CO2	The ability to design the water conveyance system 247	K3
CO3	The knowledge in various unit operations and processes in water treatment	K3
CO4	An ability to understand the various systems for advanced water treatment	K3
CO5	An insight into the structure of drinking water distribution system	K4

CO-PO Mapping

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

AAI702 - GEOGRAPHICAL INFORMATION SYSTEM							
Programme &Branch	**B.TECH& AIDS**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
Prerequisites			**OE**	**3**	**0**	**0**	**3**
Preamble	➢ To impart the knowledge on basic components, data preparation and implementation of Geographical Information System. To build test cases and execute them						
UNIT I	**FUNDAMENTALS OF GIS**						**9**

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.		
UNIT II	**SPATIAL DATA MODELS**	**9**
Database Structures – Relational, Object Oriented – Entities – ER diagram - data models - conceptual, logical and physical models - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models.		
UNIT III	**DATA INPUT AND TOPOLOGY**	**9**
Scanner - Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input – Digitizer – Datum Projection and reprojection -Coordinate Transformation – Topology - Adjacency, connectivity and containment – Topological Consistency – Non topological file formats - Attribute Data linking – Linking External Databases – GPS Data Integration		
UNIT IV	**DATA QUALITY AND STANDARDS**	**9**
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructur		
UNIT V	**DATA MANAGEMENT AND OUTPUT**	**9**
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GISdistributed GIS.		
		Total:45Periods

TEXTBOOK:

1.	Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2.	Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.

REFERENCES:

1.	Lo. C. P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006

COURSEOUTCOMES: On completion of the course, the student is expected to		**Bloom’s Taxonomy Level**
CO1	Have basic idea about the fundamentals of GIS.	K2
CO2	Understand the types of data models..	K3
CO3	Get knowledge about data input and topology	K3
CO4	Gain knowledge on data quality and standards	K3
CO5	Understand data management functions and data output	K3

CO-PO Mapping

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

AAI703 - IT IN AGRICULTURAL SYSTEM

Programme &Branch	B.TECH& AIDS	Sem.	Category	L	T	P	C
Prerequisites			OE	3	0	0	3

Preamble

- To introduce the students to areas of agricultural systems in which IT and computers play a major role.
- To also expose the students to IT applications in precision farming, environmental control systems, agricultural systems management and weather prediction models

UNIT I	**PRECISION FARMING**	**9**

Precision agriculture and agricultural management – Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.

UNIT II	**ENVIRONMENT CONTROL SYSTEMS**	**9**

Artificial light systems, management of crop growth in greenhouses, simulation of CO_2 consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture.

UNIT III	**AGRICULTURAL SYSTEMS MANAGEMENT**	**9**

Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence and decision support systems.

UNIT IV	**WEATHER PREDICTION MODELS**	**9**

Importance of climate variability and seasonal forecasting, Understanding and predicting world's climate system, Global climatic models and their potential for seasonal climate forecasting, General systems approach to applying seasonal climate forecasts.

UNIT V	**E-GOVERNANCE IN AGRICULTURAL SYSTEMS**	**9**

Expert systems, decision support systems, Agricultural and biological databases, e-commerce, business systems & applications, Technology enhanced learning systems and solutions, eLearning, Rural development and information society

Total:45 Periods

TEXTBOOK:

1. National Research Council, "Precision Agriculture in the 21st Century", National Academies Press, Canada, 1997.
2. H. Krug, Liebig, H.P. "International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation", 1989.

REFERENCES:

1.	Peart, R.M., and Shoup, W. D., “Agricultural Systems Management”, Marcel Dekker, New York, 2004.
2.	Hammer, G.L., Nicholls, N., and Mitchell, C., “Applications of Seasonal Climate”, Springer, Germany, 2000.

COURSEOUTCOMES: **Upon successful completion of the course the student will be able to**		**Bloom’s Taxonomy Level**
CO1	The students shall be able to understand the applications of IT in remote sensing applications such as Drones etc	K1
CO2	The students will be able to get a clear understanding of how a greenhouse can be automated and its advantages.	K2
CO3	The students will be able to apply IT principles and concepts for management of field operations	K4
CO4	The students will get an understanding about weather models, their inputs and applications.	K1
CO5	The students will get an understanding of how IT can be used for e-governance in agriculture	K4

