B.Tech

CURRICULUM and SYLLABUS-2017

DEPARTMENT OF AERONAUTICAL ENGINEERING

Kalasalingam Academy of Research and Education

(Deemed to be University)
Under sec.3 of UGC Ac,1956. Accredited by NAAC with 'A' Grade
Anand Nagar, Krishnankoil-626126,
Srivilliputtur (via), Virudhunagar (Dt), Tamilnadu, India.
www.kalasalingam.ac.in

KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION

VISION

To be a Centre of Excellence of International Repute in Education and Research.

MISSION

To Produce Technically Competent, Socially Committed Technocrats and Administrators through Quality Education and Research.

DEPARTMENT OF AERONAUTICAL ENGINEERING

VISION

To be a Centre of Excellence in Education and Research in the field of Aeronautical Engineering to meet global requirements of Industry and Society.

MISSION

- To impart quality education and research in Aeronautical Engineering through excellence in teaching - learning process and state of art facilities to the students.
- To inculcate students with ethical values and innovative ideas for future leadership in industry and to face societal challenges.

Program Educational Objectives

PEO-1- DIVERSIFIED KNOWLEDGE
Graduates will apply fundamental technical knowledge and skills to find workable solutions to technological challenges and problems in diversified areas such as Aerodynamics, Propulsion, Structures, control systems, Design, and allied fields of Aeronautical Engineering.

PEO-2: CONTEMPORARY ISSUES & SKILLS
Graduates will have an effective communication skills and will recognize the social impacts of problem solving, decision making and creative skills by understanding contemporary issues.

PEO-3: PROFESSIONAL ATTITUDE
Graduates will gain professional and ethical attitude towards their peers, employers, society and prove as a responsible leader in the establishments in government and private sectors.

PEO-4: PROFESSIONAL DEVELOPEMENT
Graduates will become entrepreneurs to confront business challenges or will continue their professional advancement through their knowledge horizon and inculcate lifelong learning.

Program Outcomes (POs):

PO1 - Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 - Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 - Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 - The Engineer and Society: Apply 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.

PO7 - Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

PO8 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 - Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 - Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 - Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 - Life-long learning: Recognise 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 (PSOs):

PSO1 - An ability to utilize the gained knowledge of Aeronautical engineering in design and development of new products for challenging environment.

PSO2 - An ability to design, analysis and solve the problems of components in flight vehicles imparted by simulation skills.

PSO3 - An ability to fabricate, test and develop the products through in-house and industry practices.

CURRICULUM STRUCTURE

S.No	Category		Credits
I.	Basic Sciences and Mathematics		**23**
II.	Humanities and Social Science		**7**
	Soft Skills		**3**
III.	Basic Engineering		**21**
IV.	Program Core		
	a)Core Courses	80	**93**
	b)Community Service Project	3	
	c)Project work	10	
V.	Elective Courses		
	a)Major Elective	18	**39**
	b)Open Elective	12	
	c)Humanities Elective	6	
	d)Self-study elective	3	
	Total Credits		**186**

I. Basic Sciences and Mathematics

S.No	Course Code	Course Name	Course Type	L	T	P	C
1.	PHY 17R171	Physics I	IC	3	0	1	4
2.	PHY 17R153	Material Physics	TP	3	0	0	3
3.	CHY17R171	Chemistry	IC	3	0	1	4
4.	MAT17R101	Calculus And Differential Equations	T	3	0	0	3
5.	MAT17R102	Linear Algebra, Partial Differential Equations And Complex Variable	T	3	0	0	3
8.	MAT17R202	Laplace Transforms And Statistics	T	3	0	0	3
9.	MAT17R203	Numerical Methods	T	3	0	0	3
Total				**23**			

II. Humanities and Social Science

S.No	Course Code	Course Name	Course Type	L	T	P	C
1.	HSS17R151	English for technical communication I	TP	3	0	0	2
2.	HSS17R152	English for technical communication II	TP	3	0	0	2
3.	CHY17R151	Environmental Sciences	T	3	0	0	3
Total				**7**			

Soft skills

S.No	Course Code	Course Name	Course Type	L	T	P	C
1.	HSS17R201	Soft skills-I	T	3	0	0	1
2.	HSS17R202	Soft skills-II	T	3	0	0	1
3.	HSS17R301	Soft skills-III	T	3	0	0	1
Total				**3**			

III. Basic Engineering

S.No	**Course Code**	**Course Name**	**Course Type**	**L**	**T**	**P**	**C**
1.	CIV17R101	Basic Civil Engineering	T	3	0	0	2
2.	EEE17R151	Basic Electrical and Electronics Engineering	TP	3	0	0	4
3.	MEC17R101	Engineering Drawing	TP	1	0	3	2
4.	MEC17R103	Engineering Mechanics	T	3	0	0	3
5.	CSE17R171	Programming Languages	IC	3	0	0	3
6.	MEC17R181	Engineering Practice Laboratory	L	0	0	3	2
7.	MEC17R105	Basic Mechanical Engineering	T	3	0	1	2
8.	AER17R101	Principles of Flight	T	3	0	0	3
Total				**21**			

IV. Program Core

a. Core Courses

S. No	Course Code	Course Title	Course Nature	Pre-requisite	L	T	P	C
1	MEC17R271	Strength of Materials	IC	MEC17R103	3	0	3	5
2	AER17R271	Aero Thermodynamics	IC	CHY17R171	3	0	3	5
4	MEC17R272	Fluid Mechanics and Machinery	IC	MAT17R171	3	0	3	5
5	AER17R251	Kinematics and Dynamics of Machines	TP	MEC17R103	3	1	0	4
6	AER17R201	Aerodynamics –I	T	MEC17R272	3	0	0	3
7	AER17R202	Aircraft Structures - I	T	MEC17R271	3	0	0	3
8	AER17R203	Aircraft Systems and Instruments	T	PHY17R171	3	0	0	3
9	AER17R204	Propulsion - I	T	AER17R271	3	0	0	3
10	AER17R281	Aerodynamics Laboratory	L	AER17R202	1	0	3	2
11	AER17R282	Aircraft Component Drawing Laboratory	L	MEC17R101	1	0	3	2
12	AER17R301	Aerodynamics - II	T	AER17R202	3	0	0	3
13	AER17R302	Aircraft Structures-II	T	AER17R203	3	0	0	3
14	AER17R303	Flight Mechanics	T	AER17R202	3	0	0	3
15	AER17R304	Propulsion - II	T	AER17R205	3	0	0	3
16	AER17R305	Aircraft Stability and Control	T	AER17R202	3	0	0	3
17	AER17R351	Computational Fluid Dynamics	T	AER17R202	3	0	0	3
18	AER17R352	Finite Element Methods	T	MEC17R103	3	0	1	3

S. No	Course Code	Course Title	Course Nature	Pre-requisite	L	T	P	C
19	AER17R381	Aero modelling	L	MEC17R101	1	0	3	2
20	AER17R382	Aircraft structures Laboratory	L	AER17R203	1	0	3	2
21	AER17R383	Propulsion Laboratory	L	AER17R205	1	0	3	2
22	AER17R401	Experimental Aerodynamics	T	AER17R202	3	0	0	3
23	AER17R451	Heat Transfer	T	AER17R271	3	0	1	4
24	AER17R402	Rockets and Launch Vehicles	T	AER17R304	3	0	0	3
25	AER17R481	Experiments in Flight Laboratory	L	AER17R305	1	0	3	2
26	AER17R384	Aero-Design Project	L	AER17R272	0	0	3	3
27	AER17R416	Theory of Vibrations	T	AER17R271	3	0	0	3
Total					**80**			

b. Community Service Project

S. No	Course Code	Course Name	L	T	P	C
1.	AER17R399	Community Service Project	0	0	3	3

c. Project work

S.No	Course Code	Course Name	L	T	P	C
1.	AER17R499	Project Work	0	0	26	10

V. a. Major Elective

S. No	Course Code	Course Name	Course Nature	Pre-requisite	L	T	P	C
1.	AER17R404	Aero Elasticity	T	AER17R204	3	0	0	3
2.	AER17R306	Aerospace Materials	T	MEC17R271	3	0	0	3
3.	AER17R307	Aircraft Design	T	AER17R202	3	0	0	3

4.	AER17R308	Aircraft Engine Repairs and Maintenance	T	AER17R205	3	0	0	3
5.	AER17R309	Aircraft Rules and Regulations CAR I & II	T	---	3	0	0	3
6.	AER17R310	Approximate Methods in Structural Mechanics	T	MEC17R271	3	0	0	3
7.	AER17R311	Boundary Layer Theory	T	MEC17R272	3	0	0	3
8.	AER17R312	Fatigue and Fracture Mechanics	T	MEC17R271	3	0	0	3
9.	AER17R313	Fundamentals of Control Engineering	T	EEE17R151	3	0	0	3
10.	AER17R314	Missile Aerodynamics	T	AER17R202	3	0	0	3
11.	AER17R315	Structural Dynamics	T	MEC17R271	3	0	0	3
12.	AER17R316	Theory of Plates and Shells	T	MEC17R271	3	0	0	3
13.	AER17R317	UAV System Design	T	AER17R202	3	0	0	3
14.	AER17R318	Wind Engineering	T	AER17R202	3	0	0	3
15.	AER17R319	Disaster Management	T	--	3	0	0	3
16.	AER17R405	Aircraft Systems Engineering	T	AER17R305	3	0	0	3
17.	AER17R406	Airframe Repair and Maintenance	T	AER17R203	3	0	0	3
18.	AER17R407	Avionics	T	AER17R204	3	0	0	3
19.	AER17R408	Combustion in Aerospace Vehicles	T	AER17R205	3	0	0	3
20.	AER17R409	Design of Gas Turbine Engine Components	T	AER17R205	3	0	0	3
21.	AER17R410	Helicopter Aerodynamics	T	AER17R301	3	0	0	3
22.	AER17R411	Hypersonic Aerodynamics	T	AER17R202	3	0	0	3
23.	AER17R412	Numerical Heat Transfer	T	AER17R271	3	0	0	3
24.	AER17R413	Satellite Technology	T	PHY17R171	3	0	0	3

25.	AER17R414	Space Mechanics	T	PHY17R171	3	0	0	3
26.	AER17R415	Theory of Elasticity	T	MEC17R271	3	0	0	3
27.	AER17R417	Wind Tunnel Techniques	T	AER17R202	3	0	0	3
28.	AER17R418	Experimental Stress Analysis	T	AER17R271	3	0	0	3

b. List of Open Electives

AERONAUTICAL

Course Code	Course Name	L	T	P	C
AER17R308	Aircraft Rules and Regulations CAR I & II	3	0	0	3
AER17R312	Fundamentals of Control Engineering	3	0	0	3
AER17R317	Wind Engineering	3	0	0	3
AER17R318	Disaster Management	3	0	0	3
AER17R406	Avionics	3	0	0	3
AER17R413	Space Mechanics	3	0	0	3
AER17R414	Theory of Elasticity	3	0	0	3
AER17R403	Fundamentals of Nanoscience	3	0	0	3

AUTOMOBILE

CODE NO	SUBJECT	L	T	P	C
AUT17R307	Instrumentation and Metrology	3	0	0	3
AUT17R310	Off road Vehicles	3	0	0	3
AUT17R312	Tractor and Farm Equipment's	3	0	0	3
AUT17R315	Automotive Materials	3	0	0	3
AUT17R402	Recent Vehicle Technology	3	0	0	3
AUT17R405	Automotive Safety	3	0	0	3
AUT17R412	Experimental Method in Fluids	3	0	0	3
AUT17R413	Hybrid Electric Vehicle	3	0	0	3
AUT17R414	Vehicle Maintenance	3	0	0	3
AUT17R415	Fleet Management	3	0	0	3
AUT17R416	Automotive Air-conditioning	3	0	0	3
AUT17R418	Automotive Pollution Control and Alternative Fuels	3	0	0	3
AUT17R419	Tero technology	3	0	0	3

BIO MEDICAL ENGINEERING

CODE NO	SUBJECT	L	T	P	C
BME17R205	Biomaterials and artificial Organs	3	0	0	3
BME17R301	Biomedical Instrumentation	3	0	0	3
BME17R302	Hospital Management	3	0	0	3
BME17R304	Medical Optics and lasers	3	0	0	3
BME17R305	Computers in Medicine	3	0	0	3
BME17R306	Rehabilitation Engineering	3	0	0	3
BME17R310	Occupational Health and Safety	3	0	0	3
BME17R403	Hospital Engineering	3	0	0	3
BME17R404	Telemedicine	3	0	0	3
BME17R405	Nanotechnology in Medicine	3	0	0	3
BME17R408	Biometric Systems	3	0	0	3
BME17R409	Wearable systems	3	0	0	3
BME17R410	Biomedical Waste Management	3	0	0	3

BIO TECHNOLOGY

CODE NO	SUBJECT	L	T	P	C
BIT17R307	Environmental Biotechnology	3	0	0	3
BIT17R316	Introduction to Computational Biology	3	0	0	3
BIT17R317	Biology of Cancer	3	0	0	3
BIT17R318	Engineering of crop plants	3	0	0	3
BIT17R319	Environmental Microbiology	3	0	0	3
BIT17R320	Basics in Biotechnology	3	0	0	3
BIT17R321	Exploring the microbial world	3	0	0	3
BIT17R428	Human diseases and prevention	3	0	0	3
BIT17R411	Bio resource Technology	3	0	0	3
BIT17R432	Gene Manipulation	3	0	0	3
BIT17R433	Biological Waste water treatment	3	0	0	3
BIT17R434	Bio-corrosion	3	0	0	3
BIT17R435	Applications of Plant fibres	3	0	0	3

CIVIL ENGINEERING

CODE NO	SUBJECT	L	T	P	C
CIV17R325	Introduction to Remote Sensing	3	0	0	3
CIV17R326	Air Pollution & Control	3	0	0	3
CIV17R327	Environmental Management	3	0	0	3
CIV17R328	Industrial Waste Water Management	3	0	0	3
CIV17R329	Geo- Environmental Engineering	3	0	0	3
CIV17R330	Coastal Engineering	3	0	0	3
CIV17R331	Disaster Management	3	0	0	3
CIV17R332	Advanced Remote Sensing Techniques	3	0	0	3
CIV17R420	Geographic Information systems	3	0	0	3
CIV17R421	Ecological Engineering	3	0	0	3
CIV17R422	Environmental Impact Assessment	3	0	0	3
CIV17R423	Building Services	3	0	0	3
CIV17R424	Modern Building Materials	3	0	0	3
CIV17R425	Smart Structures	3	0	0	3
CIV17R426	Valuation of Engineering Structures	3	0	0	3
CIV17R427	Seismology & Earthquake Engineering	3	0	0	3
CIV17R428	Pavement evaluation & management	3	0	0	3
CIV17R429	Pavement materials and construction	3	0	0	3
CIV17R430	Smart City	3	0	0	3
CIV17R431	Transportation economics	3	0	0	3
CIV17R432	Remote Sensing And GIS In Transport	3	0	0	3

CHEMICAL ENGINEERING

CODE NO	SUBJECT	L	T	P	C
CHE17R310	Corrosion Science and	3	0	0	3
CHE17R311	Separation Technique	3	0	0	3
CHE17R312	Fertilizer Technology	3	0	0	3
HE17R313	Membrane Science and	3	0	0	3
CHE17R314	Safety in chemical industries	3	0	0	3
CHE17R315	Bio-fuel and Combustion	3	0	0	3
CHE17R316	Pulp and Paper Technology	3	0	0	3
CHE17R317	Treatment of Industrial Effluents	3	0	0	3
CHE17R318	Coal Processing Technology	3	0	0	3
CHE17R319	Batteries and Fuels Cells	3	0	0	3
CHE17R321	Mass Transfer	3	0	0	3
CHE17R322	Green Technology	3	0	0	3
CHE17R412	Drugs and Pharmaceutical Engineering	3	0	0	3

COMPUTER SCIENCE ENGINEERING

CODE NO	SUBJECT	L	T	P	C
CSE17R302	Fundamentals of Networking	3	0	0	3
CSE17R303	OOPS using C++	3	0	0	3
CSE17R304	OOPS using JAVA	3	0	0	3
CSE17R305	Introduction to Data Analytics	3	0	0	3
CSE17R306	Introduction to Software Engineering	3	0	0	3
CSE17R307	Fundamentals of operating systems	3	0	0	3
CSE17R308	Ethical Hacking	3	0	0	3
CSE17R309	Introduction to Python Programming	3	0	0	3
CSE17R310	PC and Troubleshooting	3	0	0	3
CSE17R311	Office Automation	3	0	0	3
CSE17R312	Fundamentals of Computer Architecture	3	0	0	3
CSE17R313	Bio- Python	3	0	0	3
CSE17R314	Internet Security and Computer Forensics	3	0	0	3
CSE17R315	Bio Inspired Algorithm	3	0	0	3
CSE17R316	Introduction to Cloud Computing	3	0	0	3

CSE17R317	Programming in C# and .Net	3	0	0	3
CSE17R318	Android Programming	3	0	0	3
CSE17R319	Introduction to IOT	3	0	0	3
CSE17R320	Vehicular Ad –Hoc Network	3	0	0	3
CSE17R321	Wireless Sensor Network	3	0	0	3

ELECTRONICS AND COMMUNICATION ENGINEERING

CODE NO	SUBJECT	L	T	P	C
ECE17R321	Basics of Signals and Systems	3	0	0	3
ECE17R322	Electron Devices and Circuits	3	0	0	3
ECE17R323	Linear Integrated Circuits	3	0	0	3
ECE17R324	Digital Integrated Circuits	3	0	0	3
ECE17R325	Fibre optics and Laser Instruments	3	0	0	3
ECE17R326	Analog Communication Systems	3	0	0	3
ECE17R327	Television Engineering	3	0	0	3
ECE17R328	Consumer Electronics	3	0	0	3
ECE17R421	Microcontrollers	3	0	0	3
ECE17R422	Computer Vision	3	0	0	3
ECE17R423	Basics of VLSI Design	3	0	0	3
ECE17R424	VLSI Design using Verilog	3	0	0	3
ECE17R425	Digital Communication Systems	3	0	0	3
ECE17R426	Modern Wireless Communication	3	0	0	3
ECE17R427	Basics of Signal Processing	3	0	0	3
ECE17R428	Telecommunication Networks	3	0	0	3
ECE17R429	Basics of Satellite Communication	3	0	0	3
ECE17R430	Speech Processing	3	0	0	3
ECE17R431	VLSI Fabrication and Lithography	3	0	0	3

ELECTRICAL AND ELECTRONICS ENGINEERING

CODE NO	SUBJECT	L	T	P	C
EEE17R309	Principles of Power System	3	0	0	3
EEE17R310	Solar and Wind Energy Conversion	3	0	0	3
EEE17R311	Principles of Power Electronics	3	0	0	3
EEE17R312	Electrical Machines	3	0	0	3
EEE17R313	Auto electrical wiring	3	0	0	3
EEE17R314	Smart Grid Technology	3	0	0	3
EEE17R315	Electrical wiring Estimation and costing	3	0	0	3
EEE17R417	Electrical Safety	3	0	0	3
EEE17R418	Power Generation Systems	3	0	0	3
EEE17R419	Soft Computing Techniques	3	0	0	3
EEE17R420	Industrial Electronics	3	0	0	3
EEE17R421	Evolutionary algorithm	3	0	0	3
EEE17R422	Energy Conservation and Management	3	0	0	3
EEE17R423	Embedded System Design	3	0	0	3
EEE17R424	Hydro power generation	3	0	0	3
EEE17R425	Building Management System	3	0	0	3

ELECTRONICS AND INSTRUMENTATION ENGINEERING

CODE NO	SUBJECT	L	T	P	C
EIE17RXXX	Instrumentation in Processing Industries	4	0	0	3
EIE17RXXX	Opto-electronics instrumentation	4	0	0	3
EIE17RXXX	Environmental instrumentation	4	0	0	3
EIE17RXXX	Instrumentation in food processing industry	4	0	0	3
EIE17RXXX	Process instrumentation	4	0	0	3
EIE17RXXX	Industrial automation	4	0	0	3

IE17RXXX	Building automation	4	0	0	3
EIE17RXXX	Process modelling and optimatimization	4	0	0	3
EIE17RXXX	Programmable logic controller	4	0	0	3
EIE17RXXX	Agricultural Instrumentation	4	0	0	3
EIE17RXXX	Automobile Instrumentation	4	0	0	3
EIE17R301	Mechatronics	4	0	0	3
EIE17R315	Virutal Instrumentation	4	0	0	3
EIE17R436	System Interface for Instrumentation	4	0	0	3
EIE17R402	PCB Design Engineering	4	0	0	3

FOOD TECHNOLOGY

CODE NO	SUBJECT	COURSE TYPE	L	T	P	C
FT17R359	Technology of Convenience Foods	TP	3	0	1	4
FT17R360	Bakery and Confectionary	TP	3	0	1	4
FT17R320	Foundation of Food and Nutrition	T	3	0	0	3
FT17R321	Pollution control in Food Industries	T	3	0	0	3
FT17R361	Processing of Marine Products	TP	3	0	1	4
FT17R322	Food Laws and Standards	T	3	0	0	3
FT17R423	Nutraceuticals and Functional Foods	T	3	0	0	3
FT17R463	Beverage Technology	TP	3	0	1	4
FT17R423	Food Biotechnology	T	3	0	0	3
FT17R464	Fermented food products	TP	3	0	1	4
FT17R425	Nanotechnology in Food Processing	T	3	0	0	3

FT17R426	Composition, Quality & Safety of Foods	T	3	0	0	3
FT17R465	Packaging Technology of Foods	TP	3	0	1	4

INFORMATION TECHNOLOGY

CODE NO	SUBJECT	L	T	P	C
INT17R311	Web Programming	3	0	0	3
INT17R312	Big Data Analytics	3	0	0	3
INT17R313	Information Theory & Coding	3	0	0	3
INT17R314	Introduction to Information Security	3	0	0	3
INT17R315	Cyber Forensics	3	0	0	3
INT17R316	Essentials of Information Technology	3	0	0	3
INT17R415	Internet and Java	3	0	0	3
INT17R416	Programming with C++ and Java	3	0	0	3
INT17R417	Network Protocols	3	0	0	3
INT17R418	High Speed Networks	3	0	0	3
INT17R419	Introduction to Storage Management	3	0	0	3

MECHANICAL ENGINEERING

CODE NO	SUBJECT	L	T	P	C
MEC17R321	Optimization Techniques	3	0	0	3
MEC17R323	Materials Management	3	0	0	3
MEC17R403	Mechatronics	3	0	0	3
MEC17R427	Enterprise Resource Planning	3	0	0	3
MEC17R428	Productivity management and reengineering	3	0	0	3
MEC17R432	Nuclear Power generation	3	0	0	3
MEC17R439	Surface Engineering	3	0	0	3
MEC17R440	Basic Machining	3	0	0	3
MEC17R441	Phase Change Materials	3	0	0	3
MEC17R442	3D Printing	3	0	0	3
MEC17R443	Maintenance Engineering	3	0	0	3
MEC17R444	Project Management	3	0	0	3
MEC17R445	Finite Element Analysis	3	0	0	3
MEC17R446	Industrial Psychology	3	0	0	3
MEC17R447	Smart Materials	3	0	0	3
MEC17R448	Avionics	3	0	0	3
MEC17R449	Product life cycle management	3	0	0	3
MEC17R450	Fundamentals of entrepreneurship	3	0	0	3
MEC17R451	Supply chain management	3	0	0	3
MEC17R452	Basics in Heat transfer	3	0	0	3
MEC17R453	Automatic Guided Vehicle	3	0	0	3
MEC17R454	Thermodynamics	3	0	0	3
MEC17R455	Process equipment and design	3	0	0	3

c. List of Humanities Electives

S. No	Course Code	Course Name	Course Nature	L	T	P	C
1	HSS17R001	Management Concepts and Techniques	T	3	0	0	3
2	HSS17R002	Marketing Management	T	3	0	0	3

3	HSS17R003	Organizational Psychology	T	3	0	0	3
4	HSS17R004	Project Management	T	3	0	0	3
5	HSS17R005	Stress Management and Coping Strategies	T	3	0	0	3
6	HSS17R006	Engineering Economics	T	3	0	0	3
7	HSS17R007	Human Resource Management and Labour Law	T	3	0	0	3
8	HSS17R008	Entrepreneurship Development	T	3	0	0	3
9	HSS17R009	Cost Analysis and Control	T	3	0	0	3
10	HSS17R010	Product Design and Development	T	3	0	0	3
11	HSS17R011	Business Process Reengineering	T	3	0	0	3
12	HSS17R012	Political Economy	T	3	0	0	3
13	HSS17R013	Professional Ethics	T	3	0	0	3
14	HSS17R014	Operations Research	T	3	0	0	3
15	HSS17R015	Total Quality Management	T	3	0	0	3

d. Self-Study Elective

S. No	Course Code	Course Name	Course Nature	Pre-requisite	L	T	P	C
1	AER17R405	Aircraft Systems Engineering	T	MEC17R272	3	0	0	3
2	AER17R419	Composite Materials and Structures	T	MEC17R271	2	1	0	3

Honors

S. No	Course Code	Course Name	Course Nature	Pre-requisite	L	T	P	C
1.	AER17R311	Boundary Layer Theory	T	MEC17R272	3	0	0	3
2.	AER17R314	Missile Aerodynamics	T	AER17R301	3	0	0	3
3.	AER17R408	Combustion in Aerospace Vehicles	T	AER17R205	3	0	0	3
4.	AER17R409	Design of Gas Turbine Engine Components	T	AER17R205	3	0	0	3
5.	AER17R411	Hypersonic Aerodynamics	T	AER17R203	3	0	0	3

BASIC SCIENCES AND MATHEMATICS

DEPARTMENT OF AERONAUTICAL ENGINEERING

COURSE SYLLABUS

PHY17R171	PHYSICS I	Credits			
		L	T	P	Total
		3	0	2	4
Pre-requisite: NIL	**Course Category:** Basic Science and Mathematics **Course Type:** Integrated Course				

Course Objective(s):

- To provide an overview of the fundamentals of advanced optics and sound waves in the engineering field
- To realize the importance of structural analysis of crystalline and quantum theory to identify the various properties of advanced materials
- To understand the basic concepts of mechanical and thermal properties

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understanding the working principle, production and applications of different kind of lasers, hologram and optical fiber.

CO2: Know the basic concept and knowledge of sound waves and understand the production and applications of ultrasonic waves.

CO3: Learn some basic ideas of crystallography and preparation methods of single crystalline materials.

CO4: Gain the basic knowledge of the special theory of relativity and quantum physics

CO5: Understand the mechanical and thermal properties of materials

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit1: Modern Optics **9 Hours**

Laser and its properties – Spontaneous and stimulated emission - Einstein's coefficients - Population inversion – Pumping – The principle pumping schemes – Gas laser (He-Ne laser) – Solid state laser (Nd-YAG laser) - Hologram -construction and reconstruction process – General ideas of optical fibre – Numerical aperture and Acceptance angle of fibre – Types of optical fibre - Applications

Unit 2: Acoustics and Ultrasonics **9 Hours**

Classification of sound – decibel – Weber Fechner law – Reverberation-Sabine's formula – derivation of Sabine's equation – Acoustic design of a Hall – Common acoustical defects and

their remedies - Production of ultrasonic by magnetostriction and piezo electric methods – Acoustical grating – SONAR - depth of sea

Unit 3: Crystallography **9 Hours**

Crystalline and amorphous solids – lattice and unit cell – seven crystal systems and Bravais lattices – Miller indices – d-spacing in cubic lattice - Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Crystal preparation by slow evaporation and Czochralski method - Bragg's law for X-ray diffraction

Unit 4: Relativity and Quantum Physics **9 Hours**

Special theory of relativity – Lorentz transformation equations – length contraction – time dilation – relativity of simultaneity – addition of velocities – variation of mass with velocity – mass-energy equivalence. Photo electric effect –Wave nature of matter- de-Broglie waves – Davisson and Germer experiment, Schrodinger's wave equation (Time dependant and time independent equations)- particle confined in a one-dimensional potential well

Unit 5: Properties of Matter and Thermal Physics **9 Hours**

Elasticity- Hooke's law - stress -strain diagram – Poisson's ratio –Factors affecting elasticity – Bending moment –Young's modulus by uniform bending-Non-uniform bending- I-shaped girder. Specific heat capacity - definition - Newton's law of cooling. Thermal conductivity – Forbe's and Lee's disc methods

List of Experiments: **15 Hours**

1. Torsional pendulum- Determination of Rigidity Modulus of a Wire
2. Uniform Bending – Determination of Young's Modulus
3. Viscosity–Determination of Co-efficient of Viscosity of Liquid by Poiseuille's Flow
4. Ultrasonic Interferometer–Velocity of Ultrasonic waves in a Liquid and Compressibility of the Liquid
5. Spectrometer – Determination of Wavelength of Hg Source using Grating
6. Non-uniform Bending - Determination of Young's Modulus
7. Laser- Determination of Wavelength and particle Size Using Grating
8. Compound pendulum –Determination of the acceleration due to gravity
9. Newton's Rings - Radius of curvature of convex lens.
10. Sonometer - Determination of frequency of tuning fork

Reference(s):

1. A Gaur R. K, and Gupta S. L, Engineering Physics, Dhanpat Rai & Sons, New Delhi, 7th Edition, 1993
2. Halliday D, Resnick R and Waler J, Fundamentals of Physics, Wiley and Sons, New York, 6th Edition, 2001
3. William T. S, Laser Fundamental, Cambridge University Press, New York, 2nd Edition, 2004
4. Beiser A, Concepts of Modern Physics, Tata McGraw – Hill Publishing Company Limited, New Delhi, 5th Edition, 2000
5. Rajput B.S, Pragati Prakashan, Advanced Quantum Mechanics, Pragati publications, New Market, Begum Bridge, Meerut, 2009.
6. Brijlal and Subramaniam, Heat and Thermodynamics, S. Chand& Co., New Delhi, 2004.
7. Practical Physics – S.L. Gupta & V. Kumar (Pragati Prakashan).
8. Advanced Practical Physics – B.L. Workshop and H.T. Flint (KPH)
9. Advanced Practical Physics Vol. I & II – Chauhan & Singh (Pragati Prakashan)
10. Physics Laboratory Manual, prepared by Department of Physics, Kalasalingam University.

PHY17R153 MATERIAL PHYSICS	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: NIL	**Course Category:** Basic Science and Mathematics **Course Type:** Theory with Practical Component			

Course objectives:

- To provide an overview of the fundamentals of electrical conducting materials
- To realize the importance of semiconducting, magnetic, dielectric and superconducting materials
- To understand the basic concepts of instrumentation techniques and thermal applications

COURSE OUTCOMES (COs):

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

CO1 :Understanding the free electron theories, formation of energy bands, energy distribution and also the electron behavior in solids

CO2: To achieve the knowledge about various kinds of magnetic materials and superconducting materials, their properties and applications in advanced technologies.

CO3: To gain the knowledge about dielectric materials, nanomaterial's and some advanced engineering materials, their properties and significant applications in modern technologies.

CO4 : Learn the basic knowledge about mechanical properties of materials

CO5 : fundamental concepts of thermal properties for developing new engineering materials

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit 1: Conducting Materials **9 Hours**

Classical free electron theory of metals – drawbacks - Quantum free electron theory of metals and its importance (Qualitative) - Fermi distribution function – Density of energy states and carrier concentration in metals – Fermi energy – Band theory of solids – classification of solids

Unit – II Magnetic and Superconducting materials **9 Hours**

Origin of magnetic moment – Bohr magnetron - comparison of Dia, Para and Ferro magnetism- Domain theory – Hysteresis – soft and hard magnetic materials- Ferrites and its applications- Superconductor - definition – Meissner effect – type I & II superconductors- BCS theory (qualitative) – high temperature superconductors- Josephson effect – quantum interference (qualitative) – SQUID – applications.

