B.Tech in Mechanical Engineering

Faculty of Engineering

Revised in June 2015

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Vision of the Institute

To be a global leader in the delivery of engineering education, transforming individuals to become creative, innovative, and socially responsible contributors in their professions.

Mission of the Institute:

- To provide best-in-class infrastructure and resources to achieve excellence in technical education,
- To promote knowledge development in thematic research areas that have a positive impact on society, both nationally and globally,
- To design and maintain the highest quality education through active engagement with all stakeholders –students, faculty, industry, alumni and reputed academic institutions,
- To contribute to the quality enhancement of the local and global education ecosystem,
- To promote a culture of collaboration that allows creativity, innovation, and entrepreneurship to flourish, and
- To practice and promote high standards of professional ethics, transparency, and accountability.

Vision of the Department

To transform our students into outstanding mechanical engineers with strong domain knowledge and skills, society-centric research intent, and exemplary ethical values, making them the most desired professionals by research institutions, industry, and society.

Mission of the Department

- To develop in each student, a profound understanding of fundamentals, motivation for continuous learning, and practical problem-solving skills for building a successful career.
- To create and share technical knowledge and collaborate with Industry and Institutions for the betterment of Society.
- To imbibe ethical values, leadership skills and entrepreneurial skills in students.
- To sustain a conducive environment to involve students and faculty in research and development.

Programme Educational Objectives (PEOs)

The department envisages the students to

- Apply their Knowledge in Science, Mathematics and Engineering to address Industrial and Societal problems with a strong emphasis on creativity, confidence, ethics, and responsibility.
- Apply latest computational, analytical, simulation tools and techniques to develop and improve products and processes.
- Solve multidisciplinary problems by working in cross functional teams.
- Develop and upgrade technical, intellectual and emotional skills for life-long learning to compete in a rapidly evolving world.
- Nurture entrepreneurial ventures and foster research activities that support sustainable economic development to enhance the quality of life.

Programme Specific Outcomes (PSOs)

- Apply knowledge acquired in the field of Design, Manufacturing, Thermal, and Fluid sciences to solve real-world engineering problems using emerging technologies.
- Extend and implement innovative thinking on product design and development with the aid of modern CAD/CAM/CAE tools.
- Apply the Science and Engineering knowledge for materials design and processing for development and improvement of products and processes.

Program Outcomes (POs)

- **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

- **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specifiedneeds with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretationof data, and synthesis of the information to provide valid conclusions.
- **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **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.
- **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **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.
- **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.
- **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Semester I					
Cat.	**Code**	**Course Title**	**L-T-P**	**Cr**	**ES**
HUM	15ENG111	Communicative English	2 0 2	3	A
SCI	15MAT111	Calculus and Matrix Algebra	2 1 0	3	B
ENGG	15CSE100	Computational Thinking and Problem Solving	3 0 2	4	D
SCI	15PHY100/ 15CHY100	Physics / Chemistry	3 0 0	3	C
SCI	15PHY181/ 15CHY181	Physics Lab. / Chemistry Lab.	0 0 2	1	L1
ENGG	15MEC180/ 15EEE180	Workshop A/Workshop B	0 0 2	1	L2
ENGG	15MEC100	Engineering Drawing - CAD	2 0 2	3	E
HUM	15CUL101	Cultural Education I	2 0 0	2	F
			Total	**20**	

Semester II

Cat.	**Code**	**Course Title**	**L-T-P**	**Cr**	**ES**
SCI	15MAT121	Vector Calculus and Ordinary Differential Equations	3 1 0	4	B
SCI	15PHY100/ 15CHY100	Physics / Chemistry	3 0 0	3	C
SCI	15PHY181/ 15CHY181	Physics Lab. / Chemistry Lab.	0 0 2	1	L1
ENGG	15CSE102	Computer Programming	3 0 0	3	D
ENGG	15MEC101	Engineering Drawing - CAD II	2 0 2	3	A
ENGG	15MEC102	Engineering Mechanics	3 0 0	3	ES
SCI	15PHY181/ 15CHY181	Physics Lab. / Chemistry Lab.	0 0 2	1	L1
ENGG	15MEC180/ 15EEE180	Workshop A/Workshop B	0 0 2	1	L2
ENGG	15CSE180	Computer Programming Lab.	0 0 2	1	L3
HUM	15CUL111	Cultural Education II	2 0 0	2	F
			Total	**21**	

Semester III

Cat.	Code	Course Title	L-T-P	Cr	ES
ENGG	15MEC201	Engineering Thermodynamics	3 0 0	3	A
ENGG	15MEC202	Machine Drawing	2 0 2	3	C
ENGG	15MEC203	Material Science and Metallurgy	3 0 0	3	D
ENGG	15MEC204	Mechanics of Solids	3 0 0	3	E
ENGG	15EEE205	Electrical and Electronics Engineering	3 0 2	4	G
SCI	15MAT204	Transforms and Partial Differential Equations	2 1 0	3	B
HUM		Humanities Elective I		2	H
ENGG	15MEC281	Material Testing and Metallurgy Lab.	0 0 2	1	L1
HUM	15AVP201	Amrita Values Programme I	1 0 0	1	F
			Total	**23**	

Semester IV

Cat.	Code	Course Title	L-T-P	Cr	ES
ENGG	15MEC211	Fluid Mechanics and Machinery	4 0 0	4	A
ENGG	15MEC212	Kinematics of Machines	3 0 2	4	C
ENGG	15MEC213	Manufacturing Process I	3 0 0	3	D
SCI	15MAT214	Probability and Statistics	2 1 0	3	B
ENGG		Elective I*	3 0 0	3	E
HUM		Humanities Elective II		2	H
ENGG	15MEC285	Fluid Mechanics and Machines Lab.	0 0 2	1	L1
HUM	15SSK221	Soft Skills I	1 0 2	2	G
HUM	15AVP211	Amrita Values Programme II	1 0 0	1	F
			Total	**23**	

Semester V

Cat.	Code	Course Title	L-T-P	Cr	ES
ENGG	15MEC301	Design of Machine Elements I	3 0 0	3	A