CO-PO Mapping

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

AMB701-CORPORATE GOVERNANCE							
Programme & Branch	**MBA**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
			OEC	**3**	**0**	**0**	**3**
Preamble	➢ To understand the concepts, need for and importance of Corporate Governance. ➢ To understand the relationship between Business, government and Society. ➢ To provide the learners with different organization structures. ➢ To provide the learners to integrate with business and society. ➢ To formulate and execute the plans at various levels of management.						
Unit 1	**CORPORATE GOVERNANCE**						**9**
Corporate governance: The concept, need and importance of corporate governance, The role and purpose of the corporation, separation of ownership and control, benefits of good corporate governance, OECD (Organization for economic co-operation and development) on corporate governance, Theoretical basis for corporate governance, environmental Concerns and Corporations, environmental preservation-role of stakeholders, sustainable development, industrial pollution, role of corporate in environmental management, waste management, pollution control and environmental audit.							
Unit 2	**BUSINESS, GOVERNMENT AND SOCIETY**						**9**
An introduction to Business, Government, and Society: The Connect between Business, Government, and Society, Importance of BGS relationship in management, models of BGS relationships-Market capitalism model, dominance model, countervailing forcer's model and stakeholder model.							
Unit 3	**BUSINESS STRUCTURES**						**9**
Business structures: Meaning and nature of business structures, types, nature, advantages, limitations and applicability of - single ownership, partnerships, private limited companies, public limited companies, co-operative societies.							
Unit 4	**BUSINESS ETHICS AND CSR**						**9**
Business Ethics and Corporate Social Responsibility: Meaning of business ethics, need and purpose, importance, approaches to business ethics, roots of unethical behavior, ethical decision making some unethical issues, benefits from managing ethics at workplace. Nature of CSR, arguments for and against CSR, models of CSR, best practices of CSR-Indian examples.							
Unit 5	**BOARD OF DIRECTORS**						**9**
Role of Board of Directors in Corporate Governance, Corporate board of Management, structure and composition of the board, Types of board and directors, Size of the board, Powers of the board of directors, responsibilities, functions of the board, code of conduct for board members, training for the board of directors, effectiveness of the board members, effectiveness and powers of the board.							
							Total: 45

REFERENCE BOOK	
1	Corporate Governance: Principles, policies and Practices by Fernando A.c. Pub: Pearson, 2014.
2	Business and Government by Francis Cherunilam, Pub: Himalayan Publishing House.
3	Corporate Governance, Ethics & Social Responsibility by Balachandran C.H, Pub: PHI Pvt Ltd, 2015.

4	Business Ethics and Corporate Governance: Ghosh B.N., TMH, 2015

COURSE OUTCOMES: At the end of the course, learners will be able to		**Bloom's Taxonomy Level**
CO1	Understand to connect between the corporate, ethics and society.	K1
CO2	Decide about the appropriateness of various business structures.	K2
CO3	Understand the need for and importance of corporate governance with reference to Environment protection	K3
CO4	Make the students to understand the essence of business and how business could be mutually beneficial to the businessman and the society.	K4
CO5	Decide on the role and functions of Board of Directors in an Organization.	K5

CO-PO Mapping

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

AMB702- DIGITAL MARKETING							
Programme & Branch	**MBA**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
			OE	**3**	**0**	**0**	**3**
Preamble	➢ To understand the concepts of Digital Marketing. ➢ To understand the Online Advertising and SEO. ➢ To analyse the Social media and email Marketing. ➢ To evaluate the concepts of email marketing. ➢ To formulate mobile marketing and e-marketing strategies.						
Unit 1	**OVERVIEW OF DIGITAL MARKETING**						**9**
Digital marketing overview and meaning- benefits – platform & strategies- comparing digital with traditional marketing- latest digital marketing trends- case studies of digital marketing trends. Content Marketing, Handling Traffic.							
Unit 2	**ONLINE ADVERTISING AND SEO**						**9**
Internet and Search Engine Basics, online Advertising, Importance of online Advertising, Types of online Marketing and advertising Methods. Importance of Search Engines, How the search engine works, Understanding the SERP, Using Search Operators, Search Engine Algorithms.							
Unit 3	**SOCIAL MEDIA AND EMAIL MARKETING**						**9**
What is Social Media, SMM Vs. SMO, Benefits of using SMM, Social Media Strategy, and Impact of Social Media on SEO. Marketing strategy, Benefits, Promotional tools for- Facebook, YouTube, Twitter, Google, Linkedn. Email Marketing- Email Marketing concept, Importance, Popular Email Marketing Softwares, Email Marketing Goals and strategies, Types of Email marketing campaigns, Creating an Email Campaign, What is Newsletter, Design a Newsletter. Micro Blogging.							
Unit 4	**E COMMERCE**						**9**
Ecommerce Business Planning, eCommerce Website, Product Placements, Product Grouping, Promoting eCommerce Website, Remarketing Products: Re-Marketing Flow, Email, Facebook Re-Marketing. Understanding Coupon System, Appointing Affiliates for Products, Cross/Up/Down Selling, Introduction to payment gateway- Application and Documentation.							
Unit 5	**MOBILE MARKETING AND REMARKETING**						**9**
Overview of the B2B and B2C Mobile Marketing, Mobile Sites, Apps (Applications) and Widgets and their relevant to marketing, opportunities and pitfalls of Mobile Marketing, user interfaces and architectures. Trends in Mobile social media, Mobile Commerce, Mobile Payments and Billing, integration of mobile marketing into marketing plan.							
							Total: 45