Unit – III Dielectric and Advanced Materials **9 Hours**

Electrical susceptibility – dielectric constant-electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation-internal field – Claussius – Mossotti relation (derivation)- dielectric loss – dielectric breakdown-Metallic glasses – Preparation, properties and

applications - Shape memory alloys –characteristics, properties and applications of Nitinol-Nanomaterials - introduction and properties – synthesis – chemical vapour deposition – pulsed laser deposition

Unit – IV Mechanical Properties of Materials **9 Hours**

Introduction to mechanical properties - plastic deformation mechanisms-slip and twinning - role of dislocations in slip-strengthening methods - strain hardening - creep resistance - creep curves-mechanisms of creep - creep-resistant materials - fatigue failure - fatigue tests - methods of increasing fatigue life-hardness - Rockwell and Brinell hardness - Knoop and Vickers microhardness.

Unit – V Thermal Applications of Materials **9 Hours**

Principles of heat transfer, steady state of heat flow-conduction through compound media-series and parallel-conductivity of rubber tube and powder materials-heat gain and heat loss estimation - factors affecting the thermal performance of buildings-Thermal measurements, thermal comfort, indices of thermal comfort, climate and design of solar radiation.

List of Experiments (Any 5):

1. Specific heat capacity-Joule's colorimeter
2. To study the polarization of light by reflection and to determine the polarizing angle for air-glass interface
3. Characteristics of a transistor
4. To determine the dielectric constant of a dielectric placed inside a parallel plate capacitor using a B.G.
5. Four probe method-determination of bandgap of semiconductor
6. Determination of M and BH

Reference(s):

1. Raghavan, V., Materials Science and Engineering: A First Course, 5th Edition, PHI., 2009
2. William F.Smith, Foundations of Materials Science and Engineering, 3rd Edition, McGraw-Hill, New York, 2003.
3. Charles Kittel, Introduction to Solid State Physics, 8thEdition,Wiley, 2004
4. Cullity B. D, Stock. S.R., Elements of x-ray diffraction. Prentice Hall, 3rd Edition, 2001
5. Hobarth Willard, Lynne Merritt, John Dean, Instrumental Methods of Analysis, Wadsworth Publishing Company, 7th Edition, 1988.
6. Albert Paul Malvino, "Electronic Principles" Sixth Edition McGraw Hill, 1999.
7. Fundamentals of Photonics - Bahaa E.A. Saleh and Malvin Carl Teich

Physics Laboratory Manual, prepared by Department of Physics, Kalasalingam University.

CHY17R171 CHEMISTRY		**Credits**			
		L	**T**	**P**	**Total**
		3	**0**	**2**	**4**
Pre-requisite: NIL	**Course Category:** Basic Science and Mathematics **Course Type:** Integrated Course				

Course Objective(s):

Introducing the fundamental concepts and applications of Chemistry to the engineering students to understand, analyze and apply the same to complex technical issues.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Know the significance and role of water quality parameters in the domestic and engineering applications and analyzing the same through modern methods.

CO2: Understand and apply the principles of thermodynamics for solving engineering problems

CO3: Understand the basic concepts of electrochemistry, batteries, corrosion and to apply the same for the betterment of society.

CO4: Have a comprehensive idea about synthesis, characteristics and applications of technologically important polymers, composites and nanomaterial's.

CO5: Understand the underlying principles, instrumentation and applications of analytical techniques.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit – I Water Technology **9 Hours**

Water quality parameters - BIS and WHO standards - Determination of alkalinity of water - Hardness - Estimation of hardness by EDTA method. Water softening-Zeolite and Demineralisation (Ion- exchangers) processes. Boiler troubles and remedies. Desalination by electrodialysis and reverse osmosis. Treatment of water for domestic use.

Unit -II Thermodynamics **9 Hours**

Definition of thermodynamic terms - system and surroundings - types of system - intensive and extensive properties - thermodynamic processes - statement of first and second law of thermodynamics – Internal energy (E) and enthalpy (H). Molar heat capacities at constant volume (C_v) and at constant pressure (C_p) - relation between C_p and C_v. Concept of entropy - change in entropy for an isothermal expansion of an ideal gas, reversible and irreversible processes-problems. Free energy (G) and work function (A) - Gibbs-Helmholtz equation-problems- van't Hoff isotherm –problems. Phase rule - phase diagram- Applications to one component system (water) and two component system (Pb-Ag).

Unit - III Electrochemistry **9 Hours**

Electrode potential - Electrochemical cell - EMF of an electrochemical cell -Determination of EMF of a cell - Nernst equation.Batteries - Primary and secondary batteries-Lechlanche's cell - Lead acid storage battery, Lithium battery, Fuel cell (H_2-O_2)and solar battery. Corrosion - types of corrosion - Principle and mechanism of chemical and electrochemical corrosions - Corrosion protection by sacrificial anode and impressed current techniques (cathodic protection).

Unit - IV Polymers and Composites **9 Hours**

Introduction and classification of polymers - polymerisation - chain growth and step growth - Free radical mechanism of addition polymerisation. Molecular weight determination - viscometry. Preparation, properties and uses of industrial polymers: Polyethylene, PVC, PTFE and Nylon-6,6 - Thermoplastic &Thermosets- example and differences. Polymer processing techniques -

injection and blow moulding. Polymer composites - Preparation, types and uses of fibre reinforced polymer (FRP) composites.

Unit - V Analytical Techniques **9 Hours**

Principles, instrumentation and simple applications of UV-Visible spectroscopy, Infra-Red spectroscopy and Atomic Absorption Spectroscopy (AAS), High Performance Liquid Chromatography (HPLC), Thermogravimetric analysis (TGA).

Text Books

1. Nagarajan E.R. and Ramalingam S, Engineering Chemistry, Wiley Publishers, New Delhi, 2017.
2. Jain P.C. and Monica J., Engineering Chemistry, Dhanpat Rai Publications Co.(P) Ltd., New Delhi, 2015.

Reference Books

1. Puri B. R., Sharma L. R., and Pathania M.S., "Principles of Physical Chemistry"Vishal Publishing Co, 2008.
2. Peter Atkins, Julio de Paula, Elements of Physical Chemistry, Oxford University Press, 2016.
3. Kuriakose, J.C. and Rajaram J., "Chemistry in Engineering and Technology", Vol. I and II, Tata McGraw-Hill Publications Co.Ltd, New Delhi,1996.
4. Kund and Jain, "Physical Chemistry", S. Chand and Company, New Delhi, 1996.
5. Gordon M.Barrow, "Physical Chemistry ", Sixth Edition, Tata McGraw Hill, 1998.
6. Sharma, B.K., "Instrumental Methods of Chemical Analysis", Pragati Prakashan Publishers, 2012.

List of Experiments **15 Hours**

1. Estimation of hardness of water sample by EDTA method.
2. Determination of alkalinity of given water sample.
3. Determination of dissolved oxygen in a water sample.
4. Determination of sulphate by Turbidimetric method.
5. Estimation of hydrochloric acid by pH titration.
6. Estimation of chloride ion in a given water sample.
7. Estimation of ferrous ion by potentiometric method.
8. Conductometric titration between $BaCl_2$ and Na_2SO_4.
9. Corrosion experiment-weight loss method.
10. Conductometric titration of strong acid with strong base.

Demo Experiments

1. Estimation of iron by spectrophotometry using 1, 10-phenanthroline.
2. Determination of sodium and potassium by flame photometry.

Reference

Chemistry Laboratory Manual, Department of Chemistry, Kalasalingam University

MAT17R101 CALCULUS AND DIFFERENTIAL EQUATIONS	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: NIL	**Course Category:** Basic Science and Mathematics **Course Type:** Theory			

Course Objective(s):

To make students acquire knowledge in matrix theory, a part of linear algebra, which has wider application in engineering problems.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Know the method of finding Eigen values and Eigen vectors and the method to make a real symmetric matrix to diagonal form.

CO2: Understand the concepts of curvature, radius of curvature, centre of curvature and its applications.

CO3: Know the method of finding derivative of homogenous functions and maxima, minima in two variables.

CO4: Solve second order and higher order linear differential equations with constant coefficients and variable coefficients.

CO5: Solve first order and second order partial differential equations with constant coefficient

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit 1: Linear Algebra **9 Hours**

Rank of a Matrix- Simultaneous linear equations - Consistency of a system of linear equations- Cayley Hamilton Theorem – Eigen values and Eigen vectors – Diagonalization of a real symmetric matrix by orthogonal transformation

Unit 2: Applications of Differential Calculus **9 Hours**

Curvature – Cartesian and polar co-ordinates – Radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals

Unit 3: Functions of Several Variables **9 Hours**

Partial derivatives – Total derivatives - Higher order partial derivatives- Euler's theorem for homogenous functions – Taylor's expansion – Jacobians – Maxima and Minima – Constrained maxima and minima by Lagrangian multiplier method

Unit 4: Ordinary Differential Equations **9 Hours**

Solutions of second and higher order linear Ordinary differential equations with constant coefficients – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients - Method of variation of parameters

Unit 5: Partial Differential Equations **9 Hours**

Formation of Partial differential equations - Solutions of standard types of first order Partial differential equations - Lagrange's linear equation - Linear Partial differential equations of second and higher order with constant coefficients

Text Book(s):

1. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Mathematics for Engineers, Scitech Publications (India) Pvt. Ltd., 2008.
2. Grewal, B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 42nd Edition., 2012

Reference(s):

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore, 10^{th} Edn., 2001.
2. Venkataraman, M. K., Engineering Mathematics, First Year, The National Publishing Company, Chennai, 2^{nd} Edition., Reprint 2001

MAT17R102 LINEAR ALGEBRA, PARTIAL DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLE	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: NIL	**Course Category:** Basic Science and Mathematics **Course Type:** Theory			

Course Objective(s):

Acquire knowledge to use multiple integrals to find area and volume of surface and solids respectively.

Have a good grasp of analytic functions, complex integration and their interesting properties and its applications

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Know the method of finding values of double and triple integrals and its applications in finding area and volume.

CO2: Understand the concept of improper integrals and know the method of finding its values.

CO3: Know the method of finding line integral, surface integral and volume integral and its applications.

CO4: Understand the concept of analytic functions and conformal mappings.

CO5: Learn the method of finding expansions of analytic functions using Taylor and Laurents series and the method of finding complex integration using residues

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit 1: Multiple Integrals **9 Hours**

Double integration – Cartesian and polar coordinates – change of order of integration – change of variables between Cartesian and Polar – Area as double integral – Triple integration in Cartesian, Cylindrical and Spherical polar coordinates – Volume as triple integral

Unit 2: Improper Integrals **9 Hours**

Improper integrals of first and second kind- Evaluation of improper integrals (excluding comparison test) – Beta and Gamma functions – Properties – Evaluation of integrals involving a parameter by Leibnitz rule

Unit 3: Vector Calculus **9 Hours**

Gradient- Directional derivative- Divergence and Curl — Irrotational and Solenoidal vectors – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proof) – Simple applications

Unit 4: Analytic Function and Conformal Mapping **9 Hours**

Function of a complex variable – Analytic function – Necessary conditions (Proof excluded) – Cauchy-Riemann equations – Sufficient conditions (excluding proof) – Properties of analytic function – Harmonic conjugate – Construction of Analytic functions - Conformal mapping – Elementary transformations - w = z+a, az, 1/z, e^z, sin z, cos z-Bilinear transformation. - Fixed points

Unit 5: Complex Integration **9 Hours**

Statement and applications of Cauchy's integral theorem and integral formula – Taylor and Laurent series – Singularities – Residues - Cauchy's residue theorem - Contour integration over unit circle and semicircular contours (excluding poles on boundaries)- evaluation of real integrals using contour integration

Text Book(s):

1. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Mathematics for Engineers, Scitech Publications (India) Pvt. Ltd., Chennai, Reprint, 2014
2. R.K. Jain, S.R.K. Iyengar, Advanced Engineering Mathematics, Third edition, Narosa Publishing House, 2009

Reference(s):

1. Venkataraman, M. K., Engineering Mathematics First Year, The National Publishing Company, Chennai, 2nd Edition., Reprint 2001, 2000
2. Venkataraman, M. K., Engineering Mathematics –III, The National Publishing Company, Chennai, 11th Edition., Reprint 2002, 1998
3. Grewal, B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 42nd Edition., 5th Reprint 2004, 2003

MAT17R202 LAPLACE TRANSFORMS AND STATISTICS	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: NIL	**Course Category:** Basic Science and Mathematics **Course Type:** Theory			

Course Objective(s):

To provide students with mathematics fundamentals necessary to solve engineering process

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the concept of Laplace Transform and derivation of Laplace transform of standard functions.

CO2: Know the methods for finding inverse Laplace Transform and its application to differential equations.

CO3: Learn the standard distributions and its applications.

CO4: Solve the physical world problems using large and small sampling theory.

CO5: Know the method of using Analysis of variance to real world problems.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1: Laplace Transform **9Hours**

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties - Transforms of unit step function and impulse functions – Transform of periodic functions–Derivatives and integrals of transforms - Transforms of derivatives and integrals of functions.

UNIT 2: Inverse Laplace Transform **9 Hours**

Initial and final value theorems – Statement of Convolution theorem – Solution of linear Ordinary differential equations of second order with constant coefficients using Laplace transformation techniques.

UNIT 3: Standard Distributions **9 Hours**

Binomial, Poisson, Uniform, Exponential and Normal distributions and their properties.

UNIT 4: Testing of Hypothesis **9 Hours**

Sampling distributions – Testing of hypothesis for mean, variance, proportion and differences using Normal, t, Chi-square and F distributions – Tests for independence of attributes and goodness of fit.

UNIT 5: Design Of Experiments **9 Hours**

Analysis of variance – One way classification – CRD – Two-way classification – RBD – Latin square.

Text Book(s):

1. Grewal, B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37th Edition, 5th Reprint, 2004.
2. T. Veerarajan,Probability,Statistics and Random process, Fourth edition, Tata McGraw-Hill Education(India) Pvt. Ltd., 2016.

Textbook 1: Units-I and II. Textbook 2: Units-III, IV and V.

Reference Book(s):

1. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume II, Scitech Publications (India) Pvt. Ltd., Chennai, 1st Edn., Reprint 2000.
2. Johnson. R. A., Miller & Freund's Probability and Statistics for Engineers, Prentice Hall of India, New Delhi, 7th Edition., 2005.
3. Gupta, S.C, and Kapur, J.N., Fundamentals of Mathematical Statistics, Sultan Chand, New Delhi, 11th Edition., 2006.

MAT17R203 NUMERICAL METHODS	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: NIL	**Course Category:** Basic Science and Mathematics **Course Type:** Theory			

Course Objective(s):

Teach students to characterize phenomena of statistical in nature, understand and apply numerical methods for solving systems.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Find the solution of equations using direct and iterative methods.
CO2: Understand the concept of difference operators and its application.
CO3: Know the method of finding the values of differentiation and integration using interpolation.
CO4: Know the methods for finding solutions of initial value problems.
CO5: Know the methods for finding solutions of boundary value problems.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1: Solution of Equations **9 Hours**

Solution of Algebraic and Transcendental equations - Iterative method – Regula Falsi method – Newton – Raphson method for single variable – Solution of a system of linear equations - Gaussian Elimination method, Gauss – Jordan Method, Gauss-Jacobi Method and Gauss – Seidel method.

UNIT 2: Interpolation **9 Hours**

Forward and Backward difference operators – Newton's forward and backward interpolation formulae – Newton's divided difference formula - Lagrange's polynomial – Stirling's Central difference formula.

UNIT 3: Numerical Differentiation And Integration **9 Hours**

Numerical differentiation with interpolation polynomials – Numerical integration by Trapezoidal, Simpson's 1/3rd and 3/8th rules – Two, Three point Gaussian quadrature formula – Double integrals using Trapezoidal rule.

UNIT 4: Initial Value Problems **9 Hours**

Single step methods – Taylor Series, Euler and Modified Euler, Runge-Kutta method of order four for first and second order differential equations – Multistep method –Milne's Predictor and Corrector methods.

UNIT 5: Boundary Value Problems **9 Hours**

Finite difference solution for the second order ordinary differential equations – finite difference solution for One dimensional heat equation (implicit, explicit), One –dimensional wave equation –Two dimensional Laplace and Poisson equations.

Text Book(s):

1. Arumugam, S., A. Thangapandi Isaac, A. Somasundaram, Numerical Methods, Scitech Publications (India) (P) Ltd., Chennai, 2014

Reference Book(s):

1. Jain M.K., Iyengar S.R.K., and Jain R.K., Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd Publishers, New Delhi.
2. Bali N.P., and Narayana Iyengar.N.Ch., Engineering Mathematics, Laxmi Publishers (p) Ltd , 6th edition, New Delhi.
3. Francis Scheid, Numerical Analysis, Schaum's Outlines, Tata McGraw Hill Education Pvt. Ltd., Second Edition, New Delhi, 2009.
4. Venkataraman, M.K., Numerical Methods in Science and Engineering, The National Publishing Company, Chennai.

HUMANITIES
&
SOCIAL SCIENCES

HSS17R151 ENGLISH FOR TECHNICAL COMMUNICATION I	Credits			
	L	T	P	Total
	1	0	1	2
Pre-requisite: NIL	**Course Category:** Humanities and Social Sciences **Course Type:** Theory with Practical Component			

Course Objective(s):

- To help the learner develop listening skills by providing them with inspiring material
- To help the learner acquire the ability to speak comfortably in real-life situations
- To inculcate in students a taste for English so that they take to reading novels, dailies, and motivational books and dailies
- To help learners passionately improve their vocabulary
- To enable students to write all kinds of letters, job applications, and reports
- To help learners sit for the BEC Examinations

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Learn to speak good English covering their day to day activities
CO2: Understand the importance of Listening to communicate well
CO3: Make Situational Dialogues on emerging multiple situations
CO4: Learn the importance of Reading aloud Newspapers and other Texts
CO5: Compose effective error free composition

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit 1: Focus on Language and Communication **9 Hours**

What is Communication? Verbal and Non-verbal communication -– Cloze reading – Skimming- Scanning- Letters - Leave, Permission, Apology and Informal Letters - Spoken English – Meeting; parting; Meeting at a train station – Asking questions at the train station; Meeting at the airport; getting information at the airport- Definitions for technical terms - Etymology of Scientific Terms - Parts of Speech – Tenses – (Practical)- Preparing a short profile

Experiment: Preparing a short profile

Unit 2: Listening Skills **9 Hours**

Listening Comprehension - Listening to an audio -Types of Listening and Tips for Effective Listening. – Dialogue Writing - Telephonic Conversation. Major English Accents - British Accent (BBC) -

American Accent (CNN) - Indian Accent (Doordharshan, NDTV, etc.). Language Focus – Articles - Prepositions - Numerical Adjectives--(Practical) - Listening to Received Pronunciation

Experiment: Listening to Received Pronunciation

Unit 3: Speaking Skills **9 Hours**

Giving Instructions – Recommendations – Situational Conversations using the telephone; getting help in stores; going shopping; talking about shopping; shopping for clothes; asking about prices; Role plays - Communicating Politely- Oral Presentation Strategies - Organizing Contents -. Language Focus - Verbs—transitive and intransitive - Active Voice and Passive Voice - Direct Speech - Indirect Speech-(Practical) - Narrating events /stories

Experiment: Narrating events /stories

Unit 4: Reading Skills **9 Hours**

Converting newspaper headlines into sentences - Note-making - Outline/Linear Method of Note-making - Sentence Method of Note-making - Schematic/Mapping Method of Note-making. Creative Writing - Language Focus - Jumbled Sentences – Summary Writing –- Replacing words with the noun forms of verbs - Conditional Clauses -(Practical) Guessing Meaning from context

Experiment: Guessing Meaning from context

Unit 5: Writing Skills **9 Hours**

Dialogue Writing – Telephone conversation - Use of Abbreviations - Avoiding clichés, jargons and foreign words –Paragraph development - Kinds of Paragraphs - Effective Construction of Paragraphs, - Process Description - Language Focus - Comparison of Adjectives- (Practical)- Story Writing – Anecdote

Experiment: Story Writing –Anecdote

Text Book(s):

1. M. Asraf Rizvi. Effective Technical Communication. McGraw Hill, 2005

Reference(s):

1. Meenakshi Raman and Sangeeta Sharma. Technical Communication: English Skills for Engineers. Oxford University Press, 2008
2. Oxford Advanced Learner's Dictionary. OUP, Latest Version
3. Raymond Murphy. Murphy's English Grammar. Cambridge University Press, 2004
4. Kavitha Tyagi and Padma Misra. Advanced Technical Communication. PHI, 2011.
5. Clegg, Brain. Personal Development. Kogan Page India Private Limited, 2009.
6. Taylor, Grant. English Conversational Practice: McGraw Hill, 1975

HSS17R152 ENGLISH FOR TECHNICAL COMMUNICATION II	**Credits**			
	L	**T**	**P**	**Total**
	1	**0**	**1**	**2**
Pre-requisite: NIL	**Course Category:** Humanities and Social Sciences **Course Type:** Theory with Practical Component			

Course Objective(s):

- To help the learner construct simple sentences to express Engineering concepts.
- To help the learner express orally in understandable English.
- To help the learner familiarize in official communications like Notices, Circulars and Minutes.
- To help the learner prepare project proposals, and reports of industrial events like expansion, annexation, lockouts and fire accidents

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Apply the classroom inputs into his/ her day- to- day situations

CO2: Frame Error- free sentences to demonstrate some experience like watching movies

CO3: Learn to use Mechanics of writing

CO4: Learn to compose professional writings like Business Letters, Minutes, Circulars, and Notices etc.…

CO5: Prepare call letters for conferences, Brochures, Welcome Address, Vote of Thanks etc.….

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit 1: Aspects of Communication **9 Hours**

Impact of Power Point Presentation on burning issues- Electronic Mail- Critical Writing – Film Appreciation - Talking about demonetization with a Bank Manager Language Components-The Auxiliaries—Be and its forms; Letters - Order placing, requisition, confirmation, acceptance and other formal letters – Ordering food at a Restaurant; consulting a doctor over an ailment; question tags-Framing questions (WH)- (Practical) Listening and responding to an audio

Experiment: Listening and responding to an audio

Unit 2: Oral Communication **9 Hours**

Interview- Types – Pre-requisites –Do's and Don'ts of Interview – Instruction- Public Speaking /Presentation Skills-Taking part in group discussions with turn-taking – Expressing needs and wants – Making suggestions, arrangements and plans with other people – Discussing contemporary degrading culture -Language Components-Modal Auxiliaries –(Practical) comprehending technical topics (reading)

Experiment: Comprehending technical topics (reading)

Unit 3: Written Communication **9 Hours**

Precis Writing- Importance of Professional Writing-Features of Written Communication-Choice of Words and Phrases-Sentence Structure-Paragraph Structure-Topic Sentences- Formal Reports-Memorandum Writing-Contents-Types-Structure-Introduction to Official Communication-Notices-Agenda-Minutes- Circulars- Common Errors -Language Components- Punctuation –Capitalization-(Practical) Free Lance Writing

Experiment: Free Lance Writing

Unit 4: Business and Technical Communication **9 Hours**

Comprehending articles, advertisements, leaflets in Newspaper, magazine etc.- Interpretation of diagrams, graphs and illustrations Forms of Reports- Letter Reports- news report-accidental report – proof reading symbols - Language-Components-Adverbs- Relative pronouns – (Practical) Self - Introduction

Experiment: Self - Introduction

Unit 5: Mechanics of Manuscript Preparation **9 Hours**

Preparing a brochure, invitation, welcome note, and vote of thanks for Meeting/ Conference – Transformation of sentences –Simple, compound, complex–Words often Confused-Words commonly spelt wrongly- homonyms and homophones- Use of Infinitives, Gerunds and Participles- Building Advanced Vocabulary by adding affixes- (Practical) Conversing with peers

Experiment: Conversing with peers

Text Book(s):

1. Kumar, Sanjay and PushpaLata. Communication Skills. OUP, 2011

Reference(s):

1. David Green: Contemporary English Grammar, Structures and Composition. Macmillan, 1971
2. Krishna Mohan and Meenakshi Raman. Effective English Communication. McGraw Hill, 2009
3. Oxford Advanced Learner's English Dictionary. Latest Version
4. M. Ashraf Rizvi. Effective Technical Communication. McGraw-Hill, 2005
5. Sarah Freeman. Written Communication in English. Orient Longman
6. Clegg, Brain. Personal Development. Kogan Page India Private Limited, 2009.
7. Taylor, Grant. English Conversational Practice. McGraw Hill, 1975.
8. Meenakshi Raman and Sangeeta Sharma, Technical Communication: Principle and Practice. OUP, 2011

CHY17R101 ENVIRONMENTAL SCIENCE	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: NIL	**Course Category:** Humanities and Social Sciences **Course Type:** Theory			

Course Objective(s):

Creating awareness among engineering students about the importance of environment, the effect of technology on the environment and ecological balance is the prime aim of the course.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To Know the importance of environmental studies and methods of conservation of natural resources.

CO2: Describe the structure and function of an ecosystem and explain the values and conservation of bio-diversity.

CO3: Explain the sources, environmental effects and control measures of various types of pollutions.

CO4: Select the appropriate methods for waste management.

CO5: Recall social issues and legal provision and describe the necessities for environmental act.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit-I: Natural Resources **9 Hours**

Definition, scope, and importance of environmental science -Need for public awareness- Natural resources: Forest resources, Water resources, Land resources, Mineral resources, Energy resources - Role of an individual in conservation of natural resources.

Unit-II: Ecosystem and Biodiversity **9 Hours**

Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem - Food chains, food webs and ecological pyramids - Ecological succession. Biodiversity - Definition, value of biodiversity- Hot spots of biodiversity - Threats to biodiversity - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit-III: Environmental Pollution **9 Hours**

Sources, consequences and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear pollution. Environmental threats – Bio-magnification, Acid rain, Climate change, Global warming (Greenhouse effect), Ozone layer depletion, Fireworks: current environmental issues. Role of an individual in prevention of pollution.

Unit-IV: Management of Environmental Pollution **9 Hours**

Causes, effects, treatment methods and control measures of solid waste, municipal waste, biomedical waste and electronic waste - Waste minimization techniques - Cleaner technology- Green Chemistry- Principles and its role in controlling environmental pollution - Disaster management: flood, earthquake, cyclone, landslide and Tsunami.

Unit-V: Social Issues and the Environment **9 Hours**

Water conservation, rain water harvesting- Resettlement and rehabilitation of people - Environmental impact assessment- Precautionary and polluters pay principle- environment protection act - air (prevention and control of pollution) act - water (prevention and control of pollution) act - Population explosion - Family Welfare Programs - Environment and human health - Human Rights - Women and Child Welfare.

Text Books

1. Dhameja, S. K., Environmental Engineering and Management, S. K. Kataria and Sons, New Delhi, 1st edition 2015.
2. Anuba Kaushik and Kaushik C.P., "Environmental Science & Engineering" New Age international Publishers, New Delhi, 2010.

Reference Books

1. Miller T.G. Jr., "Environmental Science", Wadsworth Publishing Co. USA, 2nd edition 2004.
2. Erach Bharucha, "The Biodiversity of India", Mapin publishing Pvt. Ltd., Ahmedabad India, 2002.
3. Erach Bharucha, Text Book for Environmental Studies, UGC, New Delhi, 2004.
4. Trivedi R.K., "Handbook of Environmental Laws", Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro media, 2003.
5. Gilbert M. Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., second edition, 2004.
6. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
7. Wager K.D., "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.
8. Sawyer C. N, McCarty P. L, and Parkin G. F., Chemistry for Environmental Engineering, McGraw-Hill, Inc., New York, 1994.

SOFT SKILLS

HSS17R201 SOFT SKILLS - I	Credits			
	L	T	P	Total
	1	0	0	1
Pre-requisite: NIL	**Course Category:** Humanities and Social Sciences **Course Type:** Theory			

Sl. No.	Course	Module	Topics Covered	No: of Hrs.
1	Remedial English	Foundation	Parts of Speech	2
2			Articles	
3		Delightful Descriptions	Nouns	
4			Adjectives	
5		Double Actions	Verbs	2
6			Adverbs	
7		Meaningful Links	Prepositions	
8			Conjunctions	
9		Yesterday Today Tomorrow	Past Tense	2
10			Present Tense	
11			Future Tense	
12			Special Cases	
13		Matching Blocks	Subject Verb agreement	2
14		Questions and Expressions	Modals	
15			Question Tags	
16	Business English	Professional Communication	Concise Cogent Communication	2
17			Active Listening	2
18			Interact Interpret Respond	2
19		Expositions and discussions	JAM and Extempore-JAM and Extempore- BIKER B {Extempore}- Six Thinking Hats- JAM	2
20	Verbal	Grammar and Vocabulary	Finding Errors Phrase substitution	2
21			Vocabulary	2
22			Idioms and Phrases; Collocations	2
23		Blanks and Jumbles	Fill in the blanks Sentence Completion	2
24			Parajumbles/Jumbled Sentences	2
25		Reading Comprehension	Cloze Passage; Theme Detection	2
26			Reading Comprehension	2

HSS17R201 SOFT SKILLS - II	Credits			
	L	T	P	Total
	1	0	0	1
Pre-requisite: NIL	**Course Category:** Humanities and Social Sciences **Course Type:** Theory			

Sl. No.	Course	Module	Topics Covered	No: of Hrs
1	Aptitude Training	Quantitative	Number Theory- Real numbers, Divisibility, HCF and LCM, Remainder theorem, last digit, factorials, recurring decimals	2
2		Quantitative	Percentages, Profit & Loss, Discount	2
3		Quantitative	Ratio, Proportion, Allegation, Mixture, Partnership	2
4		Quantitative	Time, Speed, Distance, Trains, Boats and streams	2
5		Quantitative	Age Problem, Word Problem, Averages	2
6		Quantitative	Time & Work, pipes and cisterns	2
7		Quantitative	Mensuration 2D,Mensuration 3D, Interest calculations	2
8		Quantitative	Algebra, Clocks & Calendar	2
9		Quantitative	Probability, Permutation & Combination	2
10		Reasoning	Blood relations, Figure series	2
11		Reasoning	Series completion, cubes	2
12		Reasoning	Coding decoding, Alphabet test	2
13		Reasoning	Puzzles , Analogies	2
14		Reasoning	Syllogisms, Directions	2
15		Reasoning	Odd man out, Seating problems	2

HSS17R201 SOFT SKILLS III	Credits			
	L	T	P	Total
	1	0	0	1
Pre-requisite: NIL	**Course Category:** Humanities and Social Sciences **Course Type:** Theory			

Sl. No.	Course	Module	Topics Covered	No: of Hrs
1	Business English	Presentations	Structure	2
2			Develop and Edit	2
3			Refine and Deliver	2
4		Writing skills	Essay Writing	2
5		Expositions and Discussions	Organize Content; Emphasize Key Points	2
6			Differing Opinions; Logical Conclusions	2
7	Interview preparation and Orientation	Research and Prepare	Pre Interview Preparation	2
8			Resume Preparation	2
9		Facing Interviews	Resume Based questions; Competency Based questions	2
10			Mock Interviews	2
11		Group discussions	Group discussions	2
12			Mock GD	2
13		Corporate Rehersal	Personal Accountability; Managing self	2
14			Business Ettiquette	2
15			Team Dynamics	2

BASIC ENGINEERING

CIV17R101 BASIC CIVIL ENGINEERING	Credits			
	L	T	P	Total
	3	0	0	2
Pre-requisite: NIL	**Course Category:** Basic Engineering **Course Type:** Theory			

Course Objective(s):

To make the students know about the basic building materials and their characteristics. To know about the components of the building and prefabricated structures. To make them realize the importance of surveying and transportation systems

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the various properties of building materials.
CO2: Acquire proficiency in understanding the components of building
CO3: Understand and develop skills on basis of Surveying and GIS
CO4: Understand the importance of roads and railways
CO5: Acquire knowledge on the various types and components of bridges

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit 1: Building Materials **9 Hours**

Characteristics of good building materials such as stones, bricks, plywood, timber, cement, aggregates and concrete

Unit 2: Building Components **9 Hours**

Major components of buildings – Foundations - Purpose of a foundation – types of foundations. – Stone masonry – Hollow Block masonry. Beams – Lintels – Columns – Flooring – Damp proof course – surface finishes – Doors and windows – Roofing – Pre-fabricated structures

Unit 3: Surveying and GIS **9 Hours**

Principles and Classification of surveying, Chain surveying, Compass surveying and levelling – Introduction to remote sensing and GIS

Unit 4: Roads and Railways **9 Hours**

Classification of Roads –water bound macadam, bituminous and cement concrete roads –. Railways - Importance of railways – Gauges – Components of a permanent way

Unit 5: Bridges **9 Hours**

Bridges - Components of Culverts – Causeways, Slab Bridge, T-beam and slab bridge, Suspension bridge

Text Book(s):

1. Shanmugam, G, and Palanichamy, M.S., Basic Civil and Mechanical Engineering, McGraw Hill, 2015

REFERENCE

1. Khanna, K., Justo C E G, Highway Engineering, Khanna Publishers, Roorkee, 2014
2. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, Dhanpat Rai and Sons, New Delhi 2015.