ENGG	15MEC302	Dynamics of Machines	3 0 0	3	C
ENGG	15MEC303	Heat Power Engineering	3 0 0	3	D
ENGG	15MEC304	Manufacturing Process II	3 0 0	3	F
SCI	15MAT302	Numerical Methods	2 0 2	3	B
ENGG		Elective II*	3 0 0	3	E
ENGG	15MEC381	Manufacturing Process Lab.	0 0 2	1	L1
ENGG	15MEC382	Thermal Science Lab.	0 0 2	1	L2
HUM	15SSK321	Soft Skills II	1 0 2	2	G
ENGG	15MEC390	Live-in-Lab**		[3]	P2
			Total	**22 [+3]**	

Semester VI

Cat.	Code	Course Title	L-T-P	Cr	ES
ENGG	15MEC311	Design of Machine Elements II	3 1 0	4	A
ENGG	15MEC312	Heat Transfer	3 1 0	4	B
ENGG	15MEC313	Introduction to Finite Element Methods	3 0 2	4	C
ENGG	15MEC314	Metrology and Measurements	3 0 0	3	D
ENGG		Elective III*	3 0 0	3	E
ENGG	15MEC385	Heat Transfer and Thermal Analysis Lab.	0 0 2	1	L1
ENGG	15MEC386	Metrology and Measurements Lab.	0 0 2	1	L2
HUM	15SSK331	Soft Skills III	1 0 2	2	G
			Total	**22**	

* A maximum of One Elective course can be chosen from the Electives prescribed for other Branches or from under Science Electives.

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

Semester VII

Cat.	Code	Course Title	L-T-P	Cr	ES
ENGG		Elective V*	3 0 0	3	A
ENGG	15MEC402	Control Engineering	3 0 0	3	B

ENGG	15MEC403	Industrial Robotics	3 0 0	3	C
ENGG	15MEC404	Mechanical Vibrations	3 0 0	3	F
HUM	15ENV300	Environmental Science and Sustainability	3 0 0	3	D
ENGG		Elective IV*	3 0 0	3	E
ENGG	15MEC481	Computer Integrated Manufacturing Lab.	0 0 2	1	L1
ENGG	15MEC482	Machine Dynamics and Control Lab.	0 0 2	1	L2
PRJ	15MEC495	Project Phase I		2	P1
ENGG	15MEC490	Live-in-Lab**		[3]	P2
			Total	**22 [+3]**	

Semester VIII

Cat.	Code	Course Title	L-T-P	Cr	ES
ENGG	15MEC411	Operations Research	3 0 0	3	A
ENGG		Elective VI*	3 0 0	3	E
PRJ	15MEC499	Project Phase II		10	P
			Total	**16**	
			TOTAL	**169**	

* A maximum of One Elective course can be chosen from the Electives prescribed for other Branches or from under Science Electives.

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

ELECTIVES

DESIGN STREAM

15MEC230 Aircraft Systems and Engineering

15MEC231 Automotive Chassis Design

15MEC232 Automotive Technology

15MEC233 Condition Monitoring and Diagnostic Maintenance

15MEC234 Design for Manufacture and Assembly

15MEC235 Fracture Mechanics

15MEC236 Materials Selection in Mechanical Design

15MEC237 Mechatronics

15MEC238 Micro-Electro Mechanical Systems

15MEC239 Modelling and Simulation of Engineering Systems

15MEC240 Optimization Techniques in Engineering

15MEC241 Pressure Vessel Design

15MEC242 Theory of Elasticity

15MEC243 Tool Design

THERMAL STREAM

15MEC246 Automotive Electronics

15MEC247 Combustion Engineering

15MEC248 Computational Fluid Dynamics

15MEC249 Design of Thermal Systems

15MEC250 Fluid Power Drives and Controls

15MEC251 Fundamentals of Nuclear Engineering

15MEC252 Gas Dynamics and Jet Propulsion

15MEC253 Internal Combustion Engines and Pollution Control

15MEC254 Petroleum Refinery Engineering

15MEC255 Power Plant Engineering

15MEC256 Refrigeration and Air Conditioning

15MEC257 Renewable Sources of Energy

15MEC258 Turbomachinery

15MEC259 Advanced Fluid Mechanics

MANUFACTURING STREAM

15MEC261 Advanced Casting Technology

15MEC262 Advanced Manufacturing Processes

15MEC263 Advanced Materials and Processes

15MEC264 Advanced Metrology and Sensing Systems

15MEC265 Advanced Welding Technology

15MEC266 CNC Machines

15MEC267 Composite Materials and Processing

15MEC268 Metal Forming Technology

15MEC269 Micro-manufacturing

15MEC270 Modern Practices in Product Design and Manufacture

15MEC271 Non-Destructive Testing

15MEC272 Product Cost Estimation

15MEC273 Quality Control and Reliability Engineering

15MEC274 Simulation, Modelling of Manufacturing Systems

MANAGEMENT ELECTIVES

15MEC331 Engineering Economic Analysis

15MEC332 Enterprise Management

15MEC333 Financial Management

15MEC334 Industrial Engineering

15MEC335 Lean Manufacturing

15MEC336 Managerial Statistics

15MEC337 Marketing Management

15MEC338 Operations Management

15MEC339 Project Management

15MEC340 Supply Chain Management

15MEC341 Total Quality Management

SCIENCE ELECTIVES (3 0 0 3)