REFERENCE BOOK

1	Digital Marketing: Strategy, Implementation & Practice, Dave Chaffey & Fiona Ellis-Chadwick, 2019
2	Convert!: Designing Websites For Traffic and Conversions, Ben Hunt, 2020
3	The Social Media Bible: Tactics, Tools, & Strategies for Business Success, Lon Safko, 2018
4	Digital Marketing: Strategies for Online Success ,Godfrey Parkin, 2015

5	Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Damian Ryan, 2018

COURSE OUTCOMES: At the end of the course, learners will be able to		**Bloom's Taxonomy Level**
CO1	Understand how and why to use digital marketing for multiple goals within a larger marketing and/or media strategy.	K1
CO2	Understand the major digital marketing channels - online advertising: Digital display, video, mobile, search engine, email and social media.	K2
CO3	Learn to develop, evaluate, and execute a comprehensive digital marketing strategy and plan.	K3
CO4	Explore the concepts of Remarketing strategies	K4
CO5	Develop various payment and billing gateways in digital marketing.	K5

CO-PO Mapping

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

AMB703- RURAL MARKETING							
Programme & Branch	**MBA**	**Sem.**	**Category**	**L**	**T**	**P**	**C**
			OE	**3**	**0**	**0**	**3**
Preamble	➢ To understand the concepts of Rural Marketing ➢ To understand the types of Agricultural products for marketing. ➢ To analyse the issues in Rural Marketing. ➢ To evaluate the Rural Marketing Regulations. ➢ To formulate the strategies to satisfy rural consumers.						
Unit 1	**INTRODUCTION TO RURAL MARKETING**						**9**
Concept- Nature- Scope- Significance of Rural Marketing- Factors contributing to Growth of rural markets -Components and classification of Rural markets- Rural Market VS Urban Market- e.rural marketing.							
Unit 2	**AGRICULTURAL MARKETING**						**9**
Concept-Nature and Types of Agriculture produce- concept and types of Agricultural Markets- Marketing channels -Methods of Sales - Market functions							
Unit 3	**ISSUES IN RURAL MARKETING**						**9**
Rural Consumer behaviour- features- factors influencing- Lifestyle of rural consumer - FMCG sector in Rural India- concept and classification of consumer goods- Marketing Channels for FMCG – Fast growing FMCG -Marketing of consumer durables- The role of Advertising.							
Unit 4	**RURAL MARKETING AND MARKETING REGULATION**						**9**
Regulated Market- APMC Act 1963- Model bill Standardization and Grading - Inspection of quality control -Inspection of AGMARK - Indian Standers and Grade Specifications- Food Products order (FPO) 1955 –Consumer Protection Act 1986. The National Council for State Marketing Boards (NCOSAMB) State Trading corporation (STC), Public Distribution System (PDS).							
Unit 5	**INSTITUIONAL SUPPORT TO RURAL MARKETING**						**9**
Commission on Agriculture Costs and Prices (CACP), National Agriculture Co-operative Marketing Federation (NAFED), Agriculture and Processed Food Exports Development Authority (APEDA)							
							Total: 45

REFERENCE BOOK	
1	Badi R.V. Badi N.V.Rural Marketing Himalaya Publishing House – 2010
2	Rural Marketing- Gopalaswamy Vikas Publishing House, 2020.
3	Kashyp Pradeep, Rant Siddhartha The Rural Marketing, Biztantra, 2015.
4	Mishra and Puri Development Issues of Indian Economy Himalaya Publishing House, 2018

COURSE OUTCOMES: **At the end of the course, learners will be able to**		**Bloom's Taxonomy Level**
CO1	Understand the concepts of Rural Marketing	K1
CO2	Understand the nature of Rural Consumer Behaviour	K2

CO3	Analyse the nature of marketing rural products	K3
CO4	Identify the problems and issues in Rural Marketing	K4
CO5	Formulate the marketing strategies to satisfy the rural consumers.	K5

CO-PO Mapping

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