EEE17R151 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	**Credits**			
	L	**T**	**P**	**Total**
	3	**1**	**1**	**4**
Pre-requisite: Nil	**Course Category:** Basic Engineering **Course Type:** Theory with Practical Component			

Course Objective(s):

To focus the fundamental ideas of the Electrical and Electronics Engineering by providing wide exposure to the basic concepts of Electrical and Electronics Engineering such as DC Circuits, AC Circuits, electrical machines, measuring instruments, Basic Electronic Devices and various electronic circuits such as rectifiers, amplifiers, oscillators, etc.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Apply the basic laws of electricity in DC and AC circuits
CO2: Describe the construction and operation of static and rotating electrical machines
CO3: Explain the functioning of measuring instruments and Develop the basic domestic wiring circuit.
CO4: Describe the constructional features and operation of fundamental electronic devices
CO5: Explain the characteristics of electronic circuits

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit 1: DC Circuits and AC Circuits **12 Hours**

Electrical quantities - resistors - inductors - capacitors - Ohm's Law - Kirchhoff's Laws - series and parallel circuits - analysis of DC circuits - mesh, nodal - simple problems- Sinusoidal functions - phasor representation - RMS and Average values - form and peak factors - RLC series circuits - power and power factor-concept of three phase system.

Experiment: Verification of DC circuit and AC circuit

Unit 2: Electrical Machines **12 Hours**

Construction and principle of operation of DC machines - generator, motor - single phase transformers - alternators - three phase and single phase induction motors.

Experiment: Demonstration of DC machines, alternator, transformer and single phase induction motors

Unit 3: Measurement Instruments and Wiring Circuits **12 Hours**

Moving coil and moving iron instruments - dynamometer type wattmeter - induction type energy meter, Domestic wiring - accessories - types - staircase wiring - fluorescent tube circuits - simple layout – grounding

Experiment: Measurement of voltage, current and power. Staircase wiring and fluorescent tube wiring

Unit 4: Electronic Devices **12 Hours**

Basic concepts of PN junction diodes - Zener diode - bipolar junction transistor - unipolar devices - FET, MOSFET, UJT - Thyristor–SCR and Triac, Photoelectric Devices-Photo diode and Photo transistor

Experiment: Characteristics of PN Junction diode, Zener diode

Unit 5: Electronic Circuits **12 Hours**

Half wave and full wave rectifier –Transistor as an amplifier –RC- phase shift oscillator - RC integrator and differentiator circuits - diode clampers and clippers - multivibrators - Schmitt trigger

Text Book(s):

1. V.K. Mehta, "Principles of Electrical Engineering and Electronics", S. Chand & Company Ltd, 2012
2. Kothari D P and Nagrath I J, "Basic Electrical Engineering", McGraw Hill, 2009.
3. Mithal G K, Electronic Devices & Circuits, Khanna Publications, 1997

Reference(s):

1. T. Thyagarajan, "Fundamentals of Electrical and Electronics Engineering", SciTech publications (Ind.) Pvt. Ltd., 3rd Edition, 2015.
2. Muraleedharan K.A, Muthususbramanian R and Salivahanan S, "Basic Electrical, Electronics and Computer Engineering" Tata McGraw Hill,2006.
3. Shantha kumar S.R.J, Basic Mechanical Engineering, Third Revised Edition (Reprint 2009), Anuradha Publications, Kumbakonam, 1999.
4. Rajput R. K., Basic Mechanical Engineering, Fourth edition, Tata McGraw Hill Publishing Co., New Delhi, 2007.

MEC17R105 Basic Mechanical Engineering	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**2**
Pre-requisite: Nil	**Course Category:** Basic Engineering **Course Type:** Theory			

Course Objective(s):

The aim of undergoing this course is to develop basic understanding the topics in Mechanical Engineering

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Explain the various components and equipment in boiler and turbine.
CO2: Identify the different type of energy sources and power generation
CO3: Compare the petrol and diesel engines with working principle.
CO4: Summarize the various manufacturing processes.
CO5: Interpret the machining processes on lathe, drilling machine, milling machine etc.,

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit 1: Boilers and Turbines **9 Hours**

Boilers – fire and water tube boiler - Cochran boiler, Babcock and Wilcox boiler, Lamont boiler - Boiler mountings and accessories - Steam turbine - single stage impulse turbine, Compounding of impulse turbine, Parson's reaction turbine, difference between impulse and reaction turbines

Unit 2: Power Plants **9 Hours**

Conventional power plants – steam, nuclear, diesel, hydroelectric, pumped storage power plants – Unconventional power plants - solar, wind, tidal, bio gas, geothermal, ocean thermal energy conversion

Unit 3: Internal Combustion (IC) Engine **9 Hours**

IC engine - components, working of four stroke diesel and petrol engine – working of two stroke petrol and diesel engines – difference between SI and CI engine, Engine cooling system- air cooling and water cooling systems

Unit 4: Metal Casting and Metal Joining Process **9 Hours**

Metal casting process –patterns, green sand moulding, cupola furnace – Metal forming process - forging – rolling – extrusion – drawing - Metal joining process – arc welding, gas welding, resistance welding, brazing and soldering

Unit 5: Conventional and CNC Machining Process **9 Hours**

Metal machining process – basic components of lathe, drilling machine, milling machine, shaping machine, planning machine and its operations - work holding devices and tool holding devices - Introduction to Computer Numerical Control machining

Text Book(s):

1. Venugopal K., Prabhu Raja V., Basic Mechanical Engineering, 6th Edition (Reprint 2009), Anuradha Publications, Kumbakonam

Reference(s):

1. Shanmugam G, Basic Mechanical Engineering, Third edition, McGraw Hill Publishing Co., New Delhi, ISBN: 9780070681866, 2004
2. Shanthakumar S.R.J, Basic Mechanical Engineering, Third Revised Edition (Reprint 2009), Anuradha Publications, Kumbakonam, 1999
3. Rajput R. K., Basic Mechanical Engineering, Fourth edition, McGraw Hill Publishing Co., New Delhi, 2007.

MEC17R101 ENGINEERING DRAWING	Credits			
	L	T	P	Total
	1	0	3	2
Pre-requisite: Nil	**Course Category:** Basic Engineering **Course Type**: Theory			

Course Objective(s):

This course aims to introduce the concept of graphic communication, develop the drawing skills for communicating concepts, ideas and designs of engineering products, Demonstrate skills in interpreting, and producing engineering drawings accurately and to give exposure to national standards relating to engineering drawing

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Create the projection of points and lines

CO2: Build the planes and solid objects

CO3: Illustrate the principles of sectioning of prisms, pyramids etc.

CO4: Develop surfaces of solids.

CO5: Apply orthographic and isometric projections.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit 1: Projection of Points and Straight Lines **9 Hours**

Importance of graphics – use of drafting instruments – BIS conventions and specifications – size, layout and folding of drawing sheets – lettering dimensioning and scales - Projection of points, located in all quadrants - projection of straight lines located in the first quadrant, determination of true lengths and true inclinations

Unit 2: Projection of Planes and Solids **9 Hours**

Projection of polygonal surface and circular lamina located in first quadrant inclined to one or both reference planes-Projection of solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method

Unit 3: Section of Solids **9 Hours**

Section of simple solids like prisms, pyramids, cylinder and cone in vertical position by cutting planes inclined to any one of the reference planes, obtaining true shape of section

Unit 4: Development of Surfaces **9 Hours**

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones

Unit 5: Orthographic and Isometric Projection **9 Hours**

Orthographic principles – missing view - free hand sketching in first angle projection from pictorial views. Principles of isometric projection – isometric view and projections of simple solids, truncated prisms, pyramids, cylinders and cones.

Text Book(s):

1. Basant Aggarwal and C. Aggarwal, Engineering Drawing, McGraw-Hill, 2008.
2. N.S. Parthasarathy, Vela Murali, Engineering Drawing, Oxford University Press, 2015.

Reference(s):

1. Shah, M.B., and Rana, B.C., Engineering Drawing, Pearson 2009
2. Natarajan, K.V., A Text Book of Engineering Graphics, 21st Edition, Dhanalakshmi Publishers, Chennai, 2012.
3. Bhatt, N.D., Engineering Drawing, Charotar publishing House, New Delhi, 53trd Edition, 2016.
4. Luzadder and Duff, "Fundamentals of Engineering Drawing", Prentice Hall of India Pvt. Ltd., 2009.
5. Venugopal, K., Engineering Graphics, New Age International (P) Limited, 2009

MEC17R103 ENGINEERING MECHANICS	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: Nil	**Course Category:** Basic Engineering **Course Type:** Theory			

Course Objective(s):

- To understand the vectorial and scalar representation of forces and moments.
- To apply static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions.
- To comprehend the effect of friction on equilibrium.
- To understand the properties of surfaces and solids
- To write the dynamic equilibrium equation

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Explain the vectorial and scalar representation of forces and moments.

CO2: Apply static equilibrium of particles and rigid bodies both in two dimensions and in three dimensions.

CO3: Contrast the effect of friction on equilibrium.

CO4: Illustrate the importance of properties of surfaces and solids.

CO5: Demonstrate the dynamic equilibrium equation.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit 1: Statics of Particles **9 Hours**

Six Fundamental principles and concepts - vector algebra- basics, concurrent and non-concurrent coplanar forces - resultant and resolution of forces- static equilibrium of particles in 2-D and 3-D

Unit 2: Static of Rigid Bodies **9 Hours**

Moment about point and about axis - Varignon's theorem - Static equilibrium of rigid body in 2-D and 3-D, free body diagram, supports and reactions – Problem formulation concept in 2-D and 3-D- Ball and socket joint.

Unit 3: Friction **9 Hours**

Frictional forces- Types- laws of dry friction- simple contact friction - Sliding block, wedges, ladder friction - rolling resistance –Examples.

Unit 4: Properties of Surfaces and Solids **9 Hours**

Centre of gravity – T section, I section- Centroids of lines - areas, volumes, composite bodies, - Area moment of Inertia – T section, I section-principal moment of inertia

Unit 5: Dynamics of Particles **9 Hours**

Introduction – Kinematics of particles – Displacements, velocity and acceleration, their relationship - Equations of motions– Rectilinear motions - relative motion – Curvilinear motion –Kinetics of particles - Newton's second law – Equations of motion – rectangular components – Work Energy equation of particles.

Text Book(s):

1. Beer, F.P., and Johnson, E.R., Vector Mechanics for Engineers – Statics and Dynamics, McGraw Hill, Tenth Edition in SI units

Reference(s):

1. Merriam, J.L., Engineering Mechanics, Volume I – Statics, and Volume – II, Dynamics 2/e, Wiley International, Seventh Edition.
2. Irving, H., Shames, Engineering Mechanics, Statics and Dynamics, Prentice Hall of India Ltd., Fourth Edition

CSE17R171 PROGRAMMING LANGUAGES	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**2**	**3**
Pre-requisite: Nil	**Course Category:** Basic Engineering **Course Type:** Integrated Course			

Course Objective(s):

To make the students to understand the basic concepts of programming language, rules to be followed while writing a C program and how to compile and execute C programs.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Interpret the basic programming concepts and syntax of C language
CO2: Solve simple problems using C arrays and strings.
CO3: Apply modular programming concept of C to solve given problem
CO4: Develop efficient code using memory allocation techniques.
CO5: Create user defined data types and files to solve real world problems.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit 1: Basics of C **9 Hours**

Structure of C program - concept of a variable-Data type in C - Program Statement - Declaration – Tokens - Operators and expressions - Type Conversion - Input and output - Control statements: Selection - Iteration - Goto statement - Special control statement-Nested loops

Unit 2: Arrays and Strings **9 Hours**

Introduction - One dimensional and two dimensional arrays – Declaration of arrays - Initializing and Accessing array elements – Strings: One dimensional character arrays - Declaration and String Initialization - String Manipulation - Multidimensional Arrays - Arrays of Strings

Unit 3: Functions **9 Hours**

Introduction - Concept of function - Using Functions - Call by Value Mechanisms -Working with Functions - Passing Arrays to Functions - Scope and Extend - Storage Classes - Inline Functions – Sorting Using Functions: Bubble sort - Searching: Linear and Binary Search – Recursive Functions

Unit 4: Pointers **9 Hours**

Introduction - Address of operands – Pointer: Declaration and Initialization - Arrays and Pointers - Pointers and Strings - Pointer Arithmetic - Pointers to Pointers - Array of Pointers - Pointer to Array - Dynamic Memory Allocation (DMA)

Unit 5: User Defined Data Types and Files **9 Hours**

Introduction – Structures - Declaration and Initialization of Structures - Arrays within Structure - Structure and Pointers - Structures and Functions – Union - Enumeration types - Using Files in C - Working with Text Files - Working with binary files

Experiments: **15 Hours**

1. Programs using control and looping statements.
2. Programs using 1-D and 2-D arrays.
3. Programs using string handling functions.
4. Programs using functions with various parameter passing mechanisms.
5. Programs using recursive functions.
6. Programs using pointers and dynamic memory allocation functions for 1-D and 2-D arrays.
7. Programs to create user defined data like structures and unions to represent real world problems
8. Programs for creating text files to store and manipulate data

Text Book(s):

1. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", Oxford University Press, 2nd Edition, 2013.
2. Byron S. Gottfried, "Programming with C", Second Edition, McGraw Hill, 2006

Reference(s):

1. Brian W. Kerninghan and Dennis M. Richie, "The C Programming language", Pearson Education, 2005.
2. Johnsonbaugh R. and Kalin M, "Applications Programming in ANSI C", Third Edition, Pearson Education, 2003.
3. E. Balagurusamy, "Programming in ANSI C", Fourth Edition, McGraw Hill 2008

MEC17R181 ENGINEERING PRACTICE LABORATORY	**Credits**			
	L	**T**	**P**	**Total**
	0	**0**	**3**	**2**
Pre-requisite: Nil	**Course Category:** Basic Engineering **Course Type:** Laboratory Course			

Course Objective(s):

To make the student familiarize with the workshop process and to gain some basic knowledge about the carpentry, fitting and etc

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Develop various joints in wood and understand their applications in typical wooden products

CO2: Construct simple mating profiles with saw process and perform various machining operations like drilling, tapping, etc.

CO3: Build pipe connections with mixed pipe materials and different joining components.

CO4: Examine the LPG stove and perform troubleshooting and cleaning operation.

CO5: Inspect two-wheeler and four-wheeler for repairs and perform the basic diagnosing process.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

List of Experiments: 45 Hours

Carpentry

Carpentry tools - practice in marking, sawing, planning and chiselling – making simple joints: lap joint, T-joint, dovetail joint, mortise and tenon joint

Fitting

Fitting tools - practice in marking, filing, punching, hacksawing - fitting to size and drilling - making of simple mating profiles: V, square, dovetail, half round joints

Sheet Metal and Drilling

Study of press, die and tools - sheet metal layout - development of lateral surfaces -simple exercises: blanking, forming, bending and flanging, Drilling and tapping in drilling machines

Plumbing

Basic pipe connections-Mixed Pipe material connection-Pipe connection with different joining

LPG Stove

Troubleshooting LPG stoves -Practice in dismantling and cleaning procedures

UPS Battery Maintenance

Batteries-Lead acid battery cleaning and acid topping up- Testing with hydrometer, Voltmeter.

Two-Wheeler Service

Study of engine oil types- replacement- Setting engine idle speed, Clutch ply adjustment. Air filter cleaning methods – Practice on adjusting chain tension, carburettor adjustment

Four-Wheeler Tyre Repairs

Study of Tyres – Dimensions - Diagnosing four-wheeler puncture in Tube tyres, Tubeless tyres.

Reference(s):

1. Suyambazhahan S, “Engineering Practices”, Eastern Economy Edition, 2013.

PROGRAM CORE

MEC17R271 STRENGTH OF MATERIALS	Credits			
	L	T	P	C
	3	0	3	5
Pre-requisite: MEC17R103	**Course Category:** Program Core **Course Type:** Integrated Course			

Course Objective(s):

Students will be able to understand the concepts of deformable bodies including geometry of deformation, and material behaviour. Revelations to systematic methods of problem solving techniques. Knowledge on solving structural members subjected to the different types of loading.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Analysing the tensile and compressive strength in bars using various loads, testing the stresses using loads in different materials.

CO2: Evaluating the principal plane and stresses in two dimensional bodies and analyse the deformation in thin cylindrical and spherical shells.

CO3: Demonstrate the types of beams and supports, sketch the shear force and bending moment diagram in various loads and testing the deflections in various beams.

CO4: Analysing the stress distribution of shear and bending in the various section of the beams.

CO5: Illustrate the stress and deformation in circular structures due to combined bending and strain energy, testing the torsion on mild steel and designing the various types of springs.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit 1: Stress, Strain and Deformation in Solids **12 Hours**

Tension, compression and shear stresses – Hook's law – stress- ultimate stress and working stress – elastic constants and relationships between them – composite bars – temperature stresses – strain energy due to axial load – stress due to suddenly applied load and impact load.

Unit 2: Stress and Deformation in 2D Bodies **12 Hours**

Two dimensional state of stress at a point – normal and shear stresses on any plane, principal planes and principal stresses – graphical method – two dimensional state of strains at a point, principal strains and their directions – stresses and deformations in thin cylinders and spherical shells due to internal pressure.

Unit 3: Beams and Supports **12 Hours**

Types of beams and supports – shear force and bending moment at any cross section, sketching of shear force and bending moment diagrams for cantilever, simply supported and over hanging beams for any type of loading – relationship between rates of loading – shear force and bending moment.

Unit 4: Stresses in Beams **12 Hours**

Theory of simple bending – analysis for bending stresses – load carrying capacity of beams – proportioning sections – strain energy due to bending moment – shear stress distribution – strain energy due to transverse shear force.

Unit 5: Torsion and Springs **12 Hours**

Elastic theory of torsion – stresses and deformation in solid circular and hollow shafts – stepped shafts – composite shaft – stress due to combined bending and torsion– strain energy due to torsion-deformations and stresses in helical springs – design of buffer springs -leaf springs.

Name of the Experiments: **15 Hours**

1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Impact test on metal specimen
4. Hardness test on metals - Brinell and Rockwell hardness number
5. Deflection test on beams
6. Stiffness test on helical springs.
7. Corrosion test on mild steel plate.
8. Pin on disk – exercise on mild steel plate.

Text Book(s):

1. Popov, E.P., Engineering Mechanics of solids, Prentice Hall of India, New Delhi, 8thEdition 2014.

Reference(s):

1. Kazimi, S. M. A., Solid Mechanics, Tata McGraw Hill Book Co Ltd., 1998.
2. Rajput, Strength of Materials, S. Chand Publications, 2009.
3. Bansal, R. K., Strength of Materials, Laxmi Publications, 4th Edition, 2015

MEC17R272 FLUID MECHANICS & MACHINERY	Credits			
	L	T	P	C
	3	0	3	5
Pre-requisite: MAT17R101	**Course Category:** Program Core **Course Type:** Integrated Course			

Course Objective(s):

- To cover the basic principles and equation of fluid mechanics and to present numerous and diverse real world engineering examples to give students a feel for how fluid mechanics is applied in engineering practice.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Identity different properties of fluid and predicting the different types of pressure measuring devices for difference application

CO2: Interpret the kinematics and dynamics of fluid flow and analyze the Bernoulli's equation to real time problem.

CO3: Judging the different types of losses occurs in a pipe when fluid flows.

CO4: Contrast the working principle of different turbines and analyze the performance calculation of different turbines

CO5: Categories the working principles of different pumps and focus the performance calculation of different pump.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit1: Basic Concepts and Properties **9 Hours**

Fluid – definition, distinction between solid and fluid - units and dimensions, properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - fluid statics - concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers.

Unit2: Fluid Kinematics and Fluid Dynamics **9 Hours**

Fluid kinematics - flow visualization, lines of flow, types of flow, velocity field and acceleration, continuity equation (one and three dimensional differential forms) - equation of streamline, stream function, velocity potential function, circulation, flow net, fluid dynamics - equations of motion, Euler's equation along a streamline, Bernoulli's equation, applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis - Buckingham's theorem applications - similarity laws and models.

Unit3: Incompressible Fluid Flow **9 Hours**

Viscous flow - Navier-Stoke's equation (Statement only) - shear stress, pressure gradient relationship - laminar flow between parallel plates, Laminar flow through circular tubes (Hagen Poiseulle's) - Hydraulic and energy gradient - flow through pipes - Darcy - Weisback's equation - friction factor

minor losses – flow through pipes in series and in parallel - power transmission - boundary layer flows, boundary layer thickness, boundary layer separation.

Unit4: Hydraulic Turbines **9 Hours**

Fluid machines-definition and classification - exchange of energy - Euler's equation for turbo machines - construction of velocity vector diagrams - head and specific work - components of energy transfer - degree of reaction. Hydro turbines- definition and classifications - Pelton wheel, Francis turbine, propeller turbine , Kaplan turbine – working principles - velocity triangles, work done, specific speed, efficiencies, performance curve for turbines.

Unit5: Hydraulic Pumps **9 Hours**

Pumps- definition and classifications - Centrifugal pump - classifications, working principle, velocity triangles, specific speed, efficiency and performance curves - reciprocating pump classification, working principle, indicator diagram, work saved by air vessels and performance curves - cavitations in pumps - rotary pumps - working principles of gear and vane pumps, performance of positive displacement pump.

Name of the Experiments: **15 Hours**

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturimeter.
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 Kaplan turbine

Text Book(s):

1. Streeter, V.L., and Wylie, E.B., Fluid Mechanics, McGraw-Hill, 2010.

Reference(s):

1. Kumar, K.L., Engineering Fluid Mechanics, Eurasia Publishing House (P) Ltd, New Delhi, 7th edition, 2002.
2. Vasandani, V.P., Hydraulic Machines - Theory and Design, Khanna Publishers, 11th Edition 2010.
3. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi publications (P) Ltd, New Delhi, 9th edition,2010.
4. White, F.M., Fluid Mechanics, Tata McGraw-Hill, c, 5th Edition, 2003.
5. Ramamirtham, S., Fluid Mechanics and Hydraulics and Fluid Machines, Dhanpat Rai and Sons, Delhi, 3rd edition 1998.
6. Som, S.K., and Biswas, G., Introduction to Fluid Mechanics and Fluid Machines, Tata McGrawHill, New Delhi, 3rd Edition, 2011.

AER17R271	AERO THERMODYNAMICS	L	T	P	C
		3	0	3	5
Pre-requisite: CHY17R171	**Course Category:** Program Core **Course Type:** Integrated Course				

Course Objective(s):

Enable the students to understand the basic principles and concepts of classical thermodynamics

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Comprehend the basic thermodynamic systems.

CO2: Infer the concepts of second law of thermodynamics and Carnot cycle.

CO3: Interpret the one dimensional fluid flow and the application of continuity equation and Rankine cycle.

CO4: Illustrate about air standard cycles and P-V diagrams of four stroke and two stroke IC engines.

CO5: Demonstrate the principles of refrigeration and air conditioning.

Mapping of Course Outcome(s):

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

UNIT I FIRST LAW OF THERMODYNAMICS 9

Concept of continuum-Macroscopic approach-thermodynamic systems-properties-state, path and process, quasi-static process- work and heat-zeroth law and first law of thermodynamics-internal energy-enthalpy-applications of first law of thermodynamics to closed and open system.

UNIT II SECOND LAW OF THERMODYNAMICS 10

Second law of thermodynamics-Kelvin's and Clausius statements of second law-reversibility and irreversibility-carnot theorem-carnot cycle- reversed carnot cycle- clausius inequality-concept of entropy-principle of energy-availability and unavailability-Exergy for closed and an open systems.

UNIT III PROPERTIES OF PURE SUBSTANCES AND POWER CYCLE 8

Properties of pure substances-Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, H-S diagrams, PVT surfaces thermodynamics properties of steam, calculations of work done and heat transfer in non-flow and flow processes. Standard Rankine cycle, Reheat and Regeneration cycle.

UNIT IV AIR STANDARD CYLCES AND IC ENGINES 9

Cycle-air standard efficiency-Otto cycle-diesel cycle- dual cycle- Brayton cycle-components of IC engines-Two stroke and four stroke cycle engine-performance of IC engine-supercharging.

UNIT V REFRIGERATION, AIR CONDITIONING AND PSYCHROMETRY 9

Concepts of psychrometry, Psychrometric relation and charts-processes-Refrigeration systems- Air-conditioning systems and its types- simple vapour compression system-vapour absorption system-Refrigerants.

TEXT BOOKS:

1. Nag.P.K., "Engineering Thermodynamics", McGraw Hill Education (India) Private Limited; Fifth edition ,April 2013.

2. Rathakrishnan E, “Fundamentals of Engineering Thermodynamics”, Prentice Hall India, 2 revised edition 2005.
3. Yunus A. Cengel and Michael A. Boles, “Thermodynamics: An Engineering Approach” McGraw-Hill Science/Engineering/Math; 7th edition 2010.

REFERENCES:

1. Ramalingam K.K. “Thermodynamics”, Sci-Tech Publications, 2006
2. Holman.J.P., “Thermodynamics”, 3rd Ed. McGraw-Hill, 2007.
3. Venwylen and Sontag, “Classical Thermodynamics”, Wiley Eastern, 1987
4. Arora C.P, “Thermodynamics”, Tata McGraw-Hill, New Delhi, 2003.
5. Merala C, Pother, Craig W, Somerton, “Thermodynamics for Engineers”, Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.

AER17R101 Principles of Flight	**Credits**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
Pre-requisite: Nil	**Course Category:** Program Core **Course Type:** Integrated course			

Course Objective(s):

Understand the basic concepts of Aeronautical Engineering and current development in the field.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: explain the history of aircraft and development over the years.
CO2: classify the components, control systems of aircraft and its functions
CO3: outline the basic concepts of flight and physical properties of atmosphere.
CO4: categorize the types of fuselage construction and landing gear system
CO5:demonstrate the different types of engines and principles of rocket.

Mapping of Course Outcome(s):

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

UNIT I HISTORY OF FLIGHT 8

Balloon flight-ornithopters-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II AIRCRAFT CONFIGURATIONS AND ITS CONTROLS 10

Different types of flight vehicles, classifications-Components of an airplane and their functions-Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation.

UNIT III BASICS OF AERODYNAMICS 9

Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude relationships, Newton’s Law of Motions applied to Aeronautics-Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers.

UNIT IV BASICS OF PROPULSION 9

Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production-Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

UNITV BASICS OF AIRCRAFT STRUCTURES 9

General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials. Stresses and strains-Hooke's law- stress-strain diagrams- elastic constants-Factor of Safety.

TEXT BOOKS

1. Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition , 2015
2. Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.

REFERENCES

1. Kermode, A.C. Flight without Formulae, Pearson Education; Eleven edition, 2011

AER17R251 KINEMATICS AND DYNAMICS OF MACHINES	**L**	**T**	**P**	**C**
	3	**1**	**0**	**3**
Pre-requisite: MEC17R103	**Course Category:** Program Core **Course Type:** Theory with Practical			

Course Objective(s):

To expose the students the different mechanisms, their method of working, forces involved and consequent vibration during working.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Relate the various mechanisms and degrees of freedom.

CO2: Illustrate the effects of centrifugal and initial tension in drives and condition for maximum power transmission.

CO3: Determine the speed and torque of the various types of gear geometry and also the follower motions of cam profile.

CO4: Comprehend the concepts of balancing in rotating mass and balancing of reciprocating mass.

CO5: Examine the free, forced and damped vibrations and its force transmitted to supports.

Mapping of Course Outcome(s):

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

UNIT I MECHANISMS 12

Definition – Machine and Structure – Kinematic link, pair and chain – classification of Kinematic pairs – Constraint and motion – Degrees of freedom - Slider crank – single and double – Crank rocker mechanisms – Inversions, applications – Introduction to Kinematic analysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms.

UNIT II FRICTION 12

Types of friction – friction in screw and nut – screw jack – pivot, collar and thrust bearings – plate and cone clutch – belt (Flat and V) and rope drives – creep in belts – open and crossed belt drives – Ratio of tensions – Effect of centrifugal and initial tensions – condition for maximum power transmission.

UNIT III GEARS AND CAMS 12

Gear – Types and profile – nomenclature of spur and helical gears – laws of gearing – interference – requirement of minimum number of teeth in gears – gear trains – simple, compound and reverted gear trains – determination of speed and torque in epicyclic gear trains – cams different types of followers – Cam – Types of cams and followers – Cam design for different follower motions.

UNIT IV VIBRATION 12

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multirotor systems – geared shafts – critical speed of shafts.

UNIT V BALANCING 12

Static and dynamic balancing – single and several masses in different planes – primary and secondary balancing of reciprocating masses – Balancing of single and multi cylinder engines – Governors and Gyroscopic effects.

TEXT BOOKS:

1. Bansal R.K., "Theory of Machines", Laxmi Publications Pvt Ltd., New Delhi, 20th edition 2009.
2. Rattan S.S., "Theory of machines", Tata McGraw Hill publishing Co., New Delhi, 2nd edition 2011.

REFERENCES:

1. Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory", Second Edition, Wiley Eastern Limited, 2006.
2. Malhotra D.R. and Gupta H.C , "The Theory of machines", Satya Prakasam, Tech. India Publications, 2008.
3. Gosh A and Mallick A.K., "Theory of Machines and Mechanisms", Affiliated East West press, 2009.
4. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw Hill, 2006.

AER17R201 Aerodynamics I	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: MEC17R272	**Course Category:** Program core **Course Type:** Theory			

Course Objective(s):

To study aerodynamic concepts and understanding the motion of air around an object enables the calculation of forces and moments acting on the object.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Relate fluid mechanics concepts with aerodynamic problems
CO2: Examine the flow over wing.
CO3: Differentiate the ideal and real flows.
CO4: develop the mathematical modelling ability
CO5: demonstrate the real time viscous flow and boundary layer behavior.

Mapping of Course Outcome(s):

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

UNIT I REVIEW OF BASIC FLUID MECHANICS 10

System and Control volume approach, substantial, local and convective derivative, Continuity, momentum and energy equations, Inviscid flow, Euler equation, incompressible Bernoulli's Equation. Circulation and Vorticity, Green's Lemma and Stoke's Theorem, Barotropic Flow, Kelvin's theorem, Streamline, Stream Function, Irrotational flow, Potential Function, Equipontential Lines, Elementary Flows and their combinations.

UNIT II TWO DIMENSIONAL INVISCID INCOMPRESSIBLE FLOW 8

Ideal Flow over a circular cylinder, D'Alembert's Paradox, Magnus effect, Kutta Joukowski's Theorem, Starting Vortex, Kutta condition, Real flow over smooth and rough cylinder.

UNIT III AIRFOIL THEORY 9

Cauchy-Riemann relations, Complex Potential, Methodology of Conformal Transformation, Kutta-Joukowski transformation and its applications, Karman Trefftz Profiles, Thin Airfoil theory and its applications.