15CHY231 Advanced Polymer Chemistry

15CHY232 Biomaterials Science

15CHY233 Catalytic Chemistry

15CHY234 Chemistry of Advanced Materials

15CHY235 Chemistry of Engineering Materials

15CHY236 Chemistry of Nanomaterials

15CHY237 Chemistry of Toxicology

15CHY238 Colloidal and Interfacial Chemistry

15CHY239 Computational Chemistry and Molecular Modelling

15CHY241 Electrochemical Energy Systems and Processes

15CHY242 Environmental Chemistry

15CHY243 Fuels and Combustion

15CHY244 Green Chemistry and Technology

15CHY245 Instrumental Methods of Analysis

15CHY246 Medicinal Organic Chemistry

15CHY247 Modern Polymer Composites

15CHY248 Organic Reaction Mechanisms

15CHY249 Organic Synthesis and Stereochemistry

15CHY250 Polymer Materials and Properties

15CHY251 Polymers for Electronics

15CHY252 Solid State Chemistry

15CHY331 Batteries and Fuel Cells

15CHY332 Corrosion Science

15PHY230 Advanced Classical Dynamics

15PHY233 Biophysics and Biomaterials

15PHY234 Introduction to Computational Physics

15PHY238 Electrical Engineering Materials

15PHY239 Electromagnetic Fields and Waves

15PHY240 Electronic Material Sciences

15PHY241 Lasers in Material Processing

15PHY243 Microelectronic Fabrication

15PHY245 Nuclear Energy – Principles and Applications

15PHY247 Photovoltaics

15PHY248 Physics of Lasers and Applications

15PHY250 Quantum Physics and Applications

15PHY251 Thin Film Physics

15PHY331 Astronomy

15PHY333 Concepts of Nanophysics and Nanotechnology

15PHY335 Medical Physics

15PHY338 Physics of Semiconductor Devices

15PHY532 Astrophysics

15PHY535 Earth's Atmosphere

15PHY536 Earth's Structure and Evolution

15PHY540 Nonlinear Dynamics

15PHY542 Optoelectronic Devices

HUMANITIES ELECTIVES

15CUL230	Achieving Excellence in Life - An Indian Perspective	2 0 0 2
15CUL231	Excellence in Daily Life	2 0 0 2
15CUL232	Exploring Science and Technology in Ancient India	2 0 0 2
15CUL233	Yoga Psychology	2 0 0 2
15ENG230	Business Communication	1 0 2 2
15ENG231	Indian Thought through English	1 0 2 2
15ENG232	Insights into Life through English Literature	1 0 2 2
15ENG233	Technical Communication	1 0 2 2
15ENG234	Indian Short Stories in English	1 0 2 2
15FRE230	Proficiency in French Language (Lower)	1 0 2 2
15FRE231	Proficiency in French Language (Higher)	1 0 2 2
15GER230	German for Beginners I	1 0 2 2
15GER231	German for Beginners II	1 0 2 2
15GER232	Proficiency in German Language (Lower)	1 0 2 2
15GER233	Proficiency in German Language (Higher)	1 0 2 2
15HIN101	Hindi I	1 0 2 2
15HIN111	Hindi II	1 0 2 2
15HUM230	Emotional Intelligence	2 0 0 2
15HUM231	Glimpses into the Indian Mind - the Growth of Modern India	2 0 0 2
15HUM232	Glimpses of Eternal India	2 0 0 2
15HUM233	Glimpses of Indian Economy and Polity	2 0 0 2
15HUM234	Health and Lifestyle	1 0 2 2
15HUM235	Indian Classics for the Twenty-first Century	2 0 0 2
15HUM236	Introduction to India Studies	2 0 0 2
15HUM237	Introduction to Sanskrit Language and Literature	2 0 0 2
15HUM238	National Service Scheme	2 0 0 2
15HUM239	Psychology for Effective Living	2 0 0 2
15HUM240	Psychology for Engineers	2 0 0 2
15HUM241	Science and Society - An Indian Perspective	2 0 0 2
15HUM242	The Message of Bhagwad Gita	2 0 0 2
15HUM243	The Message of the Upanishads	2 0 0 2
15HUM244	Understanding Science of Food and Nutrition	1 0 2 2
15JAP230	Proficiency in Japanese Language (Lower)	1 0 2 2
15JAP231	Proficiency in Japanese Language (Higher)	1 0 2 2
15KAN101	Kannada I	1 0 2 2
15KAN111	Kannada II	1 0 2 2
15MAL101	Malayalam I	1 0 2 2
15MAL111	Malayalam II	1 0 2 2
15SAN101	Sanskrit I	1 0 2 2
15SAN111	Sanskrit II	1 0 2 2
15SWK230	Corporate Social Responsibility	2 0 0 2
15SWK231	Workplace Mental Health	2 0 0 2

15TAM101	Tamil I	1 0 2 2
15TAM111	Tamil II	1 0 2 2

Evaluation Pattern

50:50 (Internal: External) (All Theory Courses)

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

80:20 (Internal: External) (Lab courses and Lab based Courses having 1 Theory hour)

Assessment	Internal	External
*Continuous Assessment (CA)	80	
End Semester		20

70:30(Internal: External) (Lab based courses having 2 Theory hours/ Theory and Tutorial)

Theory- 60 Marks; Lab- 40 Marks

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

65:35 (Internal: External) (Lab based courses having 3 Theory hours/ Theory and Tutorial)

Theory- 70 Marks; Lab- 30 Marks

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

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

Letter Grade	Grade Point	Grade Description
O	10.00	Outstanding
A+	9.50	Excellent
A	9.00	Very Good
B+	8.00	Good
B	7.00	Above Average
C	6.00	Average
P	5.00	Pass
F	0.00	Fail

Grades O to P indicate successful completion of the course

$$CGPA = \frac{\sum (C_i x Gr_i)}{\sum C_i}$$

Where

C_i = Credit for the i_{th} course in any semester

Gr_i= Grade point for the i_{th} course

Cr. = Credits for the Course

Gr. = Grade Obtained

Programme Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
15ENG111.1										3		2			
15ENG111.2									2	3		2			
15ENG111.3										3					
15ENG111.4										3					
15ENG111.5								2							
15PHY100.1	3	3										1			
15PHY100.2	3	3										1			
15PHY100.3	3	3										1			
15CSE100.1	1	1													
15CSE100.2	3	2	3		3			3	3	3					
15CSE100.3	2	1													
15CSE100.4	1	1	2		2										
15MAT111.1	3	2	1									1			
15MAT111.2	1	3	1												
15MAT111.3	3											1			
15MAT111.4	3	2													
15MAT111.5	2	3	1												
15MAT111.6	3														
15MEC100.1	3	3	2	1		2				3		3	2	2	2
15MEC100.2	3	3	2	2		2				3		3	2	2	2
15MEC100.3	3	3	3	2		2				3		3	2	2	2
15MEC100.4	3	3	3	3		2				3		3	2	2	2
15MEC100.5	3	3	3	3		2				3		3	2	2	2
15MEC100.6	3	3	3	3	3	2				3		3	2	2	2
15MEC180.1	2	1							2	1		1			
15MEC180.2	2	2	1		1				2	1		1		1	
15MEC180.3	2	2							2	1		1	1		
15MEC180.4	2	1							2	1		1	1		
15CUL101.1						2	3	3	2	3	2	2			
15CUL101.2						2	3	3	2	3	2	2			
15CUL101.3						2	3	3	2	3	2	2			
15CUL101.4						2	3	3	2	3	2	2			
15CUL101.5						2	3	3	2	3	2	2			
15EEE180.1	3							3		3		1			
15EEE180.2	3	3	1					3				1			
15EEE180.3	3	1	3					3	3			1			
15EEE180.4	3	3	3					3	2			1			
15PHY181.1	2	2	2	2	2	1									

15PHY181.2	2	2	2	2	2	1									
15PHY181.3	2	2	2	2	2	1									
15MAT121.1	3	1										1			
15MAT121.2	2	3										1			
15MAT121.3	2	2	1												
15MAT121.4	3	3	1												
15MAT121.5	2														
15MAT121.6	3		1												
15CHY100.1	3														
15CHY100.2		3													
15CHY100.3			2	1											
15CSE102.1	1												3	2	
15CSE102.2	1	1	1										3	2	
15CSE102.3	1	2	2										3	2	
15CSE102.4	2	3	2										3	2	
15MEC102.1	3	3	3	2								1			
15MEC102.2	3	3	3	2								1			
15MEC102.3	3	3	3	2								1			
15MEC102.4	3	3	2	2								1			
15MEC102.5	3	3	3	2								1			
15CUL111.1						2	3	3	2	3	2	2			
15CUL111.2						2	3	3	2	3	2	2			
15CUL111.3						2	3	3	2	3	2	2			
15CUL111.4						2	3	3	2	3	2	2			
15CUL111.5						2	3	3	2	3	2	2			
15CHY181.1	3	3	1												
15CHY181.2	3	3	1												
15CHY181.3	3	3													
15CHY181.4	3	2													
15CHY181.5	3	3	1												
15CSE180.1	1	2	2										3	2	
15CSE180.2	1	1	2		1								3	2	
15CSE180.3	1	2	2										3	2	
15CSE180.4	1	2	2										3	2	
15MEC101.1	3	3	3	2		2				3		3	2	2	2
15MEC101.2	3	3	3	2		2				3		3	2	2	2
15MEC101.3	3	3	3	2		2				3		3	2	2	2
15MEC101.4	3	3	3	2		2				3		3	2	2	2
15MEC101.5	3	3	3	2		2				3		3	2	2	2
15MEC101.6	3	3	3	2		2				3		3	2	2	2

15MEC204.1	3	3	2	1								1	3	1	1
15MEC204.2	3	3	2	1								1	3	1	1
15MEC204.3	3	3	2	1								1	3	1	1
15MEC204.4	3	3	2	1								1	3	1	1
15MEC204.5	3	3	2	1								1	3	1	1
15EEE205.1	3	2	1												
15EEE205.2	2	2							1						
15EEE205.3	3	1							2						
15EEE205.4	3	1													
15EEE205.5	3	1							2						
15EEE205.6	2				1				1						
15MEC202.1	3	1		1	1	1		1		3		2	2	2	
15MEC202.2	3	3	2			2		1	2	1		2	2	2	
15MEC202.3	3	3	3	1	1			1		2		2	2	2	
15MEC202.4	3	3	3	1	1	1		1		3		1	2	2	
15MEC201.1	**3**	**3**		**1**									**3**		
15MEC201.2	**3**	**3**	**1**	**1**									**3**		
15MEC201.3	**3**	**3**	**1**	**1**									**3**		
15MEC201.4	**3**	**3**	**1**	**1**									**3**		
15MEC201.5	**3**	**3**	**1**	**1**									**3**		
15MEC201.6	**3**	**3**	**1**	**1**									**3**		
15MAT204.1	3	2		1											
15MAT204.2	2	3		1											
15MAT204.3	3			2											
15MAT204.4	3														
15MAT204.5	1	3		2											
15MAT204.6	3														
15MEC203.1	1											2	3		1
15MEC203.2	3	2										2	3		
15MEC203.3	3	3										2	3		
15MEC203.4	3	2	1									2	3		
15MEC281.1	3								2	1		1	3		
15MEC281.2	3								2	1		1	3		
15MEC281.3	3								2	1		1	3		
15MEC281.4	2			2	3				1	2		3	2		
15MEC281.5	**3**	**3**	**1**									**3**	**2**		
15MEC281.6	**3**	**3**	**1**									**3**	**2**		
15AVP201.1						2		3	3	2		3			
15AVP201.2						3		3	3	2		3			
15AVP201.3						3		3	3	2		3			

15AVP201.4						3		3	3	2		3			
15AVP201.5						3		3	3	2		3			
15TAM101.1									2	2					
15TAM101.2									2	2					
15TAM101.3									2	2					
15TAM101.4									2	2					
15TAM101.5									2	2					
15TAM101.6									2	2					
15HUM239.1						3	3		3	2		1			
15HUM239.2						3	3	2	3	3	1	2			
15HUM239.3										2	1				
15HUM239.4							3		2	2		2			
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15CSE377.4	2	3	2												
15CSE377.5	1	2	1					2							

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Objectives:

To make the students communicate their thoughts, opinions, and ideas freely andnaturally. To make them understand the different styles in communication.

To make the students understand the aesthetics of reading and writing To bring in a spirit of enquiry

To motivate critical thinking and analysis To help them ruminate on human values

Contents:

Reading: Different styles of communication –Reading Comprehension - critical thinking and analysis –Note-making – Any two pieces from the text

Writing: Prewriting techniques- Kinds of paragraphs- basics of continuous writing - Grammar & Usage: Parts of Speech, Tenses, Concord, Phrasal Verbs, Modal Auxiliaries, Modifiers (Workbook) - Any two pieces from the text.

Practical sessions (Listening& Speaking): Introduction to English pronunciation including minimal pairs and word stress– differences between British and American English –Listening comprehension and Note-taking. - Any two pieces from the text
Activities: Short speeches, seminars, quizzes, language games, debates, and discussions, Book Reviews etc.

Outcomes:

CO 1: Demonstrate competency in all the four linguistic skills viz, listening, speaking, reading and writing. CO 2: Apply different styles of communication in professional context.
CO 3: Take part in different planned & extempore communicative activities. CO 4: Interpret and Discuss facts and information in a given context.
CO 5 :Develop an appreciation for human values.