UNIT IV SUBSONIC WING THEORY 8

Vortex Filament, Biot - Savart Law, Bound Vortex and trailing Vortex, Horse Shoe Vortex, Lifting Line Theory and its limitations.

UNIT V INTRODUCTION TO LAMINAR AND TURBULENT FLOW 10

Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, Energy thickness, Shape parameter, Boundary layer equations for a steady, two dimensional incompressible flow, Boundary Layer growth over a Flat plate, Critical Reynolds Number, Blasius solution, Basics of Turbulent flow, Prandtl's mixing length hypothesis, Free shear layers.

TEXTBOOKS:

1. E. L. Houghton & N. B. Carruthers, "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 1989.
2. Anderson, J.D., Fundamentals of Aerodynamics, McGraw-Hill Education; 5th edition, 2010.

REFERENCES:

1. Milne Thomson, L.H., Theoretical Aerodynamics, Macmillan, 1985.
2. John J Bertin., Aerodynamics for Engineers, Prentice Hall publishers6th edition, 2013.
3. Clancy, L J., Aerodynamics, Shroff publishers2006

AER17R202 AIRCRAFT STRUCTURES – I	Credits			
	L	T	P	C
	3	0	0	3
Pre-requisite: MEC17R271	**Course Category:** Program core **Course Type:** Theory			

Course Objective(s):

To analyze and design simple aircraft structural components.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: solve statically indeterminate structures.
CO2: make simplified analysis of aircraft structures and apply energy methods.
CO3: determine the critical buckling load of columns.
CO4: relate failure theories with aircraft structural problems.
CO5: design the various joints for loading conditions.

Mapping of Course Outcome(s):

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

UNIT I ANALYSIS OF TRUSSES AND BEAMS 9

Plane truss analysis, plane frame analysis, analysis of a 3-D truss, analysis of continuous beams using Clapeyron's 3-moment equation.

UNIT II ENERGY METHODS OF ANALYSIS 9

Energy expression for various loadings and its application to statically determinate and indeterminate beams, trusses, frames and rings.

UNIT III BUCKLING OF COLUMNS 9

Buckling of Long column and short column- inelastic buckling- columns with different end conditions, empirical methods, the Southwell plot, use of Energy methods, imperfections in columns, stresses and deflections in a beam-column.

UNIT IV FAILURE ANALYSIS 9

Failure of Ductile and brittle materials, Theories of failure and their Failure envelopes, Introduction to fatigue failure and fracture mechanics of materials.

UNIT V DESIGN OF JOINTS 9

Types of joints and rivets. Failure of joints. Design of bolted joints. Stresses in bolts and nuts due to various loadings - Axial load, shear load and combined loading. Types of welded joints.
Strength of welded joints for various loadings

TEXT BOOKS:

1. 'Mechanics of Materials' by James M. Gere & Barry J Goodno, cengage Learning Custom Publishing; 8th edition, 2012.
2. Megson T M G, `Aircraft Structures for Engineering students' Butterworth-Heinemann publisher, 5th edition, 2012.

3. N.C. Pandya, C.S. Shah, "Elements of Machine Design", Charotar Publishing House, 15th edition, 2009.

REFERENCES:

1. Donaldson, B.K., 'Analysis of Aircraft Structures - An Introduction' Cambridge University Press publishers, 2nd edition , 2008
2. Bruhn E F, 'Analysis and Design of Flight Vehicle Structures', Tri-State Off-set Company, USA, 1985
3. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999.

AER17R203 AIRCRAFT SYSTEMS AND INSTRUMENTS	**Credits**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
Pre-requisite:PHY17R171	**Course Category:** Program core **Course Type:** Theory			

Course Objective(s):

To make the student to understand the principle and working of aircraft systems and instruments.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Explain schematic diagram of a hydraulic system for a modern aircraft and explain its function.
CO2: Comprehend the working principle of modern control system & its advantages
CO3: Describe the various systems of piston & gas turbine engines and the purpose of each system
CO4: Describe the working principle of air conditioning system & fire protection system
CO5: Understand the working principle of aircraft instruments and engine instruments in detail

Mapping of Course Outcome(s):

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

UNITI AIRCRAFT SYSTEMS 9

Hydraulic systems – Study of typical systems – components – Hydraulic systems controllers – Modes of operation – Pneumatic systems – Working principles – Typical Pneumatic Power system – Brake system – Components, Landing Gear Systems – Classification – Shock absorbers – Retractive mechanism.

UNITII AIRPLANE CONTROL SYSTEMS 10

Conventional Systems – Power assisted and fully powered flight controls – Power actuated systems – Engine control systems – Push pull rod system – operating principles – Modern control systems – Digital fly by wire systems – Auto pilot system, Active Control Technology.

UNITIII ENGINE SYSTEMS 9

Piston and Jet Engines- Fuel systems – Components - Multi-engine fuel systems, lubricating systems – Starting and Ignition systems.

UNITIV AIRCONDITIONING AND PRESSURIZING SYSTEM 8

Basic Air Cycle systems – Vapour Cycle Systems, Boot-strap air cycle system – Evaporative vapour cycle systems – Evaporation air cycle systems – Oxygen systems – Fire extinguishing system and smoke detection system, Deicing and anti-icing system.

UNITV AIRCRAFT INSTRUMENTS 9

Flight Instruments and Navigation Instruments – Accelerometers, Air speed Indicators – Mach Meters – Altimeters - Gyroscopic Instruments– Principles and operation – Study of various types of engine instruments – Tachometers – Temperature and Pressure gauges.

TEXT BOOKS

1. Mekinley, J.L. and R.D. Bent, Aircraft Power Plants, McGraw Hill 1993.
2. Pallet, E.H.J. Aircraft Instruments & Principles, Pitman & Co 1993.

REFERENCES

1. Teager, S, "Aircraft Gas Turbine technology, McGraw Hill 1997.
2. McKinley, J.L. and Bent R.D. Aircraft Maintenance & Repair, McGraw Hill, 1993.
3. Handbooks of Airframe and Power plant Mechanics, US dept. of Transportation, Federal, Aviation Administration, the English Book Store, New Delhi, 1995.

AER17R205 PROPULSION- I	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: AER17R271	**Course Category:** Program core **Course Type:** Theory			

Course Objective(s):

To study in detail about the fundamentals of aircraft propulsion. To understand the principles of operation and design of aircraft power plants.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Comprehend the working principle of gas turbine engines, thermodynamic cycles and performance characteristics of gas turbine engines

CO2: Interpret the internal flows & external characteristics near the inlets. Starting problems and different modes of operation in supersonic inlets

CO3: Classify the types and working methods in combustion chambers. The flame stabilization and flame techniques

CO4: Summarize the flow through the nozzle, choking, losses in nozzle, variable area nozzle and thrust vector control

CO5: Know the types and working principles of compressors, velocity diagrams, blade design and performance characteristics of compressor

Mapping of Course Outcome(s):

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

UNIT I FUNDAMENTALS OF GAS TURBINE ENGINES 8

Illustration of working of gas turbine engine – The thrust equation – Factors affecting thrust – Effect of pressure, velocity and temperature changes of air entering compressor – Methods of thrust augmentation – Characteristics of turboprop, turbofan and turbojet – Performance characteristics.

UNIT II INLETS 9

Internal flow and Stall in subsonic inlets – Boundary layer separation – Major features of external flow near a subsonic inlet – Relation between minimum area ratio and eternal deceleration ratio – Diffuser performance – Supersonic inlets – Starting problem on supersonic inlets – Shock swallowing by area variation – External declaration – Models of inlet operation.

UNIT III COMBUSTION CHAMBERS 9

Classification of combustion chambers – Important factors affecting combustion chamber design – Combustion process – Combustion chamber performance – Effect of operating variables on performance – Flame tube cooling – Flame stabilization – Use of flame holders – Numerical problems.

UNIT IV NOZZLES 9

Theory of flow in isentropic nozzles – Convergent nozzles and nozzle choking –Nozzle throat conditions – Nozzle efficiency – Losses in nozzles – Over expanded and under – expanded nozzles – Ejector and variable area nozzles – Interaction of nozzle flow with adjacent surfaces – Thrust reversal.

UNIT V COMPRESSORS 10

Principle of operation of centrifugal compressor – Work done and pressure rise – Velocity diagrams – Diffuser vane design considerations – Concept of prewhirl – Rotation stall – Elementary theory of axial flow compressor – Velocity triangles – degree of reaction – Three dimensional – Air angle distributions for free vortex and constant reaction designs – Compressor blade design – Centrifugal and Axial compressor performance characteristics.

TEXT BOOKS:

1. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Pearson education (2009)

REFERENCES:

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Pearson Education Canada; 6th edition, 2008.
2. Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York, 1985.
3. "Rolls Royce Jet Engine", Rolls Royce; 4th revised edition, 1986.
4. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion",
5. Standard Publishers & Distributors, Delhi, 2nd edition 2014.

AER17R281 Aerodynamics Laboratory	**Credits**			
	L	**T**	**P**	**Total**
	1	**0**	**3**	**2**
Pre-requisite: AER17R201	**Course Category:** Program core **Course Type:** Laboratory			

Course Objective(s):

To study experimentally the aerodynamic forces on different bodies at low speeds

Course Outcome(s):

After completing this course, the student will be able to:

CO1: calibrate the subsonic and supersonic wind tunnels.

CO2: determine the pressure distribution over a smooth and rough cylinder
CO3: define the pressure distribution over a symmetric and cambered airfoil
CO4: conduct a flow visualization studies in both subsonic and supersonic flows.
CO5: find pressure distribution over a finite wing of symmetric and cambered airfoil sections

Mapping of Course Outcome(s):

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

List of experiments:

1. Calibration of a subsonic wind tunnel
2. Pressure distribution over a smooth circular cylinder
3. Pressure distribution over a rough circular cylinder
4. Pressure distribution over a symmetric airfoil
5. Pressure distribution over a cambered airfoil
6. Flow visualization studies in subsonic flows,
7. Force measurements on aircraft models
8. Calibration of supersonic wind tunnels
9. Flow visualization studies in supersonic flows
10. Pressure distribution over a finite wing of symmetric aero foil sections
11. Pressure distribution over a finite wing of cambered aero foil section

AER17R282 Aircraft Component Drawing Laboratory	**Credits**			
	L	**T**	**P**	**Total**
	1	**0**	**3**	**2**
Pre-requisite: MEC17R101	**Course Category:** Program core **Course Type:** Laboratory			

Course Objective(s):

To introduce the concept of design of basic structural components and to draft both manually and using modelling package.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: design the riveted lab butt joints
CO2: design the welded and bolted joints
CO3: design the empennage of an aircraft
CO4: design the aircraft wing, fuselage, landing gear using design software.
CO5: design the aircraft control system.

Mapping of Course Outcome(s):

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

LIST OF EXPERIMENTS:

1. Design of riveted joints (Lap joint).
2. Design of riveted joints (Butt joint with single and double straps).
3. Design of welded joints.
4. Design of bolted joints.
5. Design of empennage.
6. Computer aided modeling of typical aircraft wing.
7. Computer aided modeling of typical fuselage structure.
8. Computer aided modeling of landing gear
9. Three view diagram of a typical aircraft
10. Layout of control systems.

AER17R301 AERODYNAMICS-II	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: AER17R201	**Course Category:** Program Core **Course Type:** Theory			

Course Objective(s):

To understand the behavior of air flow both internal and external in compressible flow regime with particular emphasis on supersonic flows

Course Outcome(s):

After completing this course, the student will be able to:

CO1: outline the fundamental aspect of compressible flow
CO2: Dissect the physics of shock and expansion waves
CO3: Solve the equations of two dimensional compressible flow
CO4: Find the factors affecting aircraft configurations
CO5: Categorize high speed flows, and flow visualization techniques

Mapping of Course Outcome(s):

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

UNIT I FUNDAMENTAL ASPECTS OF COMPRESSIBLE FLOW **8**

Compressibility, Continuity, Momentum and energy equation for steady one dimensional flow- compressible Bernoulli's equation-Calorically perfect gas, Mach Number, Speed of sound, Area – Mach number – Velocity relation, Mach cone, Mach angle, One dimensional Isentropic flow through variable area duct, Static and Stagnation properties, Critical conditions, Characteristic Mach number, Area-Mach number relation, Maximum discharge velocity.

UNIT II SHOCK AND EXPANSION WAVES **12**

Normal shock relations, Prandtl's relation-Hugoniot equation, Raleigh Supersonic Pitot tube equation-Moving normal shock waves, Oblique shocks, *M* relation, Shock Polar, Reflection of oblique shocks, left running and right running waves-Interaction of oblique shock waves, slip line, Rayleigh flow, Fanno flow, Expansion waves, Prandtl-Meyer expansion, Maximum turning angle, Simple and non-simple regions, operating characteristics of Nozzles, under expansion, over expansion.

UNIT III TWO DIMENSIONAL COMPRESSIBLE FLOW **9**

Potential equation for 2-dimensional compressible flow, Linearization of potential equation, perturbation potential, Linearized Pressure Coefficient, Linearized subsonic flow, Prandtl-Glauert rule, Linearized supersonic flow, Method of characteristics.

UNIT IV HIGH SPEED FLOW OVER AIRFOILS, WINGS AND AIRPLANE CONFIGURATION 8

Critical Mach number, Drag divergence Mach number, Shock Stall, Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock expansion theory, wave drag, supersonic wings, Design considerations for supersonic aircrafts.

UNIT V CHARACTERIZATION OF HIGH SPEED FLOWS **8**

Shock-Boundary layer interaction, Wind tunnels for transonic, Supersonic and hypersonic flows, shock tube, Gun tunnels, Supersonic flow visualization, Introduction to Hypersonic Flows.

TEXTBOOKS:

1. Anderson, J. D, Modern Compressible Flow: With Historical Perspective McGraw-Hill Education; 3rd edition, 2002.
2. Rathakrishnan. E, Gas Dynamics, Prentice-Hall of India Pvt.,Ltd, 2008.

REFERENCES:

1. Shapiro, A. H., Dynamics and Thermodynamics of Compressible Fluid Flow, Ronald Press, 1982.
2. Zucrow, M. J. and Anderson, J. D., Elements of Gas Dynamics, McGraw- Hill &Co., 1989.
3. Oosthuizen,P.H., & Carscallen,W.E., Compressible Fluid Flow, CRC Press; 2 edition (July 22, 2013)

AER17R302 AIRCRAFT STRUCTURES – II	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: AER17R202	**Course Category:** Program Core **Course Type:** Theory			

Course Objective(s):

To study the behavior of various aircraft structural components under different types of loads.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Determine the maximum bending stress of unsymmetrical sections
CO2: Interpret the shear center location in thin walled open section.
CO3: Interpret the shear center location in thin walled closed section.
CO4: Determine the buckling allowable load of aircraft skin.
CO5: Analyze the aircraft wing, tail, and fuselage.

Mapping of Course Outcome(s):

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

UNIT I UNSYMMETRICAL BENDING OF BEAMS 9

Unsymmetrical bending of beams – different methods of analysis (neutral axis method, 'k' method, and the principal axis method), stresses and deflections in beams under unsymmetrical bending.

UNIT II SHEAR FLOW IN OPEN SECTIONS 9

Definition and expression for shear flow due to bending, shear flow in thin-walled Open sections with and without stiffening elements, torsion of thin-walled Open sections, the shear center of symmetric and unsymmetrical open sections, structural idealization.

UNIT III SHEAR FLOW IN CLOSED SECTIONS 9

Shear flow due to bending and torsion in single-cell and multi-cell structures, the shear center of symmetric and unsymmetrical closed sections, effect of structural idealization, shear flow in a tapered beam, stress analysis of thin-webbed beams using Wagner's theory.

UNIT IV BUCKLING OF PLATES 9

Behaviour of a rectangular plate under compression, governing equation for plate buckling, buckling analysis of sheets and stiffened panel under compression, concept of the effective sheet width, buckling due to shear and combined loading, crippling.

UNIT V AIRCRAFT STRESS ANALYSIS 9

Loading and analysis of aircraft wing, fuselage, and tail unit. Use of V-n diagram for sizing the aircraft wing, fuselage, and tail unit.

TEXT BOOKS:

1. Megson T M G, 'Aircraft Structures for Engineering Students', Butterworth-Heinemann; 5 edition,2012.
2. Bruhn. E.H., 'Analysis and Design of Flight Vehicles Structures', Tri-state off-set company, USA, 1985.
3. Howard D Curtis, 'Fundamentals of Aircraft Structural Analysis', WCB-McGraw Hill, 1997

REFEENCES

1. Rivello, R.M., Theory and Analysis of Flight Structures, McGraw Hill, 1993.
2. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999

AER17R303 FLIGHT MECHANICS	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: AER17R201	**Course Category:** Program Core **Course Type:** Theory			

Course Objective(s):

Make the students to solve the preliminary aircraft design calculations using the steady and accelerated flight performance.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Know about the forces and moments that are acting on an aircraft

CO2: Examine the different types of drag, drag polar

CO3: Explain the performance in level flight, minimum drag and power required

CO4: Inspect a range of factors for gliding and climbing flight.

CO5: Explain various constraints of accelerated flight

Mapping of Course Outcome(s):

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

UNIT I GENERAL CONCEPTS 9

International Standard atmosphere, IAS, EAS, TAS, Propeller theory- Froude momentum and blade element theories, Propeller co-efficients, Use of propeller charts, Performance of fixed and variable pitch propellers, High lift devices, Thrust augmentation

UNIT II DRAG OF BODIES 8

Streamlined and bluff body, Types of drag, Effect of Reynold's number on skin friction and pressure drag, Drag reduction of airplanes, Drag polar, Effect of Mach number on drag polar. Concept of sweep- effect of sweep on drag.

UNIT III STEADY LEVEL FLIGHT 10

General equation of motion of an airplane. Steady level flight, Thrust required and Power required, Thrust available and Power available for propeller driven and jet powered aircraft, Effect of altitude, maximum level flight speed, conditions for minimum drag and minimum power required, Effect of drag divergence on maximum velocity, Range and Endurance of Propeller and Jet aircrafts. Effect of wind on range and endurance.

UNIT IV GLIDING AND CLIMBING FLIGHT 9

Shallow and steep angles of climb, Rate of climb, Climb hodograph, Maximum Climb angle and Maximum Rate of climb- Effect of design parameters for propeller jet and glider aircrafts, Absolute and service ceiling, Cruise climb, Gliding flight, Glide hodograph

UNIT V ACCELERATED FLIGHT 9

Estimation of take-off and landing distances, Methods of reducing landing distance, level turn, minimum turn radius, maximum turn rate, bank angle and load factor, Constraints on load factor, SST and MSTR. Pull up and pull down maneuvers, V-n diagram.

TEXT BOOKS:

1. Houghton,E.L. and Carruthers, N.B. Aerodynamics for engineering students, Edward Arnold Publishers, 1988.
2. Anderson, Jr., J.D. Aircraft Performance and Design, McGraw-Hill International Edition, 1999

REFERENCES:

1. Kuethe, A.M. and Chow, C.Y., Foundations of Aerodynamics, John Wiley & Sons; 5th Edition, 1997.
2. John J Bertin., Aerodynamics for Engineers, Prentice Hall; 6th edition, 2013.
3. Clancy, L J., Aerodynamics, Shroff publishers (2006)
4. Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition , 2015

AER17R304 PROPULSION – II	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: AER17R204	**Course Category:** Program Core **Course Type:** Theory			

Course Objective(s):

To have introduction of advanced propulsion system.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Comprehend the working of turbine, blade profiles, performance, cooling methods in turbine blades and its limitations

CO2: Interpret the operating principle of Ramjet, combustion and its performance

CO3: Explain the basics of Scramjet engine and integral Ram Engine

CO4: demonstrate the rocket operating principles. Rocket nozzle classifications and performance of rockets.

CO5: Explain about Electric, ion and nuclear rockets. The basics of Solar Sails and its operating principle

Mapping of Course Outcome(s):

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

UNIT I TURBINES FOR JET ENGINES 8

Principle of operation of axial flow turbines – work done and pressure rise – degree of reaction – types of design of turbines – turbine blade cooling- velocity diagrams- limitations of radial flow turbines- compressor & turbine matching – materials for turbine blades.

UNIT II RAMJET PROPULSION 8

Operating principle of ramjet engine – various components of ramjet engines and their efficiencies – Combustion in ramjet engine – critical, subcritical and supercritical modes of operation -ramjet engine and its performance characteristics – sample ramjet design calculations – flame stability problems in ramjet combustors –integral ram rockets.

UNIT III HYPERSONIC AIRBREATHING PROPULSION 10

Introduction to hypersonic air breathing propulsion, hypersonic vehicles and supersonic combustion-need for supersonic combustion for hypersonic propulsion – salient features of scramjet engine and its applications for hypersonic vehicles – problems associated with supersonic combustion – engine/airframe integration aspects of hypersonic vehicles – various types scramjet combustors – fuel injection schemes in scramjet combustors – one dimensional models for supersonic combustion using method of influence coefficients.

UNIT IV CHEMICAL ROCKET PROPULSION 11

Operating principle – specific impulse of a rocket – internal ballistics – rocket performance considerations – solid propellant rockets – selection criteria of solid propellants – propellant grain design considerations – erosive burning in solid rockets – liquid propellant rockets – selection of liquid propellants – various feed systems for liquid rockets -thrust control in liquid rockets – cooling in liquid rockets and the associated heat transfer problems – advantages of liquid rockets over solid rockets - introduction to hybrid propulsion – advantages and limitations of hybrid propulsion - static testing of rockets and safety considerations.

UNIT V ADVANCED PROPULSION TECHNIQUES 8

Introduction to nozzleless propulsion and basic concepts - Electric rocket propulsion – Ion propulsion – Nuclear rocket – comparison of performance of these propulsion systems with chemical rocket propulsion systems - Solar sail.

TEXT BOOKS:

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons; 8th Edition 2010.
2. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 2nd edition 2014.

REFERENCES:

1. David H. Heiser and David T. Pratt., "Hypersonic Air breathing Propulsion", AIAA Education Series, 1999.

AER17R305 AIRCRAFT STABILITY AND CONTROL	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: AER17R201	**Course Category:** Basic Engineering **Course Type:** Theory			

Course Objective(s):

To understand the performance of an aircraft in various operating conditions, and static, dynamic response for different disturbances.

Course Outcome(s):

After completing this course, the student will be able to:

CO1:Interpret C.G. location, aerodynamics center and static margin of an aircraft
CO2:Infer contribution of wing, fuselage, tail, and propeller on directional stability of aircraft.
CO3: Illustrate contribution of wing, fuselage, and propeller on lateral stability of an aircraft
CO4: Estimate pitch damping derivatives and damping factor
CO5: Explain the different types of dynamic instabilities

Mapping of Course Outcome(s):

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

UNIT I STATIC LONGITUDINAL STABILITY AND CONTROL 15

General concepts-Degrees of freedom of a rigid body, Static and dynamic stability,
Need for stability in an airplane, inherently and marginally stable airplanes, Stability and Controllability, Requirements of control surfaces, criteria for longitudinal static stability, contribution to stability by wing, tail, fuselage, wing fuselage combination, Total longitudinal stability, Neutral point-Stick fixed and Stick free aspects, Free elevator factor, static margin, Hinge moment, Power effects on stability-propeller and jet aircrafts, longitudinal control, Movement of centre of gravity,

elevator control effectiveness, elevator control power, elevator angle to trim, elevator angle per g, maneuver point, Stick force gradient and stick force per g, Aerodynamic balancing.

UNIT II STATIC DIRECTIONAL STABILITY AND CONTROL 12

Directional stability-yaw and sideslip, Criterion of directional stability, contribution to static directional stability by wing, fuselage, tail, Power effects on directional stabilitypropeller and jet aircrafts, Rudder fixed and rudder free aspects, Rudder lock and Dorsal fin, Directional control, rudder control effectiveness, rudder requirements, adverse yaw, asymmetric power condition, spin recovery.

UNIT III STATIC LATERAL STABILTY AND CONTROL 12

Lateral stability-Dihedral effect, criterion for lateral stability, evaluation of lateral stability-contribution of fuselage, wing, wing fuselage, tail, total static lateral stability, lateral control, aileron control power, aileron effectiveness, strip theory estimation of aileron effectiveness, roll control by spoilers, aileron reversal, aileron reversal speed.

UNIT IV DYNAMIC LONGITUDINAL STABILITY 11

Aircraft Equations of motion, small disturbance theory, Estimation of longitudinal stability derivatives stability derivatives, Routh's discriminant, solving the stability quartic, Phugoid motion, Factors affecting the period and damping.

UNIT V DYNAMIC LATERAL AND DIRECTIONAL STABILITY 10

Dutch roll and spiral instability, Auto rotation and spin, Stability derivatives for lateral and directional dynamics.

TEXT BOOKS:

1. Perkins C.D. &Hage R.E. Airplane performance, stability and control, John Wiley & Sons 1976.
2. Nelson, R.C. Flight Stability & Automatic Control, McGraw Hill, 1998.

REFERENCES:

1. McCormick, B.W. Aerodynamics, Aeronautics & Flight Mechanics John Wiley, 1995.
2. Babister, A.W. Aircraft Stability and response, Pergamon Press, 1980
3. Etkin, B., Dynamics of Flight Stability and Control, Wiley, third edition 1995.
4. Pamadi, B.N. Performance, Stability, Dynamics, and Control of Airplanes, AIAA Education Series, 2004.

AER17R351 COMPUTATIONAL FLUID DYNAMICS	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**1**	**4**
Pre-requisite: AER17R301	**Course Category:** Program Core **Course Type:** Theory with practical			

Course Objective(s):

To make the students to understand the basic concepts of fluid dynamics and to set a clear picture of the condition of a flow in real motion.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Describe the flow phenomena in a flow field with correspondence with elliptic, parabolic and hyperbolic equations.

CO2: Explains the steps involved in source and panel methods.

CO3: Describe the upwind concept and its effects in a given flow. Interpret the discretization of a flow model for analysis.

CO4: Apply the weighted variational formulae and Galerkin method for finite volume technique

CO5: know the numerical finite volume methods in computational analysis.

Mapping of Course Outcome(s):

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

UNIT I INTRODUCTION TO NUMERICAL METHODS IN FLUID DYNAMICS 9

Introduction to numerical fluid dynamics - Introduction to governing equations of fluid dynamics and modeling of fluid flow – The substantial derivative and the physical meaning of divergence of a vector. Boundary conditions for various types of fluid flow conditions - Introduction to mathematical properties of fluid dynamic equations and classification of partial differential equations - General behaviour of different classes of partial differential equations and their relation to fluid dynamics - A general discussion on hyperbolic, parabolic and elliptic equations

UNIT II SOLUTION OF FLUID FLOW EQUATIONS 9

Introduction to boundary layer equations and their solution - Discretization of the boundary layer equations and illustration of solution– Solution methods for elliptic, parabolic and hyperbolic equations-velocity potential equation.

UNIT III GRID GENERATION 8

Introduction to grid generation in computational fluid dynamics - Structured grid generation techniques – algebraic methods, conformal mapping and methods using partial differential equations - Basic ideas in numerical grid generation and mapping - Boundary value problem of numerical grid generation-grid control functions- branch cut - The boundary conditions of first kind– orthogonality of grid lines-boundary point grid control.

UNIT IV TIME DEPENDENT METHODS 9

Introduction to time dependent methods - Explicit time dependent methods –Description of Lax- Wendroff Scheme and Mac Cormack's two step predictor – corrector method - Description of time split methods. Introduction to implicit methods and respective stability properties of explicit and implicit methods - Construction of implicit methods for time dependent problems - Linearization, choice of explicit operator and numerical dissipation aspects.

UNIT V FINITE VOLUME METHOD 10

Introduction to Finite volume Method - Different Flux evaluation schemes, central, upwind and hybrid schemes - Staggered grid approach - Pressure-Velocity coupling - SIMPLE, SIMPLER algorithms-pressure correction equation (both incompressible and compressible forms) - Application of Finite Volume Method -artificial diffusion.

TEXT BOOKS:

1. C.A.J. Fletcher, "Computational Techniques for Fluid Dynamics 1" Springer Verlag,1996.
2. C.A.J. Fletcher, "Computational Techniques for Fluid Dynamics 2", Springer Verlag, 1995

REFERENCES:

1. John F Wendt (Ed.), "Computational Fluid Dynamics – An Introduction", Third Edition, Springer-Verlag, Berlin Heidelberg, 2009.
2. H.K. Versteeg and W. Malalsekera "An Introduction to Computational Fluid Dynamics, The Finite Volume Method", PHI; 2 edition 2007.
3. T. J. Chung, "Computational Fluid Dynamics", Cambridge University Press; 2 edition (27 September 2010)
4. C. Hirsch, "Numerical Computation of Internal and External Flows" Volume-2, John Wiley and Sons, 1994
5. Joel H. Ferziger & Milovan Peric, "Computational Methods for Fluid Dynamics" Springer; 3rd ed. 2002 edition 2001.

AER17R381 AERO MODELLING	Credits			
	L	T	P	Total
	1	0	3	2
Pre-requisite: AER17R203	**Course Category:** Program Core **Course Type:** Laboratory			

Course Objective(s):

Enable the students to make aircraft models.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: build the model aircraft and to select the material for an aircraft.
CO2: integrate power system with ground control system
CO3: incorporate flight stabilization system with an aircraft
CO4: integrate video capturing system and auto pilot system with an aircraft.
CO5: include the payload like camera, sensor with an aircraft.

Mapping of Course Outcome(s):

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

LIST OF EXPERIMENTS:

1. Model Building and working with Materials such as balsa wood, Coro plast, foam.
2. Power system integration including setting of thrust line.
3. Command and control system procedure.
4. Basic RF Experiments.
5. Flight Simulator Training.
6. Simple flight stabilization system integration.
7. Quad rotor stabilization (rotary).
8. Integration and setting up of video systems both 5 V and 12 V variants.
9. Auto Pilot: FY 3 ZT integration with GCS.
10. Integration of Payload like Gimbal camera and its operations, sensors etc.
11. Build an UAV airframe of own design and integrate with Autopilot system.

AER17R382 AIRCRAFT STRUCTURES LABORATORY	Credits			
	L	T	P	Total
	1	0	3	2
Pre-requisite: AER17R302	**Course Category:** Program Core **Course Type:** Laboratory			

Course Objective(s):

The objective of conducting the aircraft structure laboratory is to make the students understand and appreciate various principle and theorems involved in the theory of aircraft structures, vibrations and experimental stress analyzing the results. This will immensely help the students to

enrich their knowledge in the design of various aircraft structural components, namely, wings, fuselage, landing gear, control surfaces, etc.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: estimate the flexural strength of materials

CO2: verify the Maxwell's reciprocal theorem using deflection of beams under different loading Conditions.

CO3: estimate buckling load of columns

CO4: find the shear center location in open and closed channel sections

CO5: fabricate, test the composite beams

Mapping of Course Outcome(s):

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

LIST OF EXPERIMENTS

1. Determination of Flexural strength of materials.
2. Deflection of Beams
3. Verification of Maxwell's Reciprocal Theorem
4. Buckling Load estimation of Slender Eccentric Columns
5. Acoustic emission techniques for composites specimen.
6. Unsymmetrical Bending of a Cantilever Beam
7. Combined bending and Torsion of a Hollow Circular Tube
8. Experiment using Photo elastic setup

9 Shear Centre of a Channel Section

10. Shear center for unsymmetrical section.
11. Fabrication of a Composite Laminate.
12. Determination of characteristics for a Composite Specimen.

AER17R383 PROPULSION LABORATORY	Credits			
	L	T	P	Total
	1	0	3	2
Pre-requisite: AER17R204	**Course Category:** Program Core **Course Type:** Laboratory			

Course Objective(s):

To understand concepts of aircraft propulsion and carry out experiments.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: outline the components of piston and gas turbine engines.

CO2: draw velocity profile for free and wall jets.

CO3: measure the wall pressure and burn rate of solid propellants.