CO –PO Mapping:

	PO6	PO7	PO8	PO9	PO10	PO12
CO1					3	2
CO2				2	3	2
CO3					3	
CO4					3	
CO5			2			

TEXT BOOKS/REFERENCES:

Language through Reading: Compilation by Amrita University for internal circulation
Poems:
1. *The Poplar Field* by William Cowper
2. *Telephone Conversation* by Wole Soyinka

Prose:

1. *Higher Mathematics* by R. K. Narayan
2. *Wings of Fire* by Abdul Kalam (Part III.11)

Short Stories:

1. *Best Investment I Ever Made* by A. J. Cronin
2. *Death of an Indian* by Krishna Charan Das

1. Language through Practice: Compilation by Amrita University for internal circulation

15MAT111 **Calculus and Matrix Algebra** **2 1 0 3**

(Pre-Requisite: Nil)

Objectives:

1. To learn the theory and applications of Linear System of Equations and to solve system by Numerical Methods to use these techniques in Eigenvalue problems. To introduce the concept of eigenvalues and eigenvectors and its applications.
2. To study the concept of similar matrices and to analyze the possibility of diagonalization and hence compute a diagonal matrix, if possible. To apply the knowledge of diagonalization to transform the given quadratic form into the principal axes form and analyze the given conic section.
3. To learn to obtain dominant eigenvalue numerically as it may be required in the case of matrices of large (size)n
4. To learn to graph basic functions and to study the shifting and scaling of graphs.
5. To familiarize the types of discontinuities and the intermediate value property and the concept of non-differentiability, graphing of functions.
6. To learn the theory of integration in the setting of area beginning with finite sums and letting the number of terms goes to infinity and to use it to find volumes, lengths of plane curves etc.

Keywords:

Eigenvalues and Eigenvectors, Diagonalization, Similarity Transformation, Computational Linear Algebra, Non differentiability, Extreme values, Graphing.

Contents:

Functions and their Graphs. Shifting and Scaling of Graphs. Limit (One Sided and Two Sided) of Functions. Continuous Functions, Discontinuities, Monotonic Functions, Infinite Limits and Limit at Infinity.

Derivative of a function, non-differentiability, Intermediate Value Property, Mean Value Theorem, Extreme Values of Functions, Monotonic Functions, Concavity and Curve Sketching, Definite Integrals, The Mean Value Theorem for definite integrals, Fundamental Theorem of Calculus, Integration Techniques.

System of linear Equations, linear independence. Definitions and Properties, Positive definite, Negative Definite and Indefinite Matrices, Diagonalization and Orthogonal Diagonalization, Quadratic form, Transformation of Quadratic Form to Principal axes, Symmetric and Skew Symmetric Matrices, Hermitian and Skew Hermitian Matrices and Orthogonal Matrices. Iterative Methods for the Solution of Linear Systems, Power Method for Eigen Values and Eigen Vectors.

Outcomes:

CO1: Understand the basic concepts of functions, limits, continuity, derivatives and analyze them.

CO2: Apply the concept of differentiability to find the extreme values of the given function and analyze the derivatives to sketch the graph of the given function.

CO3: Recall the terms, facts and basic concepts of definite integrals and the techniques of obtaining antiderivatives. CO4: Understand the notion of eigenvalues and eigenvectors, analyze the possibility of diagonalization and hence compute a diagonal matrix, if possible.

CO5: Apply the knowledge of diagonalization to transform the given quadratic form into the principal axes form and analyze the given conic section.

CO6: Understand the advantages of the iterative techniques and apply it to solve the system of equations and finding eigenvectors.

CO –PO Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO2	1	3	1	-	-	-	-	-	-	-	-	0	-	-
CO3	3	0	0	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	0	-	-	-	-	-	-	-	-	0	-	-
CO5	2	3	1	-	-	-	-	-	-	-	-	0	-	-
CO6	3	0	0	-	-	-	-	-	-	-	-	0	-	-

TEXT BOOKS/REFERENCES:

1. "Calculus", G.B. Thomas Pearson Education, 2009, El
2. "Advanced Engineering Mathematics", Erwin Kreyszig,
3. "Calculus", Monty J. Strauss,lJ.Smith,3rdEdition,Gerald2002. J. Bradley an
1. "Advanced Engineering Mathematics", by Dennis G. Publishers, 2012.

15CSE100 Computational Thinking and Problem Solving 3 0 2 4

Objectives:

1. Develop algorithms by arriving at steps and rules and representing them a flow of sequential, conditional and repetitive actions. Apply logical reasoning to arrive at a reasoning sequence that makes conclusion more rational.

2. Understand and explore the building blocks of problem solving and algorithmic thinking

using tools (Spreadsheet, Scratch, Raptor and Flowgorithm).

3. Understand behavior of algorithms, model states of computation and verify it for correctness. Examine algorithms and instruction snippets to debug, find equivalent, alternative representations and/or solutions.

Keywords:

Contents:

Basics: Introduction, Information and data, Data encoding. Logic: Boolean logic, Applications of propositional logic.

Problem Solving and Algorithmic Thinking: Problem definition, Logical reasoning, Problem decomposition, Abstraction. Algorithmic thinking: Flowcharting, Name binding, Selection, Repetition, Modularization. Data organization: List and Arrays. Simple algorithms, comparison of performance of algorithms.

Problem Solving Techniques: Factoring and Recursion Techniques, Search and Sort techniques, Greedy Techniques, Divide and Conquer, Text processing and Pattern matching.

Outcomes:

CO1: Apply computational thinking principles and algorithmic building blocks to understand, define, and solve problems

CO2: Design algorithms and implement solutions for problems

CO3: Represent, organize, manipulate and interpret data

CO4: Trace computational states and analyse techniques/ strategies for given solutions

CO-PO Mapping:

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

TEXT BOOKS/REFERENCES:

1. David Riley and Kenny Hunt , “Computational thinking for modern solver”,Chapman & Hall/CRC, 2014
2. R.G. Dromey , “How to solve it by Computer”, PHI, 2

15PHY100 PHYSICS 3 0 0 3

Objectives:

3. To provide simple and clear elucidations of main physical ideas and theories of the 20-th century.
4. To explain these concepts and theories through a broad range of current applications and examples.
5. To liven up the mind with brief sketches of the historical development of 20th-century physics.
6. Develop an understanding of the current basis of broad knowledge in modern physics.
7. Enhance the critical thinking, analytical reasoning and problem solving skills.
8. Discuss the problems, confronting modern physics in the 21-st century.