CO4: predict potential core length in co-axial jet and to visualize the secondary fuel injection in a Supersonic cross flow

CO5: measure the wall pressure in subsonic diffuser and supersonic nozzle.

Mapping of Course Outcome(s):

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

LIST OF EXPERIMENTS

1. Study of aircraft piston engines and gas turbine engines
2. Velocity profiles of free jets
3. Velocity profiles of wall jets
4. Wall pressure measurements of a turbine blade passage
5. Burn rate measurements of solid propellants
6. Cascade testing of compressor blades
7. Prediction of potential core length in co-axial jets
8. Flow visualization of secondary injection in a supersonic cross flow
9. Wall pressure distribution in subsonic diffusers
10. Wall pressure measurements in supersonic nozzles

AER17R401 EXPERIMENTAL AERODYNAMICS	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: AER17R201	**Course Category:** Program Core **Course Type:** Theory			

Course Objective(s):

To determine the stress and strain in materials and structure subjected to static or dynamic forces or loads.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Interpret basic measuring techniques and various measuring instruments in fluid mechanics
CO2: Comprehend the operation of wind tunnels, and experiment with the performance of wind tunnels.
CO3: Determine the fluid flow properties using flow visualization techniques
CO4: Demonstrate the pressure, velocity, and temperature measurements
CO5: Examine the special flows and uncertainty analysis

Mapping of Course Outcome(s):

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

UNIT I BASIC MEASUREMENTS IN FLUID MECHANICS 7

Objective of experimental studies – Fluid mechanics measurements – Properties of fluids – Measuring instruments – Performance terms associated with measurement systems – Direct measurements - Analogue methods – Flow visualization – Components of measuring systems – Importance of model studies.

UNIT II WIND TUNNEL MEASEUREMENTS 10

Characteristic features, operation and performance of low speed, transonic, supersonic and special tunnels - Power losses in a wind tunnel – Instrumentation and calibration of wind tunnels – Turbulence-Wind tunnel balance – Wire balance – Strut-type – Platform-type – Yoke-type – Pyramid type – Strain gauge balance – Balance calibration.

UNIT III FLOW VISUALIZATION AND ANALOGUE METHODS 9

Visualization techniques – Smoke tunnel – Hele-Shaw apparatus - Interferometer – Fringe-Displacement method – Schlieren system – Shadowgraph - Hydraulic analogy – Hydraulic jumps – Electrolytic tank.

UNIT IV PRESSURE, VELOCITY AND TEMPERATUREMEASUREMENTS 9

Pitot - static tube characteristics - Velocity measurements - Hot-wire anemometry – Constant current and Constant temperature Hot-Wire anemometer – Pressure measurement techniques - Pressure transducers – Temperature measurements.

UNIT V SPECIAL FLOWS AND UNCERTAINTY ANALYSIS 10

Experiments on Taylor-Proudman theorem and Ekman layer – Measurements in boundary layers - Data acquisition and processing – Signal conditioning – Uncertainty analysis – Estimation of measurement errors – External estimate of the error – Internal estimate of the error – Uncertainty calculation - Uses of uncertainty analysis.

TEXT BOOKS:

1.Rathakrishnan, E., "Instrumentation, Measurements, and Experiments in Fluids," CRCPress – Taylor & Francis, 2007.

2.Robert B Northrop, "Introduction to Instrumentation and Measurements",Second Edition, CRC Press, Taylor & Francis, 2006.

AER17R451 HEAT TRANSFER	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**1**	**4**
Pre-requisite: AER17R271	**Course Category:** Program Core **Course Type:** Theory			

Course Objective(s):

The course is intended to build up necessary background for understanding the physical behavior of various modes of heat transfer like conduction, convection, and radiation.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Explain the difference between various modes of heat transfer and the resistance concepts used in heat conduction

CO2: Learn to use the basic methods in conduction. Understand the concept of lump parameter analysis and when it is applicable and earn the concepts of boundary layer.

CO3: learn to apply various correlation used in convective heat transfer and understand the concepts of black body, grey body, view factor, Radiation shielding

CO4: Solve 1-D and 2-D steady, and unsteady state heat conduction using numerical methods.

CO5: Learn to apply various technique used for high speed flow heat transfer.

Mapping of Course Outcome(s):

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

UNIT I CONDUCTION **8**

Governing equation in Cartesian, cylindrical and spherical coordinates. 1-D steady state heat conduction with and without heat generation. Composite wall- Electrical analogy – Critical thickness of insulation – Heat transfer from extended surface – Effect of temperature on conductivity- 1-D Transient analysis

UNIT II CONVECTION **11**

Review of basic equations of fluid flow – Dimensional analysis- Forced convection – Laminar flow over flat plate and flow through pipes-Flow across tube banks. Turbulent flow over flat plate and flow through pipes – Free convection – Heat transfer from vertical plate using integral method – Empirical relations - Types of heat exchangers – Overall heat transfer coefficient – LMTD and NTU methods of analysis.

UNIT III RADIATION **9**

Basic definitions – Concept of black body - Laws of black body radiation-Radiation between black surfaces – Radiation heat exchange between grey surfaces – Radiation shielding – Shape factor-Electrical network analogy in thermal radiation systems.

UNIT IV NUMERICAL METHODS **10**

1-D and 2-D steady and unsteady state heat conduction – composite walls-heat generation- variable thermal conductivity- extended surfaces analysis using finite difference method- Convective heat transfer- Stream function- vorticity method- Creeping flow analysis-convection- diffusion 1-D, 2-D analysis using finite difference approximation. Numerical methods applicable to radiation heat transfer.

UNIT V CASE STUDIES IN AEROSPACE ENGINEERING **7**

Numerical treatment of heat transfer problems pertaining to Aerospace Engineering like in gas turbines, rocket thrust chambers, Aerodynamic heating and Ablative heat transfer in thermal protection systems.

TEXT BOOKS:

1. Yunus,A.Cengel, Heat Transfer -A Practical Approach, Tata McGraw Hill, Second edition, 2003.
2. Holman,J.P., Heat Transfer, McGraw Hill Book Co.,Inc., New York, 8thEdition,1996.
3. Sachdeva,S.C., Fundamentals of Engineering Heat and Mass Transfer, new age publishers,2010.
4. Necati Ozisik, Finite Difference Method in Heat Transfer, CRC Press, second edition, 1994

REFERENCES:

1. John H. Lienhard IV & John H. Lienhard V, "A Heat Transfer Text Book, Prentice Hall Inc.,1981.
2. Sutton,G.P., Rocket Propulsion Elements, John Wiley & Sons; 8th Edition 2010.
3. Mathur,M.L. and Sharma,R.P,"Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 2nd edition 2014.

AER17R402 ROCKETS AND LAUNCH VEHICLES	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: AER17R304	**Course Category:** Program Core **Course Type:** Theory			

Course Objective(s):

To introduce the basic concepts of design and trajectory estimation of rocket and missiles, to study the performance of rocket and missiles under various operating conditions, and the fundamentals of design concepts.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Outline diverse varieties of Rockets and demonstrates the aerodynamics of launch vehicles
CO2: Examine the aerodynamics of launch vehicles
CO3: Inspect the 1-D and 2-D rocket motions in free space and homogeneous gravitational fields.
CO4: construct the staging and stage separation dynamics of rockets and launch vehicles.
CO5: Inspect a range of control methods of rockets and launch vehicles.

Mapping of Course Outcome(s):

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

UNITI CLASSIFICATION OF ROCKETS AND LAUNCH VEHICLES 9

Various methods of classification of missiles and rockets-Basic Aerodynamics characteristics of launch vehicle configurations-Examples of various Indian space launch vehicles-Current status of Indian rocket programme with respect to international scenario.

UNIT II AERODYNAMICS OF ROCKETS AND LAUNCH VEHICLES 10

Airframe components of rockets and Launch Vehicles – forces acting on a missile while passing through atmosphere – slender body aerodynamics - method of describing forces and moments – lift force and lateral moment –lateral aerodynamic damping moment – longitudinal moment – drag estimation-Rocket Dispersion.

UNITIII ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD 10

One dimensional and two-dimensional rocket motions in free space and homogeneous gravitational fields – description of vertical, inclined and gravity turn trajectories – determination of range and altitude – simple approximations to burn out velocity and altitude – estimation of culmination time and altitude.

UNITIV STAGING OF ROCKETS AND LAUNCH VEHICLES 8

Design philosophy behind multistaging of launch vehicles– multistage vehicle optimization – stage separation techniques in atmosphere and in space – stage separation dynamics and lateral separation characteristics.

UNITV CONTROL OF ROCKETS AND LAUNCH VEHICLES 8

Introduction to aerodynamic control and jet control methods- thrust control methods – various types

of thrust vector control methods including secondary injection thrust vector control for launch vehicles.

TEXT BOOKS:

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co.,Ltd, London, 1982.
2. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons; 8th Edition 2010.

REFERENCE:

1. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 2nd edition 2014.

AER17R481 EXPERIMENTS IN FLIGHT LABORATORY	**Credits**			
	L	**T**	**P**	**Total**
	1	**0**	**3**	**2**
Pre-requisite: AER17R305	**Course Category:** Program Core **Course Type:** Laboratory			

Course Objective(s):

Enable the students to operate, check, test the aircraft instruments

Course Outcome(s):

After completing this course, the student will be able to:

CO1: determine the C.G location in aircraft.
CO2: calibrate the aircraft instruments such as ASI, Altimeter.
CO3: determine stick fixed and stick free neutral point location in aircraft
CO4: verify the lateral directional equations of motions for a steady state side slip maneuver and Coordinated turn.
CO5: draw a drag polar curve for a glider.

Mapping of Course Outcome(s):

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

LIST OF EXPERIMENTS

1. C.G. determination
2. Calibration of ASI and Altimeter
3. Calibration of special instruments
4. Cruise and climb performance
5. Determination of stick fixed & stick free neutral points
6. Determination of stick fixed & stick free maneuver points
7. Verification of Lateral-directional equations of motion for a steady state side slip maneuver
8. Verification of Lateral-directional equations of motion for a steady state coordinated turn
9. Flight determination of drag polar of a glider
10. Demonstration of stall, Phugoid motion and Dutch roll

AER17R384 Aero- Design Project	Credits			
	L	T	P	Total
	0	0	3	3
Pre-requisite: AER17R272	**Course Category:** Program core **Course Type:** Laboratory			

Course Objective:

To develop the basic concept of aircraft design by assigning each student a preliminary specification to design an airplane or helicopter or any flight vehicle.

Course Outcome:

After completing this course, the student will be able to:

CO1: see how aircraft design changes from one mission to another
CO2: calculate the design parameter for the aircraft is selected
CO3: estimate weight of the aircraft components
CO4: estimate drag and find C.G of an aircraft
CO5: draw v-n diagram and to find a stall region

Mapping of Course Outcome(s):

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

List of Experiments:

1. Comparative configuration study of different types of airplanes
2. Comparative study on specification and performance details of aircraft
3. Preparation of comparative data sheets
4. Worksheet layout procedures
5. Comparative graphs preparation and selection of main parameters for the design
6. Preliminary weight estimations, selection of main parameters
7. Power plant selection, air foil selection, wing tail and control surfaces
8. Preparation of layouts of balance diagram and three view drawings
9. Drag estimation, weight calculation and v-n diagram
10. Detailed performance calculations and stability estimates.

AER17R416 THEORY OF VIBRATIONS	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite:	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Vibration and Aero Elasticity's deals with the motion of aircraft motions alongside their interactions and their vibrations

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Examine the frequency of damped and un-damped mechanical systems
CO2: Interpret the natural frequency of multi degree of freedom systems through linear algebra.
CO3: Estimate the frequency of beams and shafts
CO4: Compare the natural frequency of the system by different approximate methods.
CO5: Interpret the structural and aerodynamic factor that influences the aerodynamic problems

Mapping of Course Outcome(s):

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

UNIT I SINGLE DEGREE OF FREEDOM SYSTEMS 10

Introduction to simple harmonic motion, D'Alembert's Principle, Free vibrations – Damped vibrations – Forced Vibrations, with and without damping – support excitation – Transmissibility - Vibration measuring instruments.

UNIT II MULTI DEGREES OF FREEDOM SYSTEMS 10

Two degrees of freedom systems - Static and Dynamic couplings - vibration absorber- Principal co-ordinates - Principal modes and orthogonal conditions - Eigen value problems - Hamilton's principle - Lagrangean equations and application.

UNIT III CONTINUOUS SYSTEMS 8

Vibration of elastic bodies - Vibration of strings – Longitudinal, Lateral an d Torsional vibrations.

UNIT IV APPROXIMATE METHODS 9

Approximate methods - Rayleigh's method - Dunkerlay's method – Rayleigh-Ritz method, Matrix Iteration method.

UNIT V ELEMENTS OF AEROELASTICITY 8

Coupled flexural–Torsional oscillation of beam- Aeroelastic problems - Collars triangle – Wing Divergence - Aileron Control reversal – Flutter – Buffeting. – Elements of servo elasticity

TEXT BOOKS:

1. Leonard Meirovitch, 'Elements of Vibration Analysis' – McGraw Hill International Edition,2007
2. G.K.Grover, "Mechanical Vibrations", 7th Edition, Nem Chand Brothers, Roorkee, India,2009
3. William T. Thomson & Marie Dillon Dahleh, 'Theory of Vibration with Application", Prentice Hall publishers, 5th edition, 1997.

REFERENCES:

1. William Weaver, Stephen P. Timoshenko, Donovan H. Young, Donovan H. Young. 'Vibration Problems in Engineering' – John Wiley and Sons, New York, 2001 2. Bisplinghoff R.L., Ashely H and Hogman R.L., Aero elasticity – Addison Wesley Publication, New York, 1983.
3. William W Seto, 'Mechanical Vibrations' – McGraw Hill, Schaum Series.
4. TSE. F.S., Morse, I.F., Hinkle, R.T., 'Mechanical Vibrations' – Prentice Hall, New York, 1984.
5. Den Hartog, 'Mechanical Vibrations' Crastre Press, 2008.

MAJOR ELECTIVES

AER17R404 AERO ELASTICITY	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: AER17R202	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Facilitate the students to comprehend effect aero-elastic problems in an aircraft stability.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: interpret the interaction between aerodynamics and aircraft structures

CO2: determine the divergence speed using strip theory and successive approximation.

CO3: estimate the aileron reversal speed using semi-rigid theory

CO4: interpret the effect of moment of inertia on flutter speed.

CO5: comprehend the aero-elastic problems in civil, electrical lines and helicopters.

Mapping of Course Outcome(s):

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

UNIT I AERO ELASTICITY PHENOMENA **8**

Vibration of beams due to coupling between bending and torsion - The aero-elastic triangle of forces - Stability versus response problems – Aeroelasticity in Aircraft Design – Vortex induced vibration – Introduction to aero servo elasticity.

UNIT II DIVERGENCE OF A LIFTING SURFACE **10**

Simple two dimensional idealizations – Strip theory – Fredholm integral equation of the second kind – Exact solutions for simple rectangular wings – Semi rigid assumption and approximate solutions – Generalized coordinates – Successive approximations – Numerical approximations using matrix equations.

UNIT III STEADY STATE AEROELASTIC PROBLEMS **9**

Loss and reversal of aileron control – Critical aileron reversal speed – Aileron efficiency – Semi rigid theory and successive approximations – Lift distributions – Rigid and elastic wings.

UNIT IV FLUTTER ANALYSIS **10**

Non-dimensional parameters – Stiffness criteria Dynamic mass balancing – Model experiments – Dimensional similarity – Flutter analysis – Two dimensional thin airfoils in steady incompressible flow – Quasi steady aerodynamic derivatives – Galerkin's method for critical speed – Stability of distributed motion – Torsion flexure flutter – Solution of the flutter determinant – Methods of determining the critical flutter speeds – Flutter prevention and control.

UNIT V EXAMPLES OF AEROELASTIC PROBLEMS **8**

Galloping of transmission lines and flow induced vibrations of tall slender structures and suspension bridges – Aircraft wing flutter- Vibrational problems in Helicopters.

TEXT BOOKS:

1. Fung, Y.C. An Introduction to the theory of Aeroelasticity, Dover Publications Inc., 2008

REFERENCES:

1. Bisplinghoff., R.L. Ashley, H., and Halfman, R.L, " Aeroelasticity" Addison Wesley Publishing Co., Inc. II ed. 1996.

2. Broadbent, E.G., Elementary Theory of Aeroelasticity, Bunhill Publications Ltd., 1986.
3. Scanlan, R.H. and Rosenbaum, R., Introduction to the Study of Aircraft Vibration and Flutter, Macmillan Co., N.Y., 1991.
4. Blevins R.D, "Flow induced vibrations", Krieger Pub Co; 2 Reprint edition, 2001.

AER17R306 AEROSPACE MATERIALS	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: MEC17R271	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Enhance the students to select the material for an aircraft components.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: distinguish the requirements of aerospace materials and atomic structure of materials
CO2: classify the material based on its mechanical behavior.
CO3: Acquire knowledge about the properties of material, the process of machining them and heat treating them.
CO4: Acquire knowledge about the specification of materials, their structural applications and properties.
CO5: Illustrate the high temperature material characterization.

Mapping of Course Outcome(s):

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

UNIT I ELEMENTS OF AEROSPACE MATERIALS 9

Structure of solid materials – Atomic structure of materials – Crystal structure – Miller indices – Density – Packing factor – Space lattices – X-ray diffraction – Imperfection in crystals – general requirements of materials for aerospace applications.

UNIT II MECHANICAL BEHAVIOUR OF MATERIALS 9

Linear and non linear elastic properties – Yielding, strain hardening, fracture, Bauchinger's effect – Notch effect testing and flaw detection of materials and components – Comparative study of metals, ceramics plastics and composites.

UNIT III CORROSION & HEAT TREATMENT OF METALS AND ALLOYS 10

Types of corrosion – Effect of corrosion on mechanical properties – Stress corrosion cracking – Corrosion resistance materials used for space vehicles Heat treatment of carbon steels – aluminium alloys, magnesium alloys and titanium alloys – Effect of alloying treatment, heat resistance alloys – tool and die steels, magnetic alloys, powder metallurgy.

UNIT IV CERAMICS AND COMPOSITES 9

Introduction – physical metallurgy – modern ceramic materials – cermets - cutting tools – glass ceramic –production of semi fabricated forms - Plastics and rubber Carbon/Carbon composites,

Fabrication processes involved in metal matrix composites - shape memory alloys – applications in aerospace vehicle design

UNIT V HIGH TEMPERATURE MATERIALS CHARACTERIZATION 8

Classification, production and characteristics – Methods and testing – Determination of mechanical and thermal properties of materials at elevated temperatures – Application of these materials in Thermal protection systems of Aerospace vehicles – super alloys – High temperature material characterization.

REFERENCES

1.Titterton.G., Aircraft Materials and Processes, V Edition, Pitman Publishing Co., 1995.

2.Martin, J.W., Engineering Materials, Their properties and Applications, Wykedham Publications (London) Ltd., 1987.

3.Van Vlack.L.H., Elements of Materials Science and Engineering Prentice Hall; publishers, 6th edition, 1989

4.Raghavan.V., Materials Science and Engineering, Prentice Hall of India, New Delhi,5th edition, 2004.

AER17R307 Aircraft Design	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite:AER17R202	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Enable the students to design the aircraft.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: infer the design parameters affecting the aircraft configuration and check the feasibility of Manufacturing.

CO2: estimate the weight of the individual components of aircraft

CO3: select and locate the aircraft engines in the configuration.

CO4: determine the wing, fuselage and tail sizing parameters

CO5: interpret the loads acting on aircraft and estimate the landing gear sizing parameters.

Mapping of Course Outcome(s):

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

UNIT I INTRODUCTION 6

State of art in airplane design, Purpose and scope of airplane design, Classification of airplanes based on purpose and configuration. Factors affecting configuration, Merits of different plane layouts. Stages in Airplane design. Designing for manufacturability, Maintenance, Operational costs, Interactive designs.

UNIT II PRELIMINARY DESIGN PROCEDURE 9

Data collection and 3-view drawings,· their purpose, weight estimation, Weight equation method – Development & procedures for evaluation of component weights. Weight fractions for various segments of mission. Choice of wind loading and thrust Loading.

UNIT III POWER PLANT SELECTION 10

Choices available, comparative merits, Location of power plants, Functions dictating the locations.

UNIT IV DESIGN OF WING, FUSELAGE AND EMPHANAGE 10

Selection of aerofoil. Selection of Wing parameters, selection of sweep, Effect of Aspect ratio, Wing Design and Airworthiness requirements, V-n diagram, loads, Structural features. Elements of fuselage design, Loads on fuselage, Fuselage Design. Fuselage and tail sizing. Determination of tail surface areas, Tail design, Structural features, Check for nose wheel lift off.

UNIT V DESIGN OF LANDING GEAR AND CONTROL SURFACE 10

Landing Gear Design, Loads on landing gear, Preliminary landing gear design. Elements of Computer Aided and Design, Special consideration in configuration lay-out, Performance estimation. Stability aspects on the design of control surface.

TEXT BOOKS:

1. Torenbeck, E. Synthesis of Subsonic Airplane Design, Delft University Press, U.K. 1986.
2. Raymer, D.P. Aircraft conceptual Design, AIAA series, 5th edition, 2012.

.

REFERENCES:

1. Kuechemann, D, "The Aerodynamic Design of Aircraft, American Institute of Aeronautics publishers, 2012

AER17R308 AIRCRAFT ENGINE REPAIRS AND MAINTENANCE	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: AER17R204	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

To make the students to understand the maintenance and repair procedures of both piston and gas turbine engines and their procedures followed for overhaul of aero engines.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Describe the function of each component in piston engines and its materials. Carryout inspections and maintenance checks on aircraft piston engines; Piston engine overhaul procedure.

CO2: Investigate the performance of propeller and to detect the damages in the propeller.

CO3: Inspect damage in engine components using NDT.

CO4: Know the overhaul procedures and functions of each component in gas turbine engines; describe the trouble shooting and rectification procedures of gas turbine engines

CO5: Know the overhaul procedures and balancing of gas turbine components

Mapping of Course Outcome(s):

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

UNIT I

Classification of piston engines - Principles of operation - Function of components - Materials used- Details of starting the engines - carburetion and Fuel injection systems for small and large engines - Ignition system components - spark plug detail - Engine operating conditions at various altitudes – Engine power measurements – Classification of engine lubricants and fuels – Induction, Exhaust and cooling system - Maintenance and inspection check to be carried out. Inspection and maintenance and troubleshooting - Inspection of all engine components - Daily and routine checks- Overhaul procedures - Compression testing of cylinders - Special inspection schedules - Engine fuel, control and exhaust systems - Engine mount and super charger - Checks and inspection procedures.

UNITII

Propeller theory - operation, construction assembly and installation -Pitch change mechanism- Propeller axially system- Damage and repair criteria - General Inspection procedures - Checks on constant speed propellers - Pitch setting, Propeller Balancing, Blade cuffs, Governor/Propeller operating conditions – Damage and repair criteria.

UNIT III

Symptoms of failure - Fault diagnostics - Case studies of different engine systems - Rectification during testing equipments for overhaul: Tools and equipments requirements for various checks and alignment during overhauling - Tools for inspection - Tools for safety and for visual inspection - Methods and instruments for non-destructive testing techniques - Equipment for replacement of parts and their repair. Engine testing: Engine testing procedures and schedule preparation - Online maintenance.

UNIT IV

Types of jet engines – Fundamental principles – Bearings and seals - Inlets - compressors- turbines- exhaust section – classification and types of lubrication and fuels- Materials used - Details of control, starting around running and operating procedures – Inspection and Maintenance- permissible limits of damage and repair criteria of engine components- internal inspection of engines- compressor washing- field balancing of compressor fans- Component maintenance procedures - Systems maintenance procedures - use of instruments for online maintenance - Special inspection procedures-Foreign Object Damage - Blade damage .

UNIT V

Engine Overhaul - Overhaul procedures - Inspections and cleaning of components - Repairs schedules for overhaul - Balancing of Gas turbine components. Trouble Shooting: Procedures for trouble shooting - Condition monitoring of the engine on ground and at altitude - engine health monitoring and corrective methods.

REFERENCES:

1. Kroes & Wild, "Aircraft Power plants ", 7th Edition - McGraw Hill, New York, 1994.
2. Turbomeca, "Gas Turbine Engines ", the English Book Store ", New Delhi, 1993. 3. United Technologies' Pratt & Whitney, " The Aircraft Gas turbine Engine and its Operation", The English Book Store, New Delhi.

AER17R309 AIRCRAFT RULES AND REGULATIONS - CAR I AND II	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: NIL	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

To make the students to understand the Indian aviation rules 1937, relating to aviation and civil aviation requirement in India (DGCA)

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Know the procedure for keeping the aircraft in airworthiness conditions and describe the use of MEL, and the procedure for releasing the Aircraft under MEL.

CO2: Describe the different types of maintenance program.

CO3: Comprehend the requirements for getting AO in different categories

CO4: Describe the overhaul and inspection procedure of various instruments

CO5: Describe the detail procedure of flight test.

Mapping of Course Outcome(s):

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

UNIT I C.A.R SERIES 'A' - PROCEDURE FOR CIVIL AIR WORTHINESS REQUIREMENTS AND RESPONSIBILITY OPERATORS VIS-A-VIS AIRWORTHINESS DIRECTORATE

Responsibilities of operators / owners; Procedure of CAR issue, amendments etc., Objectives and targets of airworthiness directorate; Airworthiness regulations and safety oversight of engineering activities of operators. C.A.R. SERIES 'B' - ISSUE APPROVAL OF COCKPIT CHECK LIST, MEL, CDL - Deficiency list(MEL & CDL); Preparation and use of cockpit check list and emergency list.

UNIT II C.A.R. SERIES 'C' - DEFECT RECORDING, MONITORING, INVESTIGATION AND REPORTING

Defect recording, reporting, investigation, rectification and analysis; Flight report; Reporting and rectification of defects observed on aircraft; Analytical study of in-fight readings & recordings; Maintenance control by reliability Method.C.A.R. SERIES 'D' - AND AIRCRAFT MAINTENANCE PROGRAMMES Reliability Programme (Engines); Aircraft maintenance programme& their approval; On condition maintenance of reciprocating engines; TBO - Revision programme - Maintenance of fuel and oil uplift and consumption records - Light aircraft engines; Fixing routine maintenance periods and component TBOs - Initial & revisions.

UNIT III C.A.R. SERIES 'E' - APPROVAL OF ORGANISATIONS **10**

Approval of organizations in categories A, B, C, D, E, F, & G; Requirements of infrastructure at stations other than parent base.C.A.R. SERIES 'F' - air worthiness and continued air worthiness: Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness.

UNIT IV C.A.R. SERIES 'L' - AIRCRAFT MAINTENANCE ENGINEER - LICENSING 8

Issue of AME License, its classification and experience requirements, Complete Series 'L'.C.A.R. SERIES 'M' MANDATORY MODIFICATIONS AND INSPECTIONS: Mandatory Modifications /Inspections.

UNIT V C.A.R. SERIES 'T' - FLIGHT TESTING OF AIRCRAFT 12

Flight testing of (Series) aircraft for issue of C of A; Fight testing of aircraft for which C or A had been previously issued. C.A.R. SERIES 'X' - MISCELLANEOUS

REQUIREMENTS: Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first aid kits & Physician's kit in an aircraft; Use furnishing materials in an aircraft; Concessions; Aircraft log books; Document to be carried on board on Indian registered aircraft; Procedure for issue of taxy permit; Procedure for issue of type approval of aircraft components and equipment including instruments.

REFERENCES:

1. "Aircraft Manual (India) ", Volume - Latest Edition, The English Book Store, 171,Connaught Circus, New Delhi.
2. "Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness) ", Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi.
3. "Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA. AdvisoryCirculars ", form DGCA.

AER17R310 APPROXIMATE METHODS IN STRUCTURAL MECHANICS	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: MEC17R271	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Enable the students to analyze the statically indeterminate structures by approximate methods.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Define the analytical and numerical methods used in the structural mechanics

CO2: Solve the structural mechanics problems using approximate methods

CO3: Analyze the statically determinate and indeterminate structures using approximate methods.

CO4: Analyze the statically determinate and indeterminate structures using finite difference methods.

CO5: Create code generation for structural mechanics problems using approximate methods.

Mapping of Course Outcome(s):

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

UNIT I ANALYTICAL AND NUMERICAL METHODS

Review of analytical methods for solving ordinary differential equations related to structural mechanics problems, boundary conditions, initial conditions, Need for approximate methods,

different forms of approximate solution, Numerical integration, Elementary study on calculus of variation.

UNIT II APPROXIMATE METHODS

Weighted residual methods: Least square method, collocation method, sub-domain method, method of moments, basic Galerkin form and modified Galerkin form, Variational method: Rayleigh Ritz method.

UNIT III STATIC, DYNAMIC AND STABILITY ANALYSIS

Application to statically determinate and indeterminate structures: bar, beam, torsional member. Free vibration and stability analysis, Improvement of solution accuracy.

UNIT IV FINITE DIFFERENCE METHOD

Application to statically determinate and indeterminate structures: bar, beam, torsional member. Free vibration and stability analysis.

UNIT V CODE DEVELOPMENT

Numerical integration; Solution of simultaneous algebraic equations; Code generation for structural mechanics problems using approximate methods.

TEXT BOOKS:

1. Szilard, R., Theory and Analysis of Plates – Classical and Numerical Methods, Prentice Hall, 1984.
2. Chajes, A., Principles of Structural Stability Theory, Prentice Hall. Inc., 1987.
3. Asghar Bhatti, M., Fundamental Finite Element Analysis and Applications: with Mathematica and *MATLAB* Computations, John Wiley & Sons Inc, 2005
4. Ansel C Ugural and Saul K Fenster, 'Advanced Strength and Applied Elasticity', 4th Edition, Prentice Hall, New Jersey, 2003.

REFERENCES:

1. Tauchert, T.R., Energy Principles in Structural Mechanics, McGraw Hill, International Student Edition, 1989.
2. Bathe, K.J., and Wilson, E. L., Numerical Methods in Finite Element Method, Prentice Hall (India) Ltd., 1985.
3. Chandrupatla R. Tirupathi, Belegundu D Ashok., Introduction to Finite Elements in Engineering, Prentice Hall (India) Ltd, 2007.
4. Reddy, J. N., An Introduction to the Finite Element Method, McGraw-Hill, 2004.

AER17R311 Boundary Layer Theory	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: MEC17R272	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Make the students to understand the fundamentals of viscous flow and adapt methods of boundary layer control in laminar flow.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: illustrate the fundamentals of viscous flow

CO2: solve the viscous flow equations

CO3: infer the laminar boundary layer

CO4: explain the turbulent boundary layer
CO5: adapt the methods of boundary layer control in laminar flow

Mapping of Course Outcome(s):

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

UNIT I FUNDAMENTAL EQUATIONS OF VISCOUS FLOW 8

Fundamental equations of viscous flow, Conservation of mass, Conservation of Momentum-Navier-Stokes equations, Energy equation, Mathematical character of basic equations, Dimensional parameters in viscous flow, Non-dimensionalizing the basic equations and boundary conditions, vorticity considerations, creeping flow, boundary layer flow

UNIT II SOLUTIONS OF VISCOUS FLOW EQUATIONS 10

Solutions of viscous flow equations, Couette flows, Hagen-Poisuelle flow, Flow between rotating concentric cylinders, Combined Couette-Poiseuille Flow between parallel plates, Creeping motion, Stokes solution for an immersed sphere, Development of boundary layer, Displacement thickness, momentum and energy thickness.