Keywords:

Relativity, Quantum Mechanics, Classical and quantum statistics, solid state physics.

Contents:

Special Theory of Relativity: Frames of reference, postulates of special theory of relativity, time dilation, length contraction, relativistic mass, relativistic momentum, mass and energy, Lorentz Transformation, velocity addition, Doppler Effect.

Physical Background for Quantum Mechanics: Black body radiation, photoelectric effect, Compton effect, X-ray diffraction, pair production, de-Broglie waves, Uncertainty (I)

Quantum Mechanics: Wave function, wave equation, Schrodinger equation (time dependent), expectation values-operators, eigen functions and eigen values, Schrodinger equation (steady state), particle in a box-finite potential, tunneling effect, quantum theory of hydrogen atom. (II)

Classical and Quantum Statistics: Statistical distribution, Maxwell Boltzm gas, quantum statistics, Rayleigh Jean‟s formula,nergy Pla distribution, specific heat of solids, evolution of stars.

Solid state Physics: Crystalline and amorphous solids-ionic crystals-covalent crystals-Van der Walls bond-metallic bond-Band theory of solids-semiconductor devices. (III)

Outcomes:

CO1: Understand, Comprehend and acquaint with concepts of Modern Physics
CO2: Analyze and solve (idealized and quasi practical) physics problems pertaining to various concepts of Modern Physics
CO3: Apply concepts of Modern Physics to solve engineering problems that needs ideas from Modern Physics

CO –PO Mapping:

CO/ PO	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PO13	PSO 1	PSO 2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

EXTBOOKS/REFERENCES:

1. Arthur *Concepts*Beiser,*ofModern Physics*"", Tata Mcgraw Hill, 2003 (6 th e
1. T.Thornton *Modern*and*Physics*A.Rex,*forScientists*"*and Engineers*", Fort Worth: Saunde edition).
3. P.A.Tipler and R. *Modern*A. *Physics*Llewell",Newn, York:" Freema (3 rd edition).
4. S.H.Patil,*ElementsofModern*" *Physics*", Tata Mc Graw Hill, 1989.
5. F.K.Richtmyer, H.Kennard,*ModernPhysics*",JohnTataN.McCopper,Graw Hill," 1995

15CHY100 CHEMISTRY 3 0 0 3

Unit 1

Chemical Bonding

Review of orbital concept and electronic configuration, electrovalency and ionic bond formation, ionic compounds and their properties, lattice energy, solvation enthalpy and solubility of ionic compounds, covalent bond, covalency, orbital theory of covalency - sigma and pi bonds - formation of covalent compounds and their properties. Hybridization and geometry of covalent molecules - VSEPR theory - polar and non-polar covalent bonds, polarization of covalent bond - polarizing power, polarisability of ions and Fajan's rule, dipole moment, percentage ionic character from dipole moment, dipole moment and structure of molecules - co-ordinate covalent compounds and their characteristics, molecular orbital theory for H2, N2, O2 and CO, metallic bond - free electron, valence bond and band theories, weak chemical bonds – inter and intra molecular hydrogen bond - van der Waals forces.

Unit 2

Thermodynamic Parameters

Stoichiometry - mole concept, significance of balanced chemical equation - simple calculations - Conditions for occurrence of chemical reactions - enthalpy, entropy and free changes - spontaneity – Thermochemistry - heats of reactions - (formation, combustion, neutralization) - specific heats - variation of enthalpy change with temperature - Kirchhoff' relation (integrated form) - bond enthalpy and bond order - Problems based on the above.

Kinetics

Review of molecularity and order of a reaction, rate law expression and rate constant - first, second, third and zero order reactions, pseudo-first order reactions (pseudo-unimolecular reactions) - complex reactions - equilibrium and steady state approximations - mechanism of these reactions - effect of temperature on reaction rates - Arrhenius equation and its significance, Michaelis Menden kinetics-enzyme catalysis.

Unit 3

Electrochemistry

Electrolytes - strong and weak, dilution law, Debye-Huckel theory, faraday's laws, origin of potential, single electrode potential, electrochemical series, electrochemical cells, Nernst equation and its application, reference electrodes- SHE, Ag/AgCl, Calomel.

Photochemistry

Photochemistry, laws of photochemistry - Stark-Einstein law, Beer-Lamberts law, quantum efficiency-determination, photochemical processes - Jablonsky diagram, internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo sensitization, photo polymerization.

Outcomes:

CO1: Understand the fundamental concepts of chemistry to predict the structure and properties of engineering materials

CO 2: Develop analytical skills to evaluate the cause, feasibility and course of chemical reactions

CO 3:Design and apply the idea of cutting edge area of chemistry to solve engineering related problems

CO –PO Mapping:

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

REFERENCE BOOKS

Physical chemistry, Puri and Sharma
Inorganic chemistry, Puri and Sharma

15PHY181 Physics Lab 0 0 2 1

Objectives:

1. Physics practical work involves „learning by doing“.
2. Careful and stepwise observation of sequences during an experiment or activity facilitate personal investigation as well as small group or team learning.
3. A practical physics course should enable students to do experiments on the fundamental laws and principles, and gain experience of using a variety of measuring instruments.
4. To develop intellectual communication skills and discuss the basic understanding of various experimental principles involved.

Keywords:

Non uniform bending, Radius of curvature, wavelength, angle of minimum deviation, rigidity modulus, viscosity, energy gap, efficiency

Contents:

Introduction: Measuring instruments

1. Young‟s -nonmodulus-uniformbending
2. Newton‟s ring
3. LASER-wavelength and particle size determination
4. Spectrometer
5. Carey Foster‟s bridge
6. Rigidity modulus- Torsional pendulum
7. Viscosity of liquid by Stoke‟s method
8. Energy gap of a semiconductor
9. Solar cell characteristics

Outcomes:

CO1: Prepare for the lab experiment and perform individually a wide spectrum of experiments. CO2: Present experimental data in various appropriate forms like tabulation, and plots.
CO3: Analyze, Interpret and Summarize experimental results.
CO4: Communicate clearly understanding of various experimental principles, instruments/setup, and procedure.

CO –PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3
CO1	-	1	-	-	1	-	-	-	2	1	-	-	-	-	-	-
CO2	-	2	-	2	-	-	-	-	-	-	1	-	-	-	-	-
CO3	-	3	1	-	-	-	-	-	1	1	-	-	-	-	-	-
CO4	-	-	-	-	1	-	1	-	1	3	-	-	-	-	-	-

TEXT BOOKS/REFERENCES:

- "*Laboratory Manual*",Department of Sciences, Amrita School of Engineering, Amrita Vishwa Vidyapeetham.
- R.A. Dunlap, "*Experimental Physics: Modern Methods*",Oxford University Press, New Delhi (1988).
- E.V. Smith, "*Manual for Experiments in Applied Physics*",Butterworths (1970).

D. Malacara (ed.), "*Methods of Experimental Physics*",Series of Volumes, Academic Press Inc. (1988).

15CHY181 CHEMISTRY LAB 0 0 2 1

1. Acid base titration (double titration)
2. Complexometric titration (double titration)
3. Redox (permanganimetry) titration (double titration)
4. Conductometric titration
5. Potentiometric titration
6. Ester hydrolysis

Outcomes:

CO1:Develop analytical skills for the determination of water quality parameter

CO2:Understand the electrochemical principles of conductance and electrode potentials and its application in analytical science

CO3:Develop analytical skills in the determination of rates of chemical reactions and its application CO4:Learn the basics of redox reaction and applying it for quantitative determination.

CO5:Create skills to convert basic chemical reactions to analytical application.

CO –PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	1	-	-	-	-	-	-	-	-	-
CO2	3	3	1	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	3	1	-	-	-	-	-	-	-	-	-

15MEC180 Workshop A 0 0 2 1

Objectives:

1. To introduce basic concepts pertaining to product dismantling and assembly.
2. To enable understanding of basic pneumatic components; design and validate simple circuits.
3. To develop and fabricate simple objects with sheet metal.
4. Hands-on training on welding and soldering joints.

Keywords:

Product dismantling, arc welding, sheet metal work, pneumatic circuits, soldering.

Contents:

1. Product Workshop

Disassemble the product of sub assembly-Measure various dimensions using measuring instruments-Free hand rough

sketch of the assembly and components-Name of the components and indicate the various materials used-Study the functioning of the assembly and parts-Study the assembly and components design for compactness, processing, ease of assembly and disassembly-Assemble the product or subassembly.

1. Pneumatic and PLC Workshop

Study of pneumatic elements- Design and Assembly of simple circuits using basic pneumatic elements-Design and assembly of simple circuits using electro-pneumatics. Study of PLC and its applications –Simple programming using ladder diagrams.

1. Sheet Metal Workshop

Study of tools and equipment - Draw development drawing of simple objects on sheet metal (cone, cylinder, pyramid, prism, tray etc.)-Fabrication of components using small shearing and bending machines-Riveting and painting practice.

1. (a) Welding Workshop

Study of tools and equipment - Study of various welding methods- Arc welding practice and demonstration of gas welding and cutting.

(b) Demo and Practice Workshop

Fitting : Study of tools, practice in chipping, filing and making joints.
Carpentry : Study of tools, planning practice and making joints.

Outcomes:

CO1: Dismantle and assemble various products.
CO2: Design and simulate pneumatic and electro-pneumatic circuits.
CO3: Fabricate sheet metal objects.
CO4: Perform arc welding and soldering.

CO-PO Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1	-	-	-	-	-	-	2	1	-	1
CO 2	2	2	1	-	1	-	-	-	2	1	-	1
CO 3	2	2	-	-	-	-	-	-	2	1	-	1
CO 4	2	1	-	-	-	-	-	-	2	1	-	1

TEXT BOOK/REFERENCE:

Concerned Workshop Manuals

15EEE180 WORKSHOP B 0 0 2 1

Part A - Electronics

Identification of electronic components (Passive and Active)
Study of measuring instruments (Voltmeter, Ammeter and Multimeter) Measurement and theoretical Verification of series and parallel combination of resistors and capacitors
Calibration of CRO and measurements of signal parameters (RMS, maximum value, peak value, time and frequency)
Calibration of function generator using CRO Soldering practice

Part B - Electrical
1. Study on power supply and protective devices
2. Study on tools and electrical accessories
3. Study on sources of light
4. Study on energy efficiency
5. Study on water pump
6. Study on house hold appliances: a. Iron box
   b. Fan
   c. Refrigerator
   d. Air conditioner
7. House wiring I – Glow an incandescent lamp using SPST switch
8. House wiring II – Glow a fluorescent lamp using SPST switch
9. House wiring III – Operate a fan and an incandescent lamp using two independent SPST switch
10. House wiring IV – Operate a fluorescent lamp and a 3 pin socket using two independent SPST switch
11. House wiring V – Staircase wiring
12. House wiring VI – Godown wiring

Course Outcomes

15EEE180.1	Understand electrical safety measures and identify electrical tools, electronic components and their symbols.
15EEE180.2	Understand electric laws using simulation studies and detect failures in electrical and electronic circuits.
15EEE180.3	Build/Solder and test, residential wiring/Electronic circuits and measure electrical parameters.
15EEE180.4	Estimate the materials required for wiring a building.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
15EEE180.1	3											1		
15EEE180.2	3	3	1											
15EEE180.3	3	1	3						3					
15EEE180.4	3	3	3						2					

15MEC100 ENGINEERING DRAWING - CAD 2 0 2 3

Objectives:

1. To develop drawings using Bureau of Indian Standards (BIS)

2. To communicate effectively through drawings
3. To enhance visualization skills, which will facilitate the understanding of engineering systems.

Keywords:

Coordinate system**,** Orthographic projections, Isometric projections

Contents:

Introduction, Drawing Instruments and their uses, Layout of the Software, standard tool bar/menus, navigational tools. Co-ordinate system and reference planes. Creation of 2 dimensional environment. Selection of drawing size and scale. Commands and Dimensioning.

Orthographic Projections: Introduction, Planes of projection, reference line. Projection of points in all the four quadrants. Projection of straight lines, Projection of Plane Surfaces, and Projection of Solids in first angle projection system.