UNIT III LAMINAR BOUNDARY LAYER 10

Laminar boundary layer equations, Flat plate Integral analysis of Karman – Integral analysis of energy equation – Laminar boundary layer equations – boundary layer over a curved body-Flow separation-similarity solutions, Blasius solution for flat-plate flow, Falkner–Skan wedge flows, Boundary layer temperature profiles for constant plate temperature –Reynold's analogy, Integral equation of Boundary layer – Pohlhausen method – Thermal boundary layer calculations

UNIT IV TURBULENT BOUNDARY LAYER 10

Turbulence-physical and mathematical description, Two-dimensional turbulent boundary layer equations — Velocity profiles – The law of the wall – The law of the wake – Turbulent flow in pipes and channels – Turbulent boundary layer on a flat plate – Boundary layers with pressure gradient, Eddy Viscosity, mixing length , Turbulence modelling

UNIT V BOUNDARY LAYER CONTROL 7

Boundary layer control in laminar flow-Methods of Boundary layer control: Motion of the solid wall-Acceleration of the boundary layer-Suction- Injection of different gas-Prevention of transition-Cooling of the wall-Boundary layer suction-Injection of a different gas.

TEXT BOOKS:

1. White, F. M., Viscous Fluid Flow, McGraw-Hill Education; 3rd edition, 2005.

REFERENCES:

1. Schlichting, H., Boundary Layer Theory, Springer publishers, 8th edition, 2000.
2. Reynolds, A, J., Turbulent Flows Engineering, John Wiley and Sons, 1980.

AER17R312 FATIGUE AND FRACTURE MECHANICS	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: MEC17R271	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Facilitate students to explain the cause for crack initiation, crack propagation direction.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Become familiar with definition of fatigue and fracture mechanics
CO2: Analysis of cumulative damage
CO3: Analyze for crack initiation and crack growth.
CO4: Analyze for strength of cracked bodies
CO5: Analyze the damage tolerance structures

Mapping of Course Outcome(s):

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

UNIT I FATIGUE OF STRUCTURES **7**

S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. curves – Fatigue of composite materials.

UNIT II STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR **10**

Low cycle and high cycle fatigue - Coffin - Manson's relation - Transition life - cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques Cumulative damage - Miner's theory - Other theories.

UNIT III PHYSICAL ASPECTS OF FATIGUE **10**

Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations - fatigue fracture surfaces.

UNIT IV FRACTURE MECHANICS **10**

Strength of cracked bodies - Potential energy and surface energy - Griffith's theory - Irwin - Orwin extension of Griffith's theory to ductile materials - stress analysis of cracked bodies - Effect of thickness on fracture toughness - stress intensity factors for typical geometries.

UNIT V FATIGUE DESIGN AND TESTING **8**

Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.

TEXT BOOKS:

1. Prashant Kumar – Elements of fracture mechanics" Tata McGraw Hill Education Private Limited ,2009.
2. Barrois W, Ripley, E.L., "Fatigue of aircraft structure," _ Pergamon press. Oxford, 1983.

REFERENCES:

1. Sih C.G., Sijthoff and W Noordhoff, "Mechanics of fracture Vol - I" International Publishing Co., Netherlands, 1989.

2. Knott, J.F., "Fundamentals of Fracture Mechanics," - Buterworth& Co., Ltd., London, 1983.
3. KareHellan ,'Introduction to Fracture Mechanics', McGraw Hill, Singapore,1985

AER17R313 FUNDAMENTALS OF CONTROL ENGINEERING	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: EEE17R151	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

To understand the basic concepts of flight control system.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Relate the pneumatic, hydraulic and thermal systems with electrical system.
CO2: Deduce the block diagram of the control system and to draw the signal flow graph.
CO3: characterize the control system inputs and their response.
CO4: Check the stability criteria of control systems using Routh-Hurwitz criteria, Root locus and Bode plot techniques.
CO5: Utilize the digital PID controllers

Mapping of Course Outcome(s):

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

UNIT I INTRODUCTION 9

Historical review, Simple pneumatic, hydraulic and thermal systems, Series and parallel system, Analogies, mechanical and electrical components, Development of flight control systems.

UNIT II OPEN AND CLOSED LOOP SYSTEMS

Feedback control systems – Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios.

UNIT III CHARACTERISTIC EQUATION AND FUNCTIONS 9

Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.

UNIT IV CONCEPT OF STABILITY 12

Necessary and sufficient conditions, Routh-Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response.

UNIT V SAMPLED DATA SYSTEMS 6

Z-Transforms Introduction to digital control system, Digital Controllers and Digital PID controllers

TEXT BOOKS:

1. OGATO, Modern Control Engineering, Prentice-Hall of India Pvt. Ltd., New Delhi, 1998.
2. Azzo, J.J.D. and C.H. Houpis, Feedback control system analysis and synthesis, McGraw- Hill international 3rs Edition, 1998.

REFERENCES:

1. Kuo, B.C. Automatic control systems, Prentice-Hall of India Pvt. Ltd., New Delhi, 1998.
2. Houpis, C.H. and Lamont, G.B. Digital control Systems, McGraw Hill Book co., New York, U.S.A. 1995.
3. Naresh K Sinha, Control Systems, New Age International Publishers, New Delhi,1998.

AER17R314 MISSILE AERODYNAMICS	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: AER17R201	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Facilitate students to analyze the missile aerodynamic characteristics, formulate go

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Explain the basic characteristics of Missile aerodynamics
CO2: Summarize the missile configuration and drag estimation
CO3: Classify the aerodynamics of slender and blunt bodies
CO4: Develop the aerodynamic aspects of launching phase
CO5: Formulate the stability and control of missiles

Mapping of Course Outcome(s):

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

UNIT I BASICS ASPECTS OF MISSILE AERODYNAMICS 9

Classification of missiles-Aerodynamics characteristics and requirements of air to air missiles, air to surface missiles and surface to air missiles-Missile trajectories-fundamental aspects of hypersonic aerodynamics.

UNIT II MISSILE CONFIGURATIONS AND DRAG ESTIMATION 9

Types of Rockets and missiles-various configurations-components-forces on the vehicle during atmospheric flight-nose cone design and drag estimation

UNIT III AERODYNAMICS OF SLENDER AND BLUNT BODIES 9

Aerodynamics of slender and blunt bodies, wing-body interference effects-Asymmetric flow separation and vortex shedding-unsteady flow characteristics of launch vehicles- determination of aero elastic effects.

UNIT IV AERODYNAMIC ASPECTS OF LAUNCHING PHASE 9

Booster separation-cross wind effects-specific considerations in missile launching-missile integration and separation-methods of evaluation and determination- Wind tunnel tests – Comparison with CFD Analysis.

UNITV STABILITY AND CONTROL OF MISSILES 9

Forces and moments acting on missiles-Lateral, rolling and longitudinal moments-missile

dispersion-stability aspects of missile configuration-Aerodynamic control methods-Jet control methods-Stability derivatives.

REFERENCES:

1. Anderson, J.D., "Fundamentals of Aerodynamics", McGraw-Hill Book Co., New York, 1985.
2. Chin SS, Missile Configuration Design, McGraw Hill, New York, 1961.
3. John D. Anderson. Jr., "Hypersonic and High Temperature Gas Dynamics", AIAA; 2nd edition, 2006
4. Nielsen, Jack N, Stever, Gutford, "Missile Aerodynamics", McGraw Hill, New York, 1960.
5. John D. Anderson. Jr., "Modern Compressible flow with historical Perspective", McGraw Hill Publishing Company, 3rd edition, 2002.

AER17R315 STRUCTURAL DYNAMICS	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: MEC17R271	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Facilitate students to analyze the vibrational effects on structure using direct and approximate methods.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Explain the force deflection properties of structures
CO2: Inspect the vibrations and response to vibration of the system.
CO3: Examine the natural modes of vibrations.
CO4: Dissect the choice of energy methods for vibration analysis.
CO5: Examine a range of approximate methods for vibration analysis.

Mapping of Course Outcome(s):

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

UNIT I FORCE DEFLECTION PROPERTIES OF STRUCTURES 9

Constraints and Generalized coordinates – Virtual work and generalized forces – Force – Deflection influence functions – stiffness and flexibility methods.

UNIT II PRINCIPLES OF DYNAMICS 9

Free and forced vibrations of systems with finite degrees of freedom – Response to periodic excitation – Impulse Response Function – Convolution Integral

UNIT III NATURAL MODES OF VIBRATION 9

Equations of motion for Multi degree of freedom Systems - Solution of Eigen value problems – Normal coordinates and orthogonality Conditions. Modal Analysis.

UNIT IV ENERGY METHODS **9**

Rayleigh's principle – Rayleigh – Ritz method – Coupled natural modes – Effect of rotary inertia and shear on lateral vibrations of beams – Natural vibrations of plates.

UNIT V APPROXIMATE METHODS **9**

Approximate methods of evaluating the Eigen frequencies and Eigen vectors by reduced, subspace, Lanczos, Power, Matrix condensation and QR methods.

TEXT BOOKS:

1. F.S. Tse, I.E. Morse and H.T. Hinkle, "Mechanical Vibrations: Theory and Applications" ,Prentice Hall of India Pvt. Ltd, New Delhi, 2004.
2. W.C. Hurty and M.F. Rubinstein, "Dynamics of Structures", Prentice Hall of India Pvt. Ltd., New Delhi 1987.

REFERENCES:

1. R.K. Vierck, "Vibration Analysis", 2nd Edition, Thomas Y. Crowell & Co Harper &Row Publishers, New York, U.S.A. 1989.
2. S.P. Timoshenko ad D.H. Young, "Vibration Problems in Engineering", John Willey& Sons Inc., 1984.
3. V.Ramamurthi, "Mechanical Vibration Practice and Noise Control" Narosa Publishing House Pvt. Ltd, 2008.

AER17R316 THEORY OF PLATES AND SHELLS	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: MEC17R271	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Enable the students to formulate the governing equation for thin plates under different loading conditions.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Formulate the governing equation for thin plates under different loading conditions

CO2: Determine reaction forces acting on a simply supported rectangular plates using Navier's Method and Levy's Method

CO3: Determine reaction forces acting on a simply supported circular plates

CO4: Interpret the natural frequency of rectangular plates with different loading conditions

CO5: Determine natural frequency of rectangular plates using approximate methods

Mapping of Course Outcome(s):

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

UNIT I CLASSICAL PLATE THEORY **8**

Assumptions – Governing Equation – Boundary Conditions – Methods of Solution

UNITII RECTANGULAR PLATES **10**

Navier's Method of Solution for Simply Supported Rectangular Plates – Levy's Method of Solution for Rectangular Plates under Different Boundary Conditions and loadings.

UNIT III CIRCULAR PLATES **9**

Governing equation. Boundary conditions. Bending of circular and annular plates for different support conditions and loading cases.

UNIT IV STABILITY AND FREE VIBRATION ANALYSIS **8**

Governing equation for buckling of plates. Buckling analysis of simply supported plates for different loadings. Governing equation for free vibration of rectangular plates. Natural frequency for rectangular plates for different boundary conditions.

UNIT V APPROXIMATE METHODS **10**

Rayleigh – Ritz, Galerkin Methods– Finite Difference Method – Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.

TEXT BOOKS:

1. Timoshenko, S.P. Winowsky. S., and Kreger, Theory of Plates and Shells, McGraw Hill Book Co., 1990.
2. Ansel Ugural, Stresses in Plates & Shells, McGraw Hill, 1981
3. Varadhan.T.K. & Bhaskar.K., "Analysis of Plates – Theory and Problems", Narosa Publishing House, 2000

REFERENCES:

1. Flugge, W. Stresses in Shells, Springer – Verlag, 1985.
2. Timoshenko, S.P. and Gere, J.M., Theory of Elastic Stability, Dover Publications Inc.; 2nd Revised edition, 2009
3. Harry Kraus, 'Thin Elastic Shells', John Wiley and Sons, 1987.
4. Lloyd Hamilton, Donald, "Beams, Plates and Shells", McGraw Hill, 1976.
5. Reddy.J.N., "Theory & Analysis of Elastic Plates and Shells (Series in Systems and Control)", CRC press, 2nd Edition, 2006

AER17R317 UAV SYSTEM DESIGN	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: AER17R201	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Enable the students to design the UAV systems.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: outline the fundamentals of UAV
CO2: illustrate the designs of UAV systems.
CO3: select the avionics hardware systems for the configuration
CO4: estimate the payloads and operation range.
CO5: test the UAV and develop ground control software

Mapping of Course Outcome(s):

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

UNIT I INTRODUCTION TO UAV **9**

History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications

UNIT II THE DESIGN OF UAV SYSTEMS **9**

Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations- Characteristics of Aircraft Types- Design Standards and Regulatory Aspects-UK,USA and Europe- Design for Stealth--control surfaces-specifications.

UNIT III AVIONICS HARDWARE **9**

Autopilot –AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supply- processor, integration, installation, configuration, and testing

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS **9**

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting

UNIT V DEVELOPMENT OF UAV SYSTEMS **9**

Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing- Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.

REFERENCES:

1. Reg Austin "unmanned aircraft systems UAV design, development and deployment", Wiley, 2010.
2. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
3. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007
4. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998,
5. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems",Lockheed Martin Aeronautics Company, 2001

AER17R318 WIND ENGINEERING	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: AER17R201	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Facilitate students to understand the properties of atmosphere, formulate the governing equations of atmospheric boundary layer.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Infer the properties of atmosphere

CO2: Formulate the governing equations of atmospheric boundary layer
CO3: Characterize the flow within a boundary layer
CO4: Estimate wind loading using various assessment methods
CO5: Interpret the structural and aerodynamic factor that influences the aerodynamic problems

Mapping of Course Outcome(s):

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

UNIT I THE ATMOSPHERE **6**

Atmospheric Circulation - Stability of atmospheres -definitions & implications - Effects of friction - atmospheric motion - Local winds, Building codes, Terrains different types.

UNIT II ATMOSPHERIC BOUNDARY LAYER **9**

Governing Equations - Mean velocity profiles, Power law, logarithmic law wind speeds, Atmospheric Turbulence profiles - Spectral density function -. Length scale of turbulence, .Roughness parameters simulation techniques in wind tunnels.

UNIT III BLUFF BODY AERODYNAMICS **10**

Governing equations Boundary layers and separations - Wake and Vortex formation two dimensional- StroUhal Numbers, Reynolds numbers-Separation and Reattachments Oscillatory Flow.patterns Vortex shedding flows -Time varying forces to Wind velocity in turbulent flow - Structures in three dimensional

UNIT IV WIND LOADING: **10**

Introduction, Analysis and synthesis. Loading coefficients, local• & global coefficients pressure shear stress coefficients, force and moment coefficients - Assessment methods - Quasi steady method - Peak factor method - Extreme value method.

UNIT V AERO ELASTIC PHENOMENA: **10**

Vortex shedding and lock in phenomena in turbulent flows, across wind' galloping wake galloping Torsional divergence, along wind galloping of circular cables, cross wind galloping of circular dibble's', Wind loads &. Turbulent effects on tall. Structure - Launch vehicles.

TEXT BOOKS:

1. Emil Simiu & Robert H Scanlan, 'Wind effects of structures fundamentals and applications to design; John Wiley & Sons INC New York, 3rd edition, 1996.

REFERENCES:

1. Tom Lawson, "Building Aerodynamics",Imperial College Press London, 1st edition, 2001.
2. Cook N J, Design Guides to wind loading of buildings structures. Part I & II, Burterworths, London, 1990 .

AER17R319 DISASTER MANAGEMENT	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: NIL	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

To understand student's importance of disaster management, develop the approaches to disaster risk detections.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Define disaster and its nature
CO2: Develop the approaches to disaster risk detections
CO3: Summarize the inter-relationship between disaster and development
CO4: Interpret the disaster risk management in India
CO5: Adapt the disaster management policies for various applications

Mapping of Course Outcome(s):

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

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS **9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TEXTBOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

AER17R403 FUNDAMENTALS OF NANO SCIENCE	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: NIL	**Course Category:** Open Elective **Course Type:** Theory			

Course Objective(s):

Make the students to understand the concepts of Nano science and technologies, and analyze the properties and its applications.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Define Nanoscale science and technology and infer the concepts of Nano structured materials.
CO2: Demonstrate the preparation techniques of Nano particles.
CO3: Analyze the nano materials, properties and its applications
CO4: Outline the characterization techniques of nano Technology.
CO5: Summarize the applications of nano materials

Mapping of Course Outcome(s):

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

UNIT I INTRODUCTION **8**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION **9**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS **12**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, 92 Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structureproperty Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays-functionalization and applicationsQuantum wires, Quantum dots preparation, properties and applications

UNIT IV CHARACTERIZATION TECHNIQUES **9**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

UNIT V APPLICATIONS **7**

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TEXT BOOKS

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale characterization of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES

1. G Timp (Editor), "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia The Hand Book of Nano Technology,Nanometer Structure, Theory, Modeling and Simulations", Prentice-Hall of India (P) Ltd, New Delhi, 2007.

AER17R405 AIRCRAFT SYSTEMS ENGINEERING	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: NIL	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Facilitate students to infer the fundamental concepts of various aircraft systems, identify the factors influences the control configuration.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Infer the fundamental concepts of various aircraft systems

CO2: Test and operate the aircraft control systems

CO3: Integrate mechanical systems with electronic systems
CO4: Identify the factors that influences the control configurations
CO5: Detect the failures in the aircraft control systems

Mapping of Course Outcome(s):

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

UNIT I INTRODUCTION TO SYSTEMS ENGINEERING 9

Overview-Systems Definition and Concepts-Conceptual System Design- System Engineering Process-Everyday examples of systems-Aircraft systems

UNIT II DESIGN AND DEVELOPMENT PROCESS 9

Product Life Cycle –Concept Phase-Definition Phase-Design Phase-Build, Test, Operate and Disposal Phase-Whole Life Cycle Tasks-Systems Analysis- Design Drivers in the Project, Product, Operating Environment-Interfaces with the Subsystems.

UNIT III SYSTEM ARCHITECTURES AND INTEGRATION 9

Systems Architectures-Modeling and Trade-Offs- Evolution of Avionics Architectures-Systems Integration Definition- Examples of Systems Integration-Integration Skills-Management of Systems Integration

UNIT IV PRACTICAL CONSIDERATIONS AND CONFIGURATION CONTROL 9

Stake holders-Communications-Criticism- Configuration Control Process-Portrayal of a System-Varying Systems Configurations- Compatibility-Factors Affecting Compatibility – Systems Evolution Considerations and Integration of Aircraft Systems.

UNIT V SYSTEMS RELIABILITY AND MAINTAINABILITY 9

Systems and Components-Analysis-Influence, Economics, Design for Reliability-Fault and Failure Analysis-Case Study-Maintenance Types-Program-Planning and Design.

REFERENCES:

1. Peter.Sydenham , “Systems Approach to Engineering”, Artech house, Inc, London, 2004.
2. Aslaksen, Erik and Rod Belcher, “Systems Engineering”, Prentice Hall, 1992.
3. Allan G. Seabridge and Ian Moir, “Design and Development of Aircraft Systems: An Introduction “, (AIAA Education Series), 2004.
4. Andrew P. Sage, James E., Jr. Armstrong, "Introduction to Systems Engineering (Wiley Series in Systems Engineering and Management)”, 2000.

AER17R406 AIRFRAME REPAIR AND MAINTENANCE	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: AER17R202	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Airframe maintenance & repair deals with the maintenance and safety precautions and procedures of airframe systems and their troubleshooting practices.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Explain the welding, brazing process with the requirements of the process and significance of NDT
CO2: Interpret the various maintenance practices in plastic and composite parts of aircraft
CO3: Comprehend the precautionary steps involved in rigging, Jacking process
CO4: Gain through Understanding in parts, working methodology of basic aircraft systems.
CO5: Get a clear idea about safety practices and troubleshooting on an aircraft.

Mapping of Course Outcome(s):

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

UNIT I WELDING IN AIRCRAFT STRUCTURAL COMPONENTS 9

Equipments used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing. Sheet metal repair and maintenance: Selection of materials; Repair schemes; Fabrication of replacement patches; Tools - power/hand; Repair techniques; Close tolerance fasteners; Sealing compounds; forming/shaping; Calculation of weight of completed repair; Effect of weight - change on surrounding structure. Sheet metal inspection - N.D.T. Testing. Riveted repair design - Damage investigation - Reverse engineering.

UNIT II PLASTICS AND COMPOSITES IN AIRCRAFT 9

PLASTICS IN AIRCRAFT: Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks, holes etc., and various repairs schemes - Scopes. ADVANCED COMPOSITES IN AIRCRAFT: Cleaning of fibre reinforced plastic (FRP) materials prior to repair; Break test - Repair Schemes; FRP/honeycomb sandwich materials; laminated FRP structural members and skin panels; Tools/equipment; Vacuum-bag process. Special precautions – Autoclaves

UNIT III AIRCRAFT JACKING, ASSEMBLY AND RIGGING 9

Airplane jacking and weighing and C.G. Location. Balancing of control surfaces - Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

UNIT IV REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM 10

Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments - handling - Testing - Inspection. Inspection and maintenance of auxiliary systems - Fire protection systems - Ice protection system - Rain removal system -Position and warning system - Auxiliary Power Units (APUs).

UNIT V SAFETY PRACTICES 8

Hazardous materials storage and handling, Aircraft furnishing practices - Equipments. Trouble shooting.Theory and practices.

TEXT BOOKS:

1. Kroes, Watkins, Delp, "Aircraft Maintenance and Repair ", McGraw Hill, New York, 1992.

REFERENCES:

1. Larry Reithmeir, “Aircraft Repair Manual ", Palamar Books, Marquette, 1992. 2.
Brimm D.J. Bogges H.E., "Aircraft Maintenance ", Pitman Publishing corp.,
NewYork, 1940.
3. Delp. Bent and Mckinely “Aircraft Maintenance Repair”, McGraw Hill, New York,1987.

AER17R407 AVIONICS	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: NIL	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

To introduce the basic concepts of navigation and communication systems of aircraft

Course Outcome(s):

After completing this course, the student will be able to:

CO1: design and fabricate of modern aircraft component cockpit.
CO2: identify various cockpits in real time
CO3: identify real time applications of microprocessor in aircraft
CO4: apply basic concepts to aircraft instruments for efficient output
CO5: aware of communication and navigation systems and their applications

Mapping of Course Outcome(s):

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

UNIT I INTRODUCTION TO AVIONICS 9

Need for avionics in civil and military aircraft and space systems – Integrated avionics and weapon systems – Typical avionics subsystems, design, technologies – Introduction to Digital Computer and memories.

UNIT II DIGITAL AVIONICS ARCHITECTURE 9

Avionics system architecture – Data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629.

UNIT III FLIGHT DECKS AND COCKPITS 9

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

UNIT IV INTRODUCTION TO NAVIGATION SYSTEMS 9

Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.

UNIT V AIR DATA SYSTEMS AND AUTO PILOT 9

Air data quantities – Altitude, Air speed, Vertical speed, Mach number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

TEXT BOOKS:

1. Albert Helfrick.D., Principles of Avionics, Avionics Communications Inc., 2004
2. Collinson.R.P.G. Introduction to Avionics, Chapman and Hall, 1996.

REFERENCES:

1. Middleton, D.H., Ed., Avionics systems, Longman Scientific and Technical,
2. Longman Group UK Ltd., England, 1989.
3. Spitzer, C.R. Digital Avionics Systems, Prentice-Hall, Englewood Cliffs, N.J.,U.S.A. 1993.

4. Spitzer. C.R. The Avionics Hand Book, CRC Press, 2000
5. Pallet.E.H.J., Aircraft Instruments and Integrated Systems, Longman Scientific

AER17R408 COMBUSTION IN AEROSPACE VEHICLES	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: AER17R204	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

To make the students to examine the characteristics of flame and factors influencing the combustion efficiency.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Examine the characteristics of flames
CO2: Interpret the factors affecting the combustion efficiency and to prevent the detonation.
CO3: Estimate the combustor sizing parameters and its combustion efficiency
CO4: Examine the influences of shock waves in supersonic combustion
CO5: Categorize the performance characteristics of different chemical rockets

Mapping of Course Outcome(s):

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

UNIT I FUNDAMENTAL CONCEPTS IN COMBUSTION, CHEMICAL KINETICS AND FLAMES 9

Thermochemical equations – heat of reaction- first, second and third order reactions – premixed flames – diffusion flames – laminar and turbulent flames - measurement of burning velocity – various methods – effect of various parameters on burning velocity – flame stability – deflagration – detonation – Rankine-Hugoniot curves – radiation by flames

UNIT II COMBUSTION IN AIRCRAFT PISTON ENGINES 9

Introduction to combustion in aircraft piston engines – various factors affecting the combustion efficiency - fuels used for combustion in aircraft piston engines and their selection – detonation in piston engine combustion and the methods to prevent the detonation

UNIT III COMBUSTION IN GAS TURBINE AND RAMJET ENGINES 9

Combustion in gas turbine combustion chambers - recirculation – combustion efficiency, factors affecting combustion efficiency, estimation of adiabatic flame temperature in gas turbine combustion chambers – combustion stability –differences between the design of combustion chambers of ramjet and gas turbine engines - various types of flame holders for combustion chambers – salient features of after-burners

UNIT IV SUPERSONIC COMBUSTION 9

Introduction to supersonic combustion – supersonic combustion controlled by diffusion, mixing and heat convection – analysis of reactions and mixing processes - supersonic burning with detonation shocks - various types of supersonic combustors – high intensity combustors.

UNIT V COMBUSTION IN SOLID, LIQUID AND HYBRID ROCKETS 9

Solid propellant combustion - double and composite propellant combustion – various combustion models – combustion in liquid rocket engines – single fuel droplet combustion model – combustion models for hybrid rockets

TEXT BOOKS:

1. Sharma, S.P., and Chandra Mohan, "Fuels and Combustion", Tata Mc. Graw Hill Publishing Co., Ltd., New Delhi, 1987.
2. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 2nd edition 2014.

REFERENCES:

1. Loh, W.H.T., "Jet, Rocket, Nuclear, Ion and Electric Propulsion: Theory and Design(Applied Physics and Engineering)", Springer Verlag, New York, 2012.
2. Beer, J.M., and Chegar, N.A. "Combustion Aerodynamics", Applied Science Publishers Ltd., London, 1981.
3. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons; 8th Edition 2010.

AER17R409 DESIGN OF GAS TURBINE ENGINE COMPONENTS	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: AER17R204	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Enable the students to design the aircraft engine components.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Estimate the preliminary design parameters of aircraft engine components
CO2: Characterize the flow properties and examine the engine performance
CO3: Investigate the rotary components and its aerodynamic performance
CO4: Design the subsonic combustion chamber
CO5: Differentiate nozzle and diffuser functions, its geometry.

Mapping of Course Outcome(s):

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

UNIT I GAS TURBINE ENGINE DESIGN FUNDAMENTALS 8

Design Process- compressible flow relationship; Constrain Analysis- Concept-Design tools-preliminary estimates; Mission analysis-Concept- design tools-Aircraft weight and fuel consumption data-Example problems on Constrain analysis, Mission analysis

UNIT II ON DESIGN AND OFF-DESING PARAMETRIC ANALYSIS 9

Total and static properties-corrected mass flow rate-Engine Cycle Design- One-Dimensional Through flow Area-Flow path force on components- aircraft constraint analysis, aircraft mission

analysis, engine parametric (design point) analysis, engine performance (offdesign) analysis, engine installation drag and sizing.

UNIT III DESIGN OF ROTATING COMPONENTS 10

Engine Component Design-Fan and Compressor Aerodynamics-Diffusion factorAerofoil geometry-Flow path dimension-Radial variation-Turbine Aerodynamics- Constant axial velocity-adiabatic-selected Mach number-Mean line stage Design-stage pressure ratio-Airfoil geometry-radial variation-turbine cooling-range of turbine parameter-Engine lifeDesign Example –fan-compressor-turbine.

UNIT IV COMBUSTION CHAMBER DESIGN 9

Engine Component Design: Combustion system components- Combustion- Chemical reactor theory. Combustor Stability map-Stirring and mixing-Total pressure loss-FuelsIgnition-Combustion Systems of Main Burner Design: Air partitioning- Main burner component Design: Diffuser-types of burner-inner and outer casing Design-Fuel- nozzle-

Dome and liner-Primary zone- swirler- Secondary holes-Dilution holes-Transition duct-Example Design calculation: Design of Afterburners-Design parameters-Components Diffuser-Fuel injection-Ignition-Flame stabilization- Flame spread and after burner length Examples design calculation.

UNIT V INLET AND NOZZLE DESIGN 9

Inlets and Exhaust Nozzles Design: Elements of a Successful Inlet-Engine Integration Program- Definition of Subsonic Inlet-Engine Operational Requirements- Definition of Supersonic Inlet- Engine Operational Requirements- Engine Impact on Inlet Design- Inlet Impact on Engine Design- Validation of Inlet-Engine System-Exhaust nozzle design-Nozzle types and their design -Jet control methods for reduction of infrared signature-Simple design problem on dimensional nozzle flow

TEXT BOOKS:

1. Aircraft Engine Design, Second Edition, by J.D. Mattingly, W.H. Heiser, and D.T. Pratt, 2002, AIAA Education Series, AIAA
2. Aircraft Propulsion Systems Technology and Design, by G.C. Oates (ed.), 1989, AIAA Education Series, AIAA
3. H.I.H. Saravanamuttoo , G.F.C. Rogers, "Gas Turbine Technology", Pearson Education Canada; 6th edition, 2008.

REFERENCES:

1. High-Speed Flight Propulsion Systems, by S.N. Murthy and E.T. Curran (eds.), 1991, Volume 137, Progress in Astronautics and Aeronautics, AIAA 2. N. Cumpsty , "Jet Propulsion: A Simple Guide to the Aerodynamics and Thermodynamics Design and Performance of Jet Engines" , Cambridge University Press; 2 edition, 2003
3. Applied Gas Dynamics, by E.Rathakrishnan, John Wiley & Sons (Asia) Pvt Ltd, 2010.
4. Aircraft Gas Turbine Engine Technology, 3rd ed., by I.E. Treager, 1995, Glencoe McGraw- Hill, Inc.

AER17R410 HELICOPTER AERODYNAMICS	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: AER17R301	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Facilitate students to determine the geometry parameters of main rotor, analyze the aerodynamic characteristics of main rotor blade.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: determine the geometry parameters of main rotor

CO2: construe the aerodynamic characteristics of main rotor blades

CO3: characterize the aerodynamic performance of helicopter

CO4: Characterize the static and dynamic stability performance of helicopter at low Mach numbers.

CO5: Infer the vibrational effects of helicopter main rotors.

Mapping of Course Outcome(s):

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

UNIT I INTRODUCTION **9**

Helicopter as an aircraft, Basic features, Layout, Generation of lift, Main rotor, Gearbox, tail rotor, power plant, considerations on blade, flapping and feathering, Rotor controls and various types of rotor, Blade loading, Effect of solidity, profile drag, compressibility etc., Blade area required, number of Blades, Blade form, Power losses, Rotor efficiency.

UNIT II AERODYNAMICS OF ROTOR BLADE **9**

Aerofoil characteristics in forward flight, Hovering and Vortex ring state, Blade stall, maximum lift of the helicopter calculation of Induced Power, High speed limitations; parasite drag, power loading, ground effect.

UNIT III POWER PLANTS AND FLIGHT PERFORMANCE **9**

Piston engines, Gas turbines, Ramjet principle, Comparative performance, Horsepower required, Range and Endurance, Rate of Climb, Best Climbing speed, Ceiling in vertical climb, Autorotation.

UNIT IV STABILITY AND CONTROL **9**

Physical description of effects of disturbances, Stick fixed Longitudinal and lateral dynamic stability, lateral stability characteristics, control response. Differences between stability and control of airplane and helicopter.

UNIT V ROTOR VIBRATIONS **9**

Dynamic model of the rotor, Motion of the rigid blades, flapping motion, lagging motion, feathering motion, Properties of vibrating system, phenomenon of vibration, fuselage response, vibration absorbers, Measurement of vibration in flight. Rotor Blade Design: General considerations, Airfoil selection, Blade construction, Materials, Factors affecting weight and cost, Design conditions, Stress analysis.

TEXT BOOKS:

1. John Fay, Helicopter: history, piloting and How It Flies, Himalayan Books 1995.
2. Lalit Gupta, Helicopter Engineering; Himalayan Books New Delhi 1996.

REFERENCES:

1. Joseph Schafer, Basic Helicopter Maintenance (Aviation Technician Training Course-JS312642), Jeppesen 1980.
2. R W Prouty, Helicopter Aerodynamics, Phillips Pub Co, 1993.

AER17R411 HYPERSONIC AERODYNAMICS	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: AER17R301	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Enable the students to estimate lift coefficient, examine the high temperature effects on airframe.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: differentiate hypersonic aerodynamics from supersonic aerodynamics
CO2: Estimate lift co-efficient using Newtonian theory.
CO3: Infer the effect of boundary layer and aerodynamic heating on airframe
CO4: Summarize viscous interaction in hypersonic flow
CO5: Examine the high temperature effects on airframe.

Mapping of Course Outcome(s):

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

UNIT I FUNDAMENTALS OF HYPERSONIC AERODYNAMICS 9

Introduction to hypersonic aerodynamics – differences between hypersonic aerodynamics and supersonic aerodynamics - concept of thin shock layers and entropy layers – hypersonic flight paths – hypersonic similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.

UNIT II SIMPLE SOLUTION METHODS FOR HYPERSONIC INVISCID FLOWS 9

Local surface inclination methods – Newtonian theory – modified Newtonian law tangent wedge and tangent cone and shock expansion methods – approximate methods - hypersonic small disturbance theory – thin shock layer theory- blast wave theory-hypersonic equivalence principle.

UNIT III VISCOUS HYPERSONIC FLOW THEORY 9

Boundary layer equations for hypersonic flow – hypersonic boundary layers – self similar and non self-similar boundary layers – solution methods for non self-similar boundary layers – aerodynamic heating and its adverse effects on airframe.

UNIT IV VISCOUS INTERACTIONS IN HYPERSONIC FLOWS 9

Introduction to the concept of viscous interaction in hypersonic flows - Strong and weak viscous interactions - hypersonic viscous interaction similarity parameter – introduction to shock wave boundary layer interactions.

UNIT V HIGH TEMPERATURE EFFECTS IN HYPERSONIC FLOWS 9

Nature of high temperature flows – chemical effects in air – real and perfect gases – Gibb's free energy and entropy - chemically reacting boundary layers – recombination and dissociation.

TEXT BOOKS:

1. John D. Anderson. Jr., "Hypersonic and High Temperature Gas Dynamics", AIAA; 2nd Edition, 2006

REFERENCES:

1. John D. Anderson. Jr., "Modern Compressible flow with historical Perspective", McGraw Hill Publishing Company, 3rd edition,, 2002.
2. John T. Bertin, "Hypersonic Aerothermodynamics", published by AIAA Inc., Washington. D.C., 1994.

AER17R412 NUMERICAL HEAT TRANSFER	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: AER17R451	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

The course intended to build up necessary background for understanding the physical behavior of various modes of heat transfer like conduction, convection and radiation numerically.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Formulate the governing equations for heat transfer problems using Taylor series.
CO2: Apply knowledge on conduction heat transfer and perform its calculations.
CO3: Solve transient heat conduction real time problems
Co4: Solve free convection real time problems
Co5: Examine the factors influencing radiation heat transfer

Mapping of Course Outcome(s):

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

UNIT I INTRODUCTION **9**

Finite Difference Method-Introduction-Taylor's series expansion-Discretisation Methods Forward, backward and central differencing scheme for first order and second order Derivatives – Types of partial differential equations-Types of errors. Solution to algebraic equation-Direct Method and Indirect Method-Types of boundary condition.FDM - FEM - FVM.

UNIT II CONDUCTIVE HEAT TRANSFER **9**

General 3D-heat conduction equation in Cartesian, cylindrical and spherical coordinates. Computation(FDM) of One –dimensional steady state heat conduction with Heat generation-without Heat generation- 2D-heat conduction problem with different boundary conditions-Numerical treatment for extended surfaces. Numerical treatment for 3D- Heat conduction. Numerical treatment to 1D-steady heat conduction using FEM.

UNIT III TRANSIENT HEAT CONDUCTION **9**

Introduction to Implicit, explicit Schemes and crank-Nicolson Schemes Computation(FDM) of One– dimensional un-steady heat conduction –with heat Generation-without Heat generation - 2D-transient heat conduction problem with different boundary conditions using Implicit, explicit

Schemes. Importance of Courant number. Analysis for I-D,2-D transient heat Conduction problems.

UNIT IV CONVECTIVE HEAT TRANSFER 9

Convection- Numerical treatment (FDM) of steady and unsteady 1 -D and 2-d heat convection-diffusion steady-unsteady problems- Computation of thermal and Velocity boundary layer flows. Upwind scheme.Stream function-vorticity approach-Creeping flow.

UNIT V RADIATIVE HEAT TRANSFER 9

Radiation fundamentals-Shape factor calculation-Radiosity method- Absorption Method – Montacalro method-Introduction to Finite Volume Method- Numerical treatment of radiation enclosures using finite Volume method. Developing a numerical code for 1D, 2D heat transfer problems.

REFERENCES:

1. Necati Ozisik, Finite Difference Method in Heat Transfer, CRC Press, second edition, 1994.
2. Yogesh Jaluria, Kenneth E Torrence, Computational Heat transfer, CRC Press, second edition, 2002.
3. Pradip Majumdar, Computational Methods for Heat & Mass Transfer, CRC Press, 2005
4. Yunus A. Cengel, Heat Transfer – A Practical Approach Tata McGraw Hill Edition, 2003.
5. Sachdeva,S.C., Fundamentals of Engineering Heat and Mass Transfer, NEW AGE publishers,2010.
6. John D. Anderson, JR" Computational Fluid Dynamics", McGraw-Hill Book Co., Inc., New York, 1995.
7. T.J. Chung, Computational Fluid Dynamics, Cambridge University Press, 2002.

AER17R413 SATELLITE TECHNOLOGY	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: NIL	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Facilitate students to examine the structural configurations and to select the materials for satellite.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Define the stabilization axis, spacecraft orbits
CO2: Ensure the orbit orientation of satellites
CO3: Examine the structural configurations and to select the materials for satellite
CO4: Estimate moment co-efficient for trajectory controls
CO5: Outline the ground control systems to control the spacecraft

Mapping of Course Outcome(s):

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

UNIT I INTRODUCTION TO SATELLITE SYSTEMS 9

Common satellite applications and missions – Typical spacecraft orbits – Definitions of spin the three axis stabilization-Space environment – Launch vehicles – Satellite system and their functions (structure, thermal, mechanisms, power, propulsion, guidance and control, bus electronics).

UNIT II ORBITAL MECHANICS 9

Fundamental of flight dynamics – Time and coordinate systems – Orbit determination and prediction – Orbital maneuvers – GPS systems and application for satellite/orbit determination – Ground station network requirements

UNIT III SATELLITE STRUCTURES & THERMAL CONTROL 9

Satellite mechanical and structural configuration: Satellite configuration choices, launch loads, separation induced loads, deployment requirements – Design and analysis of satellite structures – Structural materials and fabrication – The need of thermal control: externally induced thermal environment – Internally induced thermal environment - Heat transfer mechanism: internal to the spacecraft and external heat load variations – Thermal control systems: active and passive methods.

UNIT IV SPACECRAFT CONTROL 9

Control requirements: attitude control and station keeping functions, type of control maneuvers – Stabilization schemes: spin stabilization, gravity gradient methods, 3 axis stabilization – Commonly used control systems: mass expulsion systems, momentum exchange systems, gyro and magnetic torque - Sensors star and sun sensors, earth sensor, magnetometers and inertial sensors

UNIT V POWER SYSTEM AND BUS ELECTRONICS 9

Solar panels: Silicon and Ga-As cells, power generation capacity, efficiency – Space battery systems – battery types, characteristics and efficiency parameters – Power electronics. Telemetry and telecommand systems: Tm & TC functions, generally employed communication bands (UHF/VHF, S, L, Ku, Kaetc), their characteristics and applications- Coding Systems – Onboard computer-Ground checkout Systems.

TEXT BOOKS:

1. Analysis and Design of Flight Vehicle Structures, Tri-State off set company, USA, 1980.
2. Space Systems Engineering Rilay, FF, McGraw Hill, 1982.
3. Principles of Astronautics Vertregt.M.,Elsevier Publishing Company, 1985.
4. Introduction Space Flight, Francis J. Hale Prentice Hall, 1994.
5. Space Vehicle Design, Michael D. Griffin and James R. French, AIAA Education Series, 1991.

REFERENCES:

1. Spacecraft Thermal Control, Hand Book, Aerospace Press, 2002.
2. Structural Design of Missiles & Space Craft Lewis H. Abraham, McGraw Hill, 92. 3. Space Communications Systems, Richard.F, Filipowsky Eugen I Muehllorf, Prentice Hall, 1995.
4. Hughes, P.C. Spacecraft Altitude Dynamics, Wilsey, 1986.

AER17R414 SPACE MECHANICS	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: NIL	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Facilitate students explain the laws for planetary motion, evaluate influence coefficient, perturbation velocity.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Describe the space environment, its effect on materials

CO2: Explain the laws for planetary motion.

CO3: Evaluate the perturbation velocities using Cowell's method and Encke's method.

CO4: Interpret the interplanetary trajectory motion

CO5: Infer the influence co-efficient on ballistic missile trajectory

Mapping of Course Outcome(s):

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

UNIT I SPACE ENVIRONMENT **8**

Peculiarities of space environment and its description– effect of space environment on materials of spacecraft structure and astronauts- manned space missions – effect on satellite life time

UNIT II BASIC CONCEPTS AND THE GENERAL N- BODY PROBLEM **10**

The solar system – reference frames and coordinate systems – terminology related to the celestial sphere and its associated concepts – Kepler's laws of planetary motion and proof of the laws – Newton's universal law of gravitation - the many body problem - LagrangeJacobi identity – the circular restricted three body problem – libration points – the general N-body problem – two body problem – relations between position and time.

UNIT III SATELLITE INJECTION AND SATELLITE PERTURBATIONS **10**

General aspects of satellite injection – satellite orbit transfer – various cases – orbit deviations due to injection errors – special and general perturbations – Cowell's method and Encke's method – method of variations of orbital elements – general perturbations approach.

UNIT IV INTERPLANETARY TRAJECTORIES **8**

Two-dimensional interplanetary trajectories – fast interplanetary trajectories – three dimensional interplanetary trajectories – launch of interplanetary spacecraft – trajectory estimation about the target planet – concept of sphere of influence – Lambert's theorem

UNIT V BALLISTIC MISSILE TRAJECTORIES **9**

Introduction to ballistic missile trajectories – boost phase – the ballistic phase – trajectory geometry – optimal flights – time of flight – re-entry phase – the position of impact point – influence coefficients.

TEXT BOOKS:

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W. Freeman &Co.,Ltd, London, 1982
2. Parker, E.R., "Materials for Missiles and Spacecraft", Mc.Graw Hill Book Co. Inc., 1982.

REFERENCES:

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons; 8th Edition 2010.

AER17R415 THEORY OF ELASTICITY	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: MEC17R271	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

To study the behavior of various aircraft structural components under different types of loads.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: formulate stress tensor matrix, find its components

CO2: estimate stress components using Airy's stress function

CO3: derive the equations of equilibrium for rotating discs

CO4: determine polar moment of inertia for shafts with cross section such as circular, elliptical, equilateral triangle

CO5: derive the equation of equilibrium for plates and shells with different loading conditions.

Mapping of Course Outcome(s):

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

UNIT I BASIC EQUATIONS OF ELASTICITY **9**

Definition of Stress and Strain: Stress - Strain relationships - Equations of Equilibrium, Compatibility equations, Boundary Conditions, Saint Venant's principle - Principal Stresses, Stress Ellipsoid - Stress invariants.

UNIT II PLANE STRESS AND PLANE STRAIN PROBLEMS **9**

Airy's stress function, Bi-harmonic equations, Polynomial solutions, Simple two dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.

UNIT III POLAR COORDINATES **9**

Equations of equilibrium, Strain - displacement relations, Stress – strain relations, Airy's stress function, Axi – symmetric problems, Introduction to Dunder's table, Curved beam analysis, Lame's, Kirsch, Michell's and Boussinesque problems – Rotating discs.

UNIT IV TORSION **9**

Navier's theory, St. Venant's theory, Prandtl's theory on torsion, semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections. Membrane Analogy.

UNIT V INTRODUCTION TO THEORY OF PLATES AND SHELLS **9**

Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier's method of solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions.

TEXT BOOKS:

1. Timoshenko, S.P, and Goodier, T.N., Theory of Elasticity, McGraw – Hill Ltd., Tokyo, 1990.
2. Ansel C Ugural and Saul K Fenster, 'Advanced Strength and Applied Elasticity', 4th Edition, Prentice Hall, New Jersey,4th edition 2003.
3. Bhaskar, K., and Varadan, T. K., Theory of Isotropic/Orthotropic Elasticity, CRC Press USA, 2009.

REFERENCES:

1. Wang, C. T., Applied Elasticity, McGraw – Hill Co., New York, 1993.
2. Sokolnikoff, I. S., Mathematical Theory of Elasticity, McGraw – Hill, New York, 1978.
3. Volterra& J.H. Caines, Advanced Strength of Materials, Prentice Hall, New Jersey, 1991
4. Barber, J. R., Elasticity (Solid Mechanics and Its Applications), Springer publishers, 3rd edition,2010.

AER17R417 WIND TUNNEL TECHNIQUES	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: AER17R201	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

Wind tunnel techniques course depicts the types, working and characteristics of wind tunnels in the laboratory. The flow characteristics, flow visualization in the tunnel are recorded for further observations.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Determine the Non dimensional numbers
CO2: Classify the wind tunnels, and estimate wind tunnel sizing parameters.
CO3: Calibrate the low and high speed wind tunnels
CO4: Measure the fundamental flow properties using conventional equipment's
CO5: Outline the working principle of high speed tunnels

Mapping of Course Outcome(s):

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

UNIT I PRINCIPLES OF MODEL TESTING **6**

Buckingham Theorem – Non dimensional numbers – Scale effect – Geometric Kinematic and Dynamic similarities.

UNIT II TYPES AND FUNCTIONS OF WIND TUNNELS **6**

Classification and types – special problems of testing in subsonic, transonic, supersonic and hypersonic speed regions – Layouts – sizing and design parameters.

UNIT III CALIBRATION OF WIND TUNNELS **9**

Test section speed – Horizontal buoyancy – Flow angularities – Flow uniformity &turbulence measurements – Associated instrumentation – Calibration of subsonic &supersonic tunnels.

UNIT IV CONVENTIONAL MEASUREMENT TECHNIQUES **12**

Force measurements and measuring systems – Multi component internal and external balances – Pressure measurement system - Steady and Unsteady Pressure- single and multiple measurements - Velocity measurements – Intrusive and Non-intrusive methods – Flow visualization techniques- surface flow, oil and tuft - flow field visualization, smoke and other optical and nonintrusive techniques.

UNIT V SPECIAL WIND TUNNEL TECHNIQUES 12

Intake tests – store carriage and separation tests - Unsteady force and pressure measurements – wind tunnel model design

TEXT BOOKS:

1. Rae, W.H. and Pope, A., Low Speed Wind Tunnel Testing, John Wiley Publication, 1984.
2. NAL-UNI Lecture Series 12: Experimental Aerodynamics, NAL SP 98 01April , 1998

REFERENCES:

1. Pope, A., and Goin, L., High Speed Wind Tunnel Testing, John Wiley, 1985.
2. Bradsaw Experimental Fluid Mechanics. Short term course on Flow visualization techniques, NAL , 2009
3. Lecture course on Advanced Flow diagnostic techniques 17-19 September 2008 NAL, Bangalore

AER17R418 EXPERIMENTAL STRESS ANALYSIS	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Pre-requisite: MEC17R271	**Course Category:** Major Elective **Course Type:** Theory			

Course Objective(s):

To determine the stress and strain in materials and structures subjected to static or dynamic forces or loads.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Measure the deflection in the structure using extensometers
CO2: Determine the stress at a point in the structure using strain gauges.
CO3: Show the stress pattern using photo elastic materials
CO4: Interpret the effect of coating on stress components
CO5: Test and find the crack in the specimen using different NDT techniques.

Mapping of Course Outcome(s):

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

UNIT I EXTENSOMETERS AND DISPLACEMENT SENSORS 8

Principles of measurements, Accuracy, Sensitivity and range of measurements, Mechanical, Optical, Acoustical and Electrical extensometers and their uses, Advantages and disadvantages**,** Capacitance gauges, Laser displacement sensors.

UNIT II ELECTRICAL RESISTANCE STRAIN GAUGES 12

Principle of operation and requirements, Types and their uses, Materials for strain gauges, Calibration and temperature compensation, cross sensitivity, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators, Rosette analysis, stress gauges, load cells, Data acquisition, six component balance.

UNIT III PHOTOELASTICITY **11**

Two dimensional photo elasticity, Photo elastic materials, Concept of light - photoelastic effects, stress optic law, Transmission photoelasticity, Jones calculus, plane and circular polariscopes, Interpretation of fringe pattern, Calibration of photoelastic materials, Compensation and separation techniques, Introduction to three dimensional photo elasticity.

UNIT IV BRITTLE COATING AND MOIRE TECHNIQUES **7**

Relation between stresses in coating and specimen, use of failure theories in brittle coating, Moire method of strain analysis.

UNIT V NON – DESTRUCTIVE TESTING **7**

Fundamentals of NDT, Acoustic Emission Technique, Radiography, Thermography, Ultrasonics, Eddy Current testing, Fluorescent Penetrant Testing,

TEXT BOOKS:

1. Dally, J.W., and Riley, W.F., Experimental Stress Analysis, McGraw Hill Inc., New York 1998.
2. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., Experimental Stress Analysis, Tata McGraw Hill, New Delhi, 1984.
3. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 2009.

REFERENCES:

1. Hetenyi, M., Hand book of Experimental Stress Analysis, John Wiley and Sons Inc., New York, 1972.
2. Pollock A.A., Acoustic Emission in Acoustics and Vibration Progress, Ed. Stephens R.W.B., Chapman and Hall, 1993.
3. Max Mark Frocht, Photo Elasticity, John Wiley and Sons Inc., New York, 1968
4. A.J.Durelli, Applied Stress Analysis, Prentice Hall of India Pvt Ltd., New Delhi, 1970
5. Ramesh, K., Digital Photoelasticity, Springer, New York, 2000.

AER17R419 COMPOSITE MATERIALS AND STRUCTURES		**Credits**			
		L	**T**	**P**	**Total**
		3	**0**	**0**	**3**
Pre-requisite: Nil	**Course Category:** Major Elective **Course Type:** Theory				

Course Objective(s):

Analysis and design of composite structures using Moulding methods of construction, fabrication to evaluate and understand the concepts of laminated plate

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Determine the elastic moduli of composite structures.
CO2: Identify the number of elastic constants for different composite materials.
CO3: Analyze sandwich and laminated plates
CO4: Demonstrate the fabrication and repair techniques of composite materials
CO5: construct and analysis different composite technique

Mapping of Course Outcome(s):

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

UNIT I MICROMECHANICS **10**

Introduction - Advantages and application of composite materials – Types of reinforcements and matrices - Micro mechanics – Mechanics of materials approach, elasticity approach- Bounding Techniques – Fiber Volume ratio – Mass fraction – Density of composites. Effect of voids in Composites.

UNIT II MACROMECHANICS **10**

Generalized Hooke's Law - Elastic constants for anisotropic, orthotropic and isotropic materials - Macro Mechanics – Stress-strain relations with respect to natural axis, arbitrary axis – Determination of In plane strengths of a lamina - Experimental characterization of lamina. Failure theories of a lamina. Hygrothermal effects on lamina.

UNIT III LAMINATED PLATE THEORY **10**

Governing differential equation for a Laminate. Stress – Strain relations for a laminate. Different types of laminates. In plane and Flexural constants of a laminate. Hygrothermal stresses and strains in a laminate. Failure analysis of a laminate. Impact resistance and Interlaminar stresses. Netting analysis

UNIT IV FABRICATION PROCESS AND REPAIR METHODS **8**

Various open and closed mould processes, Manufacture of fibers, Importance of repair and different types of repair techniques in Composites – Autoclave and non-autoclave methods.

UNIT V SANDWICH CONSTRUCTIONS **7**

Basic design concepts of sandwich construction - Materials used for sandwich construction - Failure modes of sandwich panels - Bending stress and shear flow in composite beams.

TEXT BOOKS:

1. Isaac M. Daniel & Ori Ishai , "Mechanics of Composite Materials," OUP USA publishers, 2nd edition, 2005.
2. Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 2nd edition, 2005.
3. Madhujit Mukhopadhyay, Mechanics of Composite Materials and Structures, University Press, 2004

REFERENCES:

1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," John Wiley & Sons, 3rd edition, July 2006.
2. Lubing, Handbook on Advanced Plastics and Fibre Glass, Von Nostran Reinhold Co., New York, 1989.
3. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Nostrand Reinhold Company, New York 1998.
4. Allen Baker, Composite Materials for Aircraft Structures, AIAA Series, 2nd Edition, 2004.

HUMANITIES ELECTIVES

HSS17R001 MANAGEMENT CONCEPTS AND TECHNIQUES	Credits			
	L	T	P	Total
	3	0	0	3
Course Category: Humanities Elective – Theory				

Course Objective(s):

This course addresses the definition of management, its characteristics, evolution and importance as well as the functions performed by manages-planning, organizing, directing and controlling. The course also intends to show students the applications of management functions in various enterprises such as marketing, finance, personnel, production, etc.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To Explain the historical backdrop and fundamentals of Management thoughts vital for understanding the conceptual frame work of Management as a discipline.

CO2: To Discuss about the various concepts of planning, Decision making and controlling to help solving managerial problems

CO3: To Understanding concepts of Ethics, Delegation, Coordination and Team work

CO4: To Study and understand the management concepts and styles in Global context

CO5: To develop an understanding about emerging concepts in management thought and philosophy

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1: DEVELOPMENT OF MANAGEMENT THOUGHTS 9 Hours

Scientific Management Movement - Administrative Movement - Human Relations Movement - Decision Movement - Behavioural Science Movement - Systems Movement - Contingency Movement.

Unit 2:ESSENTIALS OF PLANNING 9 Hours

Planning Objectives – Goals - Programmed Decisions and Unprogrammed Decisions; Decision – Making - Creativity in Decision - Making, Forecasting and Strategy to Formulation

Unit 3: EFFECTIVE ORGANISING 9 Hours

Span of Control – Departmentation - Authority; Responsibility - Bureaucracy and Adhocracy; Group Dynamics

Unit 4: STAFFING AND DIRECTING 9 Hours

Staffing: Manpower Planning – Recruitment Sources – Selection Procedure – Training Methods – Performance Evaluation Methods – Executive Development Programs - Directing: Communication Process and Barriers – Motivation Techniques – Financial and Non – Financial Motivation- Leadership Qualities and Styles

Unit 5: CONTROLLING AND RECENT CONCEPTS 9 Hours

Controlling: Meaning and Process - Requisites of Effective Control - Control Techniques. Emerging Issues in Management: Japanese and American Management – Management by Objectives –

Knowledge Management – Technology Management – Business Process Outsourcing- Social Responsibility and Business Ethics

Text Book(s):

1. Harold Koontz, Heinz Weihrich, Essentials of Management: An International, Innovation and Leadership Perspective, 10th Edition, McGraw Hill, 2016
2. Stephen P. Robbins, Mary A. Coulter, Management, 13th Edition, Pearson Education Limited, New Delhi, 2016

Reference(s):

1. C.B.Gupta, Management Theory and Practice, 19th Revised Edition, Sultan Chand and Sons.2017.
2. L.M.Prasad, Principles and Practices of Management, 9th Edition, Sultan Chand and Sons, 2015.
3. K.Aswathappa, Essentials of Business Environment: Text Cases and Exercises 12th, edition, Himalaya Publishing House, Mumbai, 2014.
4. Tripathi, Reddy, Principles of Management, 5th Edition, McGraw Hill, 2012

HSS17R002 MARKETING MANAGEMENT	Credits			
	L	T	P	Total
	3	0	0	3
Course Category: Humanities Elective - Theory				

Course Objective(s):

This course develops students understanding of how organizations match the requirements of consumers in competitive environments, and develop strategies to create the competitive edge. It covers areas such as analysis, planning, implementation, and control, as well as the marketing mix, exportation, and the social aspects of marketing.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To Develop understanding of marketing concepts, philosophies and historical background.

CO2: To Develop understanding of marketing operations and complexities for students to apply in practical business situations.

CO3: To Understand concepts related to Segmentation, Targeting and Positioning, product attributes, and pricing strategies prevalent in domestic and international scenario.

CO4: To Study various tools and techniques of promoting the products in ethical manner.

CO5: To Understand emerging concepts of marketing in the emerging global markets

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1:MARKETING **9 Hours**

Meaning - concept - functions - marketing Planning and implementation marketing Programmes - Marketing environment – Market Segmentation and consumer behaviour – Influencing factors, Decision process –Marketing mix – Marketing department

Unit 2:PRODUCT **9 Hours**

Meaning - Product planning - policies - positioning - New product development Product life cycle – BCG Matrix - branding. Packing, labelling

Unit 3: PRICING **9 Hours**

Pricing objectives – Setting and modifying the price – Different pricing method Product line pricing and new product pricing

Unit 4:DISTRIBUTION **9 Hours**

Nature of Marketing channels - Types of Channel flows – Channel functions - Channel co-operation, conflict and competition - Direct Marketing Telemarketing, Internet shopping

Unit 5: PROMOTION **9 Hours**

Promotion Mix - Advertisement - Message - copy writing – Advertisement - budgeting - Measuring advertisement effectiveness - Media strategy - sales promotion - Personal selling steps, publicity and direct marketing

Text Book(s):

1. Philip.T. Khotler, Kevin Lane Keller, Marketing Management, 15th Edition, Pearson Education, New Delhi, 2016.
2. Ramaswamy.VS, Namakumari. S, Marketing Management – Global Perspective, Indian Context, McGraw Hill, 2013

Reference(s):

1. Rajan Saxena, Dorector, Jain S.P., Marketing Management, McGraw Hill, 2006.
2. K.S. Chandrasekar, Marketing Management, Text and Cases, McGraw hill 2013.

Tapan K. Panda, Marketing Management Text and Cases, 2nd Edition, Excel Books.2008.

HSS17R003 ORGANISATIONAL PSYCHOLOGY	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Course Category: Humanities Elective - Theory				

Course Objective(s):

This course aims to clarify the principles and basic concepts of organizational psychology. Including organizations and understanding its business design based on efficiency and quality of employee life. It also aims at enhancing the quality of life of employees. When organization's aspects are gauged in terms of psychological assessment, personnel decisions in line with training and development, organizational change and organizational health in specific the intrinsic problems are understood paving way towards standards that are high.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To learn basic concepts of industrial and organisational psychology

CO2: To illustrate different ways of achieving organisational effectiveness through individual behaviour.

CO3: To learn the concepts relating to individual behaviour to achieve group target and achieve leadership position in organisation.

CO4: To understand the organisational changes and means to evaluate based on nature of organisations.

CO5: To learn implications of changes aligning the interest of individual, group and organisation.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1: FOCUS AND PURPOSE **9 Hours**

Organisational Behaviour - Need and importance, nature and scope, framework

Unit 2: INDIVIDUAL BEHAVIOUR **9 Hours**

Personality – types – factors influencing personality – theories – learning – types of learners – learning theories – organizational Behaviour modification. Attitudes – characteristics –components – formation – measurement. Perceptions – importance – factors influencing perception – interpersonal perception

Unit 3: GROUP BEHAVIOUR **9 Hours**

Pricing objectives – Setting and modifying the price – Different pricing method Product line pricing and new product pricing

Unit 4:LEADERSHIP **9 Hours**

Leadership styles – theories – Qualities - leaders Vs managers – sources of power – power centres – power and Organisational Politics- Motivation

Unit 5:ORGANISATIONAL DEVELOPMENT **9 Hours**

Organizational development - Importance, characteristics, objectives, stability Vs change, proactive vs reaction change, the change process, resistance to change, managing change, team building - Organizational effectiveness, perspective, effectiveness Vs efficiency, approaches, the time dimension, achieving organizational effectiveness

Text Book(s):

1. Stephen Probing and Timothy A. Judge, Organisational Behavior, Peason Education, 17th edition, 2017.
2. Fred Luthans, Organisational Behavior, McGraw Education, 12th Edition, 2010

Reference(s):

1. Aswathappa, Organisational Behavior, Himalaya Publishing House, 12th edition, 2016.
2. P.Subba Rao, Management and Organisational behavior: Text, Cases and Games, Himalaya Publishing House, 1st edition, 2010.
3. Mullins, Organisational Behavior, Pearson Education Limited, 9th edition, 2010.

L.M.Prasad, Organisational Behavior, 5th edition, Sultan Chand and Sons, New Delhi, 2014.

HSS17R004 PROJECT MANAGEMENT	Credits			
	L	T	P	Total
	3	0	0	3
Course Category: Humanities Elective - Theory				

Course Objective(s):

This course describes concepts relating to project management and enable students to evolve project objectives appropriately with relevance to business proposals. It covers the required dimensions relating to evaluation of project by testing the technical feasibility, financial viability, market

acceptability and social desirability of projects. It gives an account on risk and profitability analysis that facilitates the making of the effective project proposal and guides learners in project planning, implementation and control. It also emancipates the scope of project management in undertaking foreign collaboration projects.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Familiarizes the concept of project and steps in project management.

CO2: Understand the basics stages involved in preparing business proposals.

CO3: Evaluate the technical feasibility, financial viability, market acceptability and social desirability of projects.

CO4: Enabled to analyse the Risk and profitability of the project proposals

CO5: Act effectively as project managers and as part of project teams

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1: INTRODUCTION TO PROJECT MANAGEMENT 9 Hours

Projects - Project ideas and preliminary screening. Developments - Project planning to Project completion - Pre-investment phase, Investment phase, operational phase - Governmental Regulatory framework. Capital Budgeting

Unit 2: STAGES OF PROJECT MANAGEMENT 9 Hours

Opportunity studies - prefeasibility studies, functional studies or support studies, feasibility study expansion projects, data for feasibility study. Market and Technical Appraisal: Market and Demand analysis, Market Survey, Demand forecasting. Technical analysis- Materials and inputs, Choice of Technology, Product mix, Plant location, capacity, Machinery and equipment

Unit 3: APPRAISAL PROCESS 9 Hours

Concepts. Time value of money - Present and future value. Appraisal criteria - Urgency, Payback period, Rate of return, Debt service coverage ratio, Net present value, Benefit cost ratio, Internal rate of return, Annual capital charge, Investment appraisal in practice

Unit 4: RISK AND PROFITABILITY ANALYSIS 9 Hours

Risk analysis- Measures of risk, Sensitivity analysis, and Decision tree analysis. Means of financing, Term Loans, Financial Institutions. Cost of capital. Profitability - Cost of Production, Break-even analysis. Assessing the tax burden and financial projections

Unit 5: PROJECT PLANNING, IMPLEMENTATION AND CONTROL 9 Hours

Forms of Project Organization, Project Planning, Implementation, and Control - Network construction, CPM, PERT, Development of Project schedule, Crashing of Project Network. Introduction to Foreign collaboration projects - Governmental policy framework, Need for foreign technology, Royalty payments, Foreign investments and procedural aspects

Text Book(s):

1. Prasanna Chandra, Projects: Planning, Analysis, Selection, Financing, Implementation, 8th Edition, McGraw Hill, 2014.
2. M.R. Gopalan, Project Management Core Textbook, 2nd edition, Wiley India, 2015

Reference(s):

1. Harold Kerzne, Project Management - Best Practices: Achieving Global Excellence, 3edition, Wiley Publications, 2013
2. George Ritz, Sidney Levy, Project Management in Construction, Sixth Edition, Mc. Graw Hill Education, 2011.
3. Gary Heerkens, Project Management, 2ndEdition, Mc. Graw Hill, 2013
4. P.Gopalakrishnan and V.E.Rama Moorthy Text Book of Project Management,1st Edition, Macmillan India Ltd., New Delhi, 2014.

John M. Nicholas, Herman Steyn, Project Management for Engineering, Business and Technology, 5th Edition, Routledge, 2016.

HSS17R005 STRESS MANAGEMENT AND COPING STRATEGIES	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Course Category: Humanities Elective – Theory				

Course Objective(s):

Stress has become an integral part of every professional's life. Approaching the stress in the right manner has become imperative as it has become an unavoidable one. The stress and its effect over performance has also become notable in today's organization. To cope well and to sustain in market, for that the skills are required to understand and to overcome the same. This course helps in understanding the intricacies of stress and overcoming the stress through appropriate approaches.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: The students understand the responsibility of tackling stress

CO2: The students identify and modify the approaches of stress accordingly while dealing with team in workplace.

CO3: Those students who are prone to face high- pressure working conditions will be able to tackle stress appropriately without ignoring.

CO4: The students will implement a stress -free work environment.

CO5: The students will enrich their way of behaviour and personality and ensure professional working condition and balanced quality of life.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1: UNDERSTANDING STRESS **9 Hours**

Meaning - Symptoms: Biological and Behavioural - Work Related Stress - Individual Stress – Reducing Stress – Burnout

Unit 2: COMMON STRESS FACTORS TIME **9 Hours**

Common Sources of Stress Biological, Personality and Environmental – Time Management – Techniques – Importance of planning the day – Time management schedule – Developing concentration – Organizing the Work Area - Prioritizing – Beginning at the start – Techniques for conquering procrastination – Sensible delegation – Taking the right breaks – Learning to say 'No'

Unit 3: CRISIS MANAGEMENT **9 Hours**

Implications – People issues – Structure issues, environmental issues, psychological fall outs – Learning to keep calm – Preventing interruptions – Controlling crisis – Importance of good communication – Taking advantage of crisis – Pushing new ideas – Empowerment

Unit 4: WORK PLACE HUMOUR **9 Hours**

Developing a sense of Humour – Learning to laugh, role of group cohesion and team spirit, using humour at work, reducing conflicts with humour. Coping Styles Defensive Behaviours and Problem-Solving

Unit 5: SELF DEVELOPMENT **9 Hours**

Improving Personality – Leading with Integrity, enhancing creativity – Effective Decision Making – Sensible Communication – The Listening Game – Managing Self - Meditation for Peace – Yoga for Life

Text Book(s):

1. D. Gordano and G. Everly., "Controlling Stress and Tension", 9th Edition, Prentice-Hall, 2013.
2. Greenberg Jerrold S., Comprehensive Stress Management, 14th Edition, McGraw Hill Education, 2017.

Reference(s):

1. Dr. P.K.Dutta, "Stress Management" Himalaya Publishing House, First Edition 2010.
2. Schafer, Stress Management, 4th Edition, Cengage Learning, Delhi, 2008
3. Wolfgang Linden, Stress Management, Sage Publication, 1st Edition 2005.
4. Daniel Girdano, Dorothy Dusek and George S. Everly, Controlling Stress and Tension, 8th Edition, Pearson Education, 2009.
5. Brian Luke Seaward, Essentials of managing Stress, 1st edition, Jones & Bartlett Publishers, 2013

HSS17R006 ECONOMICS FOR ENGINEERS	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Course Category: Humanities Elective - Theory				

Course Objective(s):

This course introduces a broad range of economic concepts, theories and analytical techniques. It considers both microeconomics - the analysis of choices made by individual decision-making units (households and firms) - and macroeconomics - the analysis of the economy. Demand and market structure will be analysed at the firm level. Macroeconomic issues regarding National Income, Inflation, labour and money at an aggregate level will be modelled. The role of government policy to address microeconomic market failures and macroeconomic objectives will be examined.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Identify and learn economic concepts into market economies.

CO2: Understand the pricing methods, interpret the market factors to determine the price for products or services and to making decisions based on demand factors.

CO3: Understand the major characteristics of different market structures and the implications for the behaviour of the firm.
CO4: Measure living standards, inflation, and unemployment for use as economic indicators.
CO5: Understand the role of international trade,
CO6: Analyse the determinants of the relative strengths of monetary policy for sustainable growth of our nation and International Trade.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1											3				
CO2						1		1			2				
CO3						1	1		2	1	1				
CO4	3	3									1				
CO5	1							1	1						
CO6											3				

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1: DEFINITION AND SCOPE OF ECONOMICS 9 Hours

Meaning - Symptoms: Biological and Behavioural - Work Related Stress - Individual Stress – Reducing StressDefinitions by A. Smith, A. Marshal and L. Robbins, P.Samuels on and their critical examination - Nature and scope of Economics - Micro-economics in relation to other branches of Economics

Unit 2: PRICING AND LAW OF DEMAND 9 Hours

Demand, Factors influencing demand, Elasticity of demand - price, income and cross, concepts and measurement - Break Even Analysis – Law of Demand - Price, income and substitution effects - Giffen goods- Pricing Methods.

Unit 3: MARKET STRUCTURE 9 Hours

Definition of market. Concepts of product and factor markets. Different types of market: perfect competition, monopoly, imperfect competition, monopolistic, competition and oligopoly. Demand and Supply schedules. Price determination under perfect competition in long and short run. Price determination under monopoly. Discriminating monopoly

Unit 4: MACRO ECONOMICS 9 Hours

Meaning, Macro-economic Policy and Its Objectives and Instruments - National Income and Social Accounting - Concepts, components, and measurement - Basic circular flow of income model, Unemployment, trade cycle, Inflation - causes, types, effects and control

Unit 5: COMMERCIAL AND CENTRAL BANKS 9 Hours

Credit creation, monetary policy and tools - Balance of payments - Items in the balance of payments account, equilibrium in the balance of payments

Text Book(s):

1. Gupta, S.B., Monetary Economics, S. Chand & Co., New Delhi, 2nd Edition, 2009.
2. Ruddar Datt and K.P.M. Sundharam, Indian Economy, 70th Edition, S. Chand & Company Ltd., New Delhi, 2013.

Reference(s):

1. D.N. Dewedi, Managerial Economics, 8th Edition, S. Chand & Company Ltd., New Delhi, 2005.

2. Gupta, G.S. Macroeconomics, Theory and Applications, 2nd edition, Tata McGraw-Hill publishing company Ltd., New Delhi, 2004.
3. Macroeconomic –Theory and policy, 3rd Edition, Tata McGraw-Hill publishing company Ltd., New Delhi, 2010.
4. Micro Economics, Mas Colell, 1st edition, Oxford Press, Delhi, 2012

HSS17R007 HUMAN RESOURCE MANAGEMENT AND LABOUR LAW	Credits			
	L	T	P	Total
	3	0	0	3
Course Category: Humanities Elective – Theory				

Course Objective(s):

This course aims at exploring key issues related to the management, performance, and development of human resources in the workplace. It places special emphasis on making decisions and developing plans that will enable managers to make the best possible use of their human resources, and covers areas such as: manpower planning, analysis and evaluation, recruitment and selection, wages and salaries, training and management development, performance appraisal, and industrial relations.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To provide the basic knowledge on developing the employment relations and knowledge to resolve the issues.

CO2: To design an appropriate and suitable role of HR specialist for implementing Human Resource Management policies.

CO3: To Manage the manpower to motivate and attract them to retain in the organization.

CO4: To Develop the responsibility of employer and legal system to manage the employment relations

CO5: To Provide more insights on the applicability of business law on various functional domains this in turn enhances a strong human relation

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1: FUNDAMENTALS OF HRM **9 Hours**

Human Resource Development Systems-HR environment in India-Functions and Operations of a Personnel Office - Emerging HR Trends - HR information system

Unit 2: HRM FUNCTIONS **9 Hours**

Job analysis and job design - HR planning – Recruitment - selection and induction- Staff Training and Development-Career planning and Development- Job Evaluation-Performance Appraisal and Potential Evaluation-Wage determination; salary structure-Wage policies and Regulations-Employee benefits and services.

Unit 3: MOTIVATING HUMAN RESOURCES **9 Hours**

Team and Team work - Collective Bargaining Employee Morale – Participative Management – Quality Circle – Empowerment –counselling and mentoring

Unit 4: MAINTENANCE OF WORKERS **9 Hours**

Compensation Management- Reward system – Labour relations –Employee Welfare, Safety and Health – Employee benefits and services – Promotion, Transfers and separation – Ethical issues in HR Management and International Human Resource Management - Legal Aspect of Labour

Unit 5: BUSINESS LAW **9 Hours**

Factories Act, 1948 - Industrial Dispute Act, 1947 – Industrial employment – Standing Orders Act, 1946 – Trade Union Act, 1926 - Workmen Compensation Act, 1923, Employees State Insurance Act, 1948, Employees Provident Fund and Miscellaneous Provision Act, 1952, Payment of Gratuity Act, 1972. Payment of Wages Act 1936, Minimum wages Act, 1948– Payment of Bonus Act, 1965.Tamil Nadu Shops and Establishments Act.

Text Book(s):

1. Decenzo and Robbins, Human Resource Management, Wiley, 12th edition, 2015.
2. Prasad L.M., Human Resource Management, Sultan Chand, 2014.

Reference(s):

1. Biswajeet Pattanayak, Human Resource Management, 3rd edition, Eastern Economy Edition, New Delhi, 2010.
2. C.B. Gupta, Human Resource Management, 13th Edition, Sultan Chand
3. V.S.P. Rao, Human Resource Management, 3rd edition, Excel Books.
4. Frank B. Cross and Roger LeRoy Miller, The Legal Environment of Business Text and cases, 9th Edition, Cengage Learning, 2015.

HSS17R008 ENTREPRENEURSHIP DEVELOPMENT	Credits			
	L	T	P	Total
	3	0	0	3
Course Category: Humanities Elective - Theory				

Course Objective(s):

This course focuses on the entrepreneurial process and the different kinds of entrepreneurial outcomes. Topics covered include opportunity identification through analysis of industry niches, skills needed to turn an opportunity into reality, business plans, launch decisions, and obtaining risk capital. This course deals with the problems and challenges facing the management of businesses in raising funds, marketing products and services, improving effectiveness and flexibility, and achieving growth.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: It provides more insights into the concept of entrepreneurship and which in turn leads to think creatively for new business opportunities to sustain individual as well as social goals.

CO2: It provides and promotes entrepreneurial spirit and provides a framework of successful business world with relation to agencies to promote employment opportunities.

CO3: It focuses on women entrepreneurship and promotes a successful business models and explains operational implementations for investment details.

CO4: It provides the role of government in promoting the entrepreneurship among the individuals and organizations as a whole

CO5: To Understand emerging concepts of marketing in the emerging global markets and provide more insights into project management and venture promotion

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1: BASICS 9 Hours

Concepts of entrepreneur, entrepreneurship and entrepreneur - Characteristics and competencies of a successful entrepreneur - General functions of an entrepreneur - Type of entrepreneurs - Role of entrepreneur in economic development - Distinction between an entrepreneur and a manager - Entrepreneur and Intrapreneur

Unit 2: GROWTH OF ENTREPRENEURSHIP 9 Hours

Emergence of entrepreneurship - Economic and non-economic factors for stimulating entrepreneurship development - Obstacles to entrepreneurship development in India - Growth of entrepreneurship in India.

Unit 3: WOMEN AND ENTREPRENEURSHIP 9 Hours

Concept of women entrepreneurship - Reasons for growth of woman entrepreneurship - Problems faced by them and remedial measures

Unit 4:ROLE OF THE GOVERNMENT IN ENTREPRENEURSHIP DEVELOPMENT 9 Hours

Concept and meaning of entrepreneurship development - Need for entrepreneurship development programmes (EDPs) - Objectives of EDPs - Organizations for EDPs in India; NIESBUD, SISI – their roles and activities.

Unit 5: VENTURE PROMOTION AND PROJECT FORMULATION 9 Hours

Concept of projects classification of projects and project report - Project identification and selection - Constraints in project identification - Techniques of Project Identification, Significance – contents - formulation of project report - Need for Project Formulation - Elements of project Formulation

Text Book(s):

1. Michael H Morris, Corporate Entrepreneurship and Innovation in Corporations, 7th Edition, CENGAGE Learning, Delhi, 2010
2. Jerry Katz, Entrepreneurship Small Business, 5th edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007

Reference(s):

1. Khanka S.S., Entrepreneurial Development, 1st edition, S. Chand and Company Limited, New Delhi, 2013.
2. Prasama Chandra, Projects: Planning, Analysis, Selection, Implementation and Reviews, 2nd edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1996.
3. Robert D. Hisrich, Entrepreneurship, 10th edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017.

HSS17R009 COST ANALYSIS AND CONTROL	Credits			
	L	T	P	Total
	3	0	0	3
Course Category: Humanities Elective – Theory				

Course Objective(s):

This course in meant to exhibit the concepts on costing by describing its elements, types and cost sheet preparation. It also encompasses the analytical framework that can be applied in cost analysis like Marginal costing, CVP analysis, break even analysis, etc. enabling the students to make decisions on cost parameters. Students are enabled to apply techniques like standard costing, activity based costing, etc. to manage and control cost effectively.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the basics of Costing and preparation of Cost sheet.

CO2: Analyse the cost by applying tools like Marginal costing, CVP analysis and other applications.

CO3: Enabled to use Budgets for controlling cost in Manufacturing or Production Centres.

CO4: Defining cost standards and critically examining the application of Standard costing in a Production Centre.

CO5: Understanding the application of various strategic cost alternatives including Activity based costing.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1: BASICS OF COSTING **9 Hours**

Costing, Elements of costing, Types of cost, Preparation of cost sheet

Unit 2: COST ANALYSIS **9 Hours**

Marginal costing, Cost - volume – Profit analysis, Break-Even- Analysis, Break –Even - Chart, Applications.

Unit 3: CONTROL TECHNIQUES **9 Hours**

Budgeting and Budgetary control, Types of Budgets, Preparation of purchase Budget, Flexible budgets, Cash Budget, Sales Budget, Materials Budget, Master Budget, zero based Budgeting

Unit 4:STANDARD COSTING **9 Hours**

Types of Standards, Setting up of standards, Advantages and Criticism of Standard Costing –Control through variances.

Unit 5: ACTIVITY BASED COSTING **9 Hours**

Transfer Pricing, Target costing, Life Style Costing, Activity Based Costing (only theory)

Text Book(s):

1. K.Saxena & C.D. Vashist, Advanced Cost Accounting and Cost Systems, 2nd Edition, V.Sultan Chand & Sons Publishers. 2014
2. S.P. Jain & K. L. Narang, Advances Cost Accounting Kalyani Publishers, 1st Edition, 2017

Reference(s):

1. J. Blocher, K. H. Chen, G. Cokins and T. W. Lin., Cost Management: A Strategic Emphasis, Irwin/McGraw-Hill, 3d edition, 2008
2. Don R. Hansen, Maryanne M. Mowen, Cornerstones of Cost Management, 6th Edition, Cengage Learning, 2015
3. Roger Hussey, Audra Ong, Strategic Cost Analysis, Business Expert Press, 2012.

HSS17R010 PRODUCT DESIGN AND DEVELOPMENT	Credits			
	L	T	P	Total
	3	0	0	3
Course Category: Humanities Elective - Theory				

Course Objective(s):

This course aims to clarify the principles and basic concepts of Product Design and Development. Including organizations and understanding of its products. It also aims at enhancing the quality of products. Product Design means recognition of a new product need, information gathering and requirements setting up, unambitious-clear and complete specification list, study on the product's mechanical architecture, selection of materials and production processes and engineering the various components necessary to make the product work. Product Development means identification of market opportunity, creation of product to appeal to the identified market, and finally, testing, modifying and optimizing the product until it is ready for production.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To learn basic concepts related to design and development of New product

CO2: To understand the structured approach towards incorporating quality, safety, and reliability into design.

CO3: To learn the concepts relating to simulating product performance and manufacturing processes.

CO4: To understand the technologies related to computer aided group technology

CO5: To learn implications of changes related to Economic analysis.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1: NEW PRODUCT IDEA **9 Hours**

Definition – Design by Evolution and by Innovation - factors to be considered for product design – Production-Consumption cycle – The morphology of design – Primary design Phases and flowcharting. Role of Allowance, Process Capability, and Tolerance in Detailed Design and Assembly Product strategies, Market research – identifying customer needs – Analysis of product – locating ideas for new products, Selecting the right product, creative thinking, curiosity, imagination and brain storming - product specification

Unit 2: NEW PRODUCT DESIGN **9 Hours**

Task - Structured approaches – clarification – search – external and internal – systematic exploration – conception, selection - methodology benefits. The value of appearance - principles and laws of appearance – incorporating quality, safety, and reliability into design. Man-machine considerations – Designing for ease of maintenance.

Unit 3: ROLE OF TECHNOLOGY IN DESIGNING **9 Hours**

Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing process – Needs for industrial design-impact – Industrial design process – Technology driven products - user driven products – assessing the quality of the product

Unit 4:METHODS AND PRINCIPLES OF DESIGNING **9 Hours**

Methodologies and tools - Design axioms - Design for assembly and evaluation - Minimum part assessment - Taguchi Method - Robustness assessment - Manufacturing process rules - Designer's tool kit - Computer aided group process rules - Designer's tool kit - Computer aided group technology - Failure Mode Effective Analysis – Design for minimum number of parts – Development of modular design – Minimising part variations – Design of parts to be multifunctional, multi-use, ease of fabrication – Pooka Yoka principles.

Unit 5: FEASIBILITY ANALYSIS **9 Hours**

Estimation of manufacturing cost – cost procedures – Value Engineering - reducing the component cost and assembly cost – minimizing the system complexity – Basics and Principals of prototyping – Economic Analysis: Break even analysis. Classes of exclusive rights – Patents – Combination versus aggregation – Novelty and Utility – Design patents – Paten disclosure – Patent application steps - Patent Office prosecution - Sales of patent rights - Trademarks – copy rights.

Text Book(s):

1. Karl. T.Ulrich, Steven D., Product Design and Development, McGraw Hill International, 6th Edition, 2016.
2. A.K.Chitale and R.C.Gupta, Product Design and Manufacturing, 3rd edition, Prentice Hall of India Private Limited, New Delhi, 2005

Reference(s):

1. Richard Crowson, Product Design and Factory Development, 2nd Edition, CRC Press, 2005.
2. Thomke, Stefan, and Ashok Nimgade. "IDEO Product Development." Boston, MA: Harvard Business School Case 9-600-143, June 22, 2000.
3. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill Higher Education, 4th Edition, 2012.
4. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2004, Pearson Education

HSS17R011 BUSINESS PROCESS REENGINEERING	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Course Category: Humanities Elective - Theory				

Course Objective(s):

This course aims to clarify the principles and basic concepts of Business Process Engineering.

This course focuses on both quantitative and qualitative analytical skills and models essential to operations process design, management, and improvement in both service and manufacturing oriented companies. The main objective of the course is to prepare the student to play a significant role in the management of a world class company which serves satisfied customers through empowered employees, leading to increased revenues and decreased costs.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To learn the basic concepts related to Business Process Reengineering.

CO2: To understand the methodologies and tools used for Business Process Reengineering.

CO3: To learn the concepts relating to benefit/cost analysis and its impact on the business organizations.

CO4: To understand the need for assessment of business re-engineering and the factors contributing to its success.

CO5: To learn the best practices used in Business Process Reengineering with illustrations from corporate world.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1: BASIC CONCEPTS **9 Hours**

Introduction to BPR Definition; the paradigm shifts in production; the positioning concept; the re-engineering visions; the benefits of business re-engineering

Unit 2: METHODOLOGIES FOR BPR **9 Hours**

Methodologies and Tools for BPR, Process management; dynamic business re-engineering change framework; steps to reengineer the process.

Unit 3: MODELLING THE BUSINESS **9 Hours**

Methodologies and Tools for BPR, Process management; dynamic business re-engineering change framework; steps to reengineer the process

Unit 4:CHANGE MANAGEMENT **9 Hours**

Change Management, Planned changes in business re-engineering projects; challenges of business change; business change development. Success factors in re-engineering. The assessment of business re-engineering.

Unit 5: BEST PRACTICES IN BPR **9 Hours**

Best Practices in BPR, Case studies: Bell Atlantic, Nissan, Chrysler, Xerox, and Hewlett Packard etc.

Text Book(s):

1. Ali K. Kamrani, Maryam Azimi (2011). New Methods in Product Design: New Strategies in Reengineering (Engineering and Management Innovation). CRC Press. 1st ed.
2. Bassam Hussein (2008). PRISM: Process Reengineering Integrated Spiral Model. VDM Verlag Dr. Mueller e.K

Reference(s):

1. Harmon, P. (2007), Business Process Change: A Guide for Business Managers and BPM and Six Sigma Professionals, Elsevier/Morgan Kaufmann Publishers.
2. 2. R. Anupindi et al. (2006), Managing Business Process Flows: Principles of Operations Management, Pearson

HSS17R012 POLITICAL ECONOMY	Credits			
	L	T	P	Total
	3	0	0	3
Course Category: Humanities Elective - Theory				

Course Objective(s):

This course introduces the political economy of India. It examines the interplay of politics and economics. Some of the key themes to be explored are globalization, economic reform, poverty, redistribution, federalism, political protest, public goods delivery, gender, and ethnic politics. Although this class focuses specifically on India, many the themes discussed in this course are functions of institutions, rights, Party Systems and challenges.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Explain the key concepts of political economy analyse the significant developments in the political ideologies.

CO2: Describe the salient features of the constitution of India and its functions and interpret, integrate and critically analyse the fundamental rights duties and responsibilities.

CO3: Understand the Political party system their evolution and role in the economy

CO4: Understand the various ideological of Indian Political Thoughts

CO5: Have a deep understanding and appreciation of India undergoing major economic and social transformation

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1: BASICS OF POLITICAL ECONOMY **9 Hours**

Political Economy as a Method, perspectives, Politics as Reproduction of Social Relations, State and Social Opportunity, Politics of Rent Seeking -Evolution of State in India: Historical Roots of planning, Redistribution

Unit 2: INDIAN CONSTITUTION **9 Hours**

The Pre-amble- Fundamental rights and duties, Directive Principles- Offices of the President, Prime Minister, Cabinet Government, Chief Election Commissioner, and Governor – Parliamentary system and Procedures - The Judiciary system.

Unit 3: PARTY SYSTEM **9 Hours**

National and regional political parties, ideological and social bases of parties; patterns of coalition politics; Pressure groups, trends in electoral behaviour; changing socio- economic profile of Legislators.

Unit 4:INDIAN POLITICAL THOUGHT **9 Hours**

Political Ideologies: Liberalism, Socialism, Marxism, Fascism, Gandhism and Feminism - Dharamshastra, Arthashastra and Buddhist traditions; Sir Syed Ahmed Khan, Sri Aurobindo, M.K. Gandhi, B.R. Ambedkar, M.N. Roy.

Unit 5: CHALLENGES TO INDIAN DEMOCRACY **9 Hours**

Uneven Development of Regions in India – Communalism – Regionalism – Violence – Corruption – environmental degradation- illiteracy –**p**opulation

Text Book(s):

1. Charles Sackrey, Geoffrey Schneider, Janet Knoedler, Introduction to Political Economy, Dollars & Sense, 8th Edition, 2016.
2. Robert.S.Dimand, Review of Political Economy: An Introductory Text, 1st Edition, Routledge, 2008.

Reference(s):

1. Barry R. weingast and Donald A.Wittman, Handbook of Political Economy, 1st Edition, Oxford University Press, New York, 2006.
2. Ed. Sanjay Ruparelia; Sanjay Reddy; John Harriss & Stuart Corbridge, Understanding India's New Political Economy: A Great Transformation, Routledge 1st Edition 2011.
3. M.Laxmikanth, Indian Polity, 4th Edition, McGraw Hill Education, New Delhi,2017.
4. Niraja Gopal Jayal, Pratap Bhanu Mehra, The Oxford Companion to Politics in India: Student Edition, Oxford Press, 2011

HSS17R013 PROFESSIONAL ETHICS	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Course Category: Humanities Elective – Theory				

Course Objective(s):

This subject will provide students with ability to understand and analyse managerial problems in industry so that they can use resources (capitals, materials, staffing, and machines) more effectively.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Identify the multiple ethical interests at stake in a real-world situation or practice

CO2: Assess their own ethical values and the social context of problems

CO3: Develop critical thinking skills and professional judgement and understand practical difficulties of bringing about change

CO4: demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work

CO5: Manage differing opinions on complex ethical scenarios. It's important for those confronted with ethical challenges to be able to hold multiple conflicting points of view, without necessarily adhering to any of them.

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1: ENGINEERING ETHICS **9 Hours**

Functions of Being a Manager – Stock holder and stakeholder management – Ethical treatment of employees - ethical treatment of customers- supply chain management and other issues

Unit 2: ENGINEERING AS SOCIAL EXPERIMENTATION **9 Hours**

Senses of Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional ideals and virtues – Theories about right action – Self-interest – Customs and religion – Use of Ethical Theories.

Unit 3: ENGINEER RESPONSIBILITY FOR SAFETY **9 Hours**

Corporate social responsibility - Collegiality and loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Discrimination.

Unit 4: RESPONSIBILITY AND RIGHTS **9 Hours**

Moral imagination, stake holder theory and systems thinking - One approach to management decision – making Leadership.

Unit 5: GLOBAL ISSUES **9 Hours**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Sample code of conduct

Text Book(s):

1. Mike Martin and Roland Schinzinger, Introduction to Engineering Ethics, 2nd Edition, McGraw Hill, 2010.
2. Charles D Fledderman, Engineering Ethics, Pearson, 2011.

Reference(s):

1. R.S.Nagarajan, Text book on Professional Ethics and Human Values, New Age International, 2007.
2. Gail Baura, Engineering Ethics- An Industrial Perspective, 1st Edition, Academic Press, 2006.
3. Charles e. Harris, Michael s. Pritchard and Michael J. Rabins Texas, Engineering Ethics- Conecpts and Cases, 4th Edition, Cengage Learning, 2009.
4. Charles Byms Fleddermann, Engineering Ethics, Pearson, 2008.
5. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2013.
6. Dr.V.Jeyakumar, Mathematics
7. , Lakshmi Publication, Chennai, 2014

HSS17R014 OPERATIONS RESEARCH	**Credits**			
	L	**T**	**P**	**Total**
	3	**0**	**0**	**3**
Course Category: Humanities Elective - Theory				

Course Objective(s):

It is essential for professionals in any field to understand the ethical problems and principles in their field. The general principles of professional ethics will be examined, as well as the distinctive problems. This course is presented in three parts: theory; case studies; and research and presentation. Theory includes ethics and philosophy of engineering.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Identify and develop operational research models from the verbal description of the real System.
CO2: Build and solve Transportation Models and Assignment Models
CO3: Use mathematical software to solve the proposed models.
CO4: Develop a report that describes the model and the solving technique, analyse theresults and propose recommendations in language understandable to the decision-making processes in Management Engineering.
CO5: Design new simple models, like: CPM, MSPT to improve decision –making and develop critical thinking and objective analysis of decision problems

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1: LINEAR PROGRAMMING BASICS 9 Hours

Introduction to applications of operations research in functional areas of management - Linear Programming - formulation, solution by graphical and simplex methods (Primal - Penalty, Two Phase), Special cases - Dual simplex method

Unit 2: TRANSPORTATION MODELS AND ASSIGNMENT MODELS 9 Hours

Transportation Models (Minimising and Maximising Cases) – Balanced and unbalanced cases – Initial Basic feasible solution by N-W Corner Rule, Least cost and Vogel's approximation methods - Check for optimality - Solution by MODI / Stepping Stone method - Cases of degeneracy - Transhipment Models - Assignment Models (Minimising and Maximising Cases) – Balanced and Unbalanced Cases - Solution by Hungarian and Branch and Bound Algorithms - Travelling Salesman problem - Crew Assignment Models.

Unit 3: INTEGER LINEAR PROGRAMMING AND GAME THEORY 9 Hours

Solution to pure and mixed integer programming problem by Branch and Bound and cutting plane algorithms - Game Theory - Two Person Zero sum games - Saddle point, Dominance Rule, graphical and LP solutions.

Unit 4: REPLACEMENT MODELS AND DECISION THEORY 9 Hours

Replacement Models-Individuals Replacement Models (With and without time value of money) – Group Replacement Models - Decision making under risk – Decision trees – Decision making under uncertainty- Hurwicz criterion-Expected Monetary Value criterion-Expected Value of Perfect Information(E.V.P. I.)

Unit 5: PROJECT MANAGEMENT METHOD AND SIMULATION 9 Hours

PERT / CPM – Drawing the network, computation of processing time, floats and critical path. Resource levelling techniques - Application of simulation techniques for decision making

Text Book(s):

1. Kalavathy S, Operations Research, Vikas Publishing House, 4TH Edition, 2013.
2. Paneerselvam R., Operations Research, Prentice Hall of India, 2ND Edition, 2006.
3. Tulsian P.C, Vishal Pandey, Quantitative Techniques (Theory and Problems), Pearson Education, Asia, First Indian Reprint 2002.

Reference(s):

1. D.S.Hira, Problems in Operations Research, Kindle Edition, S.Chand, 2010.
2. Prem Kumar Gupta and D.S. Hira, Operations Research,S.Chand, 2016.
3. R.C.Mishra,Principles of Operations Research, 1st Edition, New Age International 2011.
4. Kanti Swarup, P.K.Gupta and Man Mohan, Operations Research, 15th Edition, Sultan Chand and Sons 2010

HSS17R015 TOTAL QUALITY MANAGEMENT	Credits			
	L	T	P	Total
	3	0	0	3
Course Category: Humanities Elective – Theory				

Course Objective(s):

This subject provides students with the knowledge to understand the philosophy and core values of Total Quality Management (TQM). It helps to determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization; apply and evaluate best practices for the attainment of total quality. Students who complete this course will be able to critically appraise management techniques, choose appropriate statistical techniques for improving processes and write reports to management describing processes and recommending ways to improve them.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Understand the role and nature of quality in evolving international economic conditions
CO2: Apply the Principles of Quality Management for real time problems.
CO3: the quality encounter process, including supporting facilities and customer requirements/characteristics
CO4: Classify quality measurement methods and continuous improvement process
CO5: Frame Management strategy methods, including identification, development, implementation and feedback processes

Mapping of Course Outcome(s):

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

3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation

Course Topics:

Unit 1: INTRODUCTION TO QUALITY MANAGEMENT 9 Hours

Definitions – TOM framework, benefits, awareness and obstacles - Quality – vision, mission and policy statements - Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality

Unit 2: PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT 9 Hours

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi, Shingeo and Walter Shewhart - Concepts of Quality circle, Japanese 5S principles and 8D methodology.

Unit 3: STATISTICAL PROCESS CONTROL AND PROCESS CAPABILITY9 Hours

Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed - Process capability – meaning, significance and measurement – Six sigma concepts of process capability - Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve - Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

Unit 4: TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT 9 Hours

Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation.

Unit 5: TAGUCHI TECHNIQUE 9 Hours

Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio - Seven old (statistical) tools - Seven new management tools - Bench marking and POKA YOKE

Text Book(s):

1. Poornima M.Charantimath., Total quality management, Pearson Education, 2nd Edition, 2011.
2. Dale H.Besterfield et al, Total Quality Management, Perarson Education, Thrid edition, (First Indian Reprints 2004).

Reference(s):

1. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition, 2002.
2. Jams R. Evans, Total Quality: Management, Organisation and strategy, 4th Edition, South-Western College, 2004.
3. Vincent K.Omachonu, Joel E.Ross, Principles of Total Quality, 3rd Edition, CRC Press, 2004.
4. S.Rajaram, M. Sivakumar, Total Quality Management, Wiley Publishers, 1st Edition, 2008