Outcomes:

CO1: Understand the fundamental principles of first angle and third angle projections. CO2: Dimension and label the drawings as per standards.
CO3: Construct the drawings by choosing appropriate line type.
CO4: Visualize and construct projections of line and lamina when inclined to one reference plane and both reference planes.
CO5: Visualize and construct solid entities in its simple position and when inclined to one reference plane. CO6: Construct the drawings using computer aided design and drafting software package

CO –PO Mapping:

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

TEXTBOOKS/REFERANCES:

1. 1. Bhat N.D. and Panchal"*Engineering*V.M. *Drawing*,— *Plane*",42e,Charoatar*and*Publishing*Solid G*
2. House, 2010
3. 2. James D."*Engineering*Bethune,— *Graphics"*,PearsonEducation,*with*2014*AutoCAD*‖
4. K.R. Gopalakrishna,"*EngineeringDrawing"*‖,2014,—Subhas Publications
5. Narayan K.L. and Kannaiah P, "*Engineering Drawing*",SciTech Publications, 2003

15CUL101 Cultural Education I 2 0 0 2

Objectives:

The course is designed as an introductory guide to the variegated dimensions of Indian cultural and intellectual heritage, to enable students to obtain a synoptic view of the grandiose achievements of India

in diverse fields. It will equip students with concrete knowledge of their country and the mind of its people and instil in them some of the great values of Indian culture.

Keywords:

Culture, Purusharthas, Symbols, Epics

Contents:

The necessity of Cultural Education, Know your university, Meaning of college prayer, Know your Chancellor-Introduction to Amma.

Purusharthas (Goals of life), Varnasrama Dharma, Doctrine of Karma, Practices for Happiness.

Symbols of Indian Culture, Festivals of India, Living in harmony with nature, Relevance of our epics in this scientific age, Lessons from Ramayana and Mahatmas.

Outcomes:

CO1: Be introduced to the foundational concepts of Indian culture and heritage, will be able to understand the cultural ethos of Amrita Vishwa Vidyapeetham, and Amma‟s life.

CO2: Understand the foundational concepts of Indian civilization like purusharthas, law of karma, etc, which contributes towards personality growth.

CO3: Gain a positive appreciation of Indian culture, traditions, customs and practices CO4: Imbibe spirit of living in harmony with nature, and principles and practices of Yoga CO5: Get guidelines for healthy and happy living from the great spiritual masters

CO-PO Mapping:

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

TEXT BOOKS/REFERENCES:

1. *“Eternal Values for a Changing Society”*, Swami Ranganathananda
2. “*Symbolism in Hinduism*”,Swami Nityanand

15MAT121 **Vector Calculus and Ordinary Differential Equations** **3 0 0 1**

(Pre-Requisite: Nil)

Objectives:

1. To understand the basic concepts of ODE, apply them in modeling and solving first order equations.
2. To recall the techniques of solving second order linear homogeneous ODE with constant coefficients.
3. Understand and modify the above techniques for solving Euler-Cauchy equations. Understand and apply methods of undetermined coefficients and variations of parameters to solve the second order linear nonhomogeneous differential equations.
4. Understand and apply the techniques of solving system of linear ODE. Understand and analyze the critical points and stability of the system.
5. Understand the vector functions, scalar and vector fields. Understand the derivatives of vector functions and its physical and geometrical interpretations. Understand the concept of gradient, divergence and curl and apply them appropriately.
6. Under the concept of line integral and analyze the independence of path.
7. Understand the concept of multiple integrals. Apply Green‟s theorem for pl Stokes‟ theorem to evaluate the integrals of vector

Keywords:

ODE, Homogeneous, non- homogeneous, linear non homogeneous, undetermined coefficients , surfaces, vector fields.

Contents:

Ordinary Differential Equations: First Order ODE (basic Concepts of Modeling),Exact Differential equations and Integrating Factors (sections 1.1,1.4)

Second Order Differential Equations:Homogeneous and non- homogeneous linear differential equations of second order (Review), Modeling of Free Oscillations of Mass Spring system, Euler-Cauchy Equations, Solution by the method of Undetermined Coefficients and solution by the method of variation of parameters(Sections 2.1,2.2,2.4,2.5,2.7,2.10)

System of Ordinary Differential Equations:Engineering Applications, Basic Theor Constant Coefficient systems, Phase plane method, Criteria for critical Points, Stability (sections4.1,4.2,4.3,4.4)

Vector Differential Calculus: Gradient ,Divergence and Curl :Vector Differentiation: Vector and Scalar Functions and their fields, Vector calculus Derivatives, Curves, Arc Length, Calculus Review, Functions of several variables(Optional) Gradient , of a scalar field, Directional Derivative, Divergence of a vector field, Curl of a vector Field, (Sections 9.4,9.5,9.7.9.8,9.9)

Vector Integral Calculus(Integral Theorem): Line integrals , Path Independence of line integrals , Calculus review, Double Integrals Green‟s Theorem, in the plane, –Surfac Divergence Theorem of Gauss, Stokes‟ Theorem. (section

Outcomes:

CO 1: Able to understand , and interpret the concepts. CO 2: Able to apply the concept and understand them

CO 3: Able to understand and implement the concepts in application oriented problems .

CO 4: Able to understand and analyze the and apply the knowledge of diagonalization of matrices to transform the given quadratic form.

CO5: Able to understand the basic concepts and apply them in modeling the first order ODEs.

CO6: Able to understand and apply methods of undetermined coefficients and variation of parameters to solve second order ODEs.

CO –PO Mapping:

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

REFERENCE BOOKS:

1. *'Advanced Engineering Mathematics', Dennis G. Zill and Michael R. Cullen, second edition, CBS Publishers, 2012.*
2. *'Calculus', G. B. Thomas Pearson Education, 2009, Eleventh Edition.*
3. *'Calculus', Monty J. Strauss, Gerald J. Bradley and Karl J. Smith, 3rd Edition, 2002.*

15CSE102 COMPUTER PROGRAMMING 3 0 0 3

Unit 1

Introduction to C language: Structure of a C program, comments, Data types, Variables, constants, Data input and output statements, input assertions; expressions and evaluation. Functions: inter function communication, standard functions, scope. Selection: two way selection, multi-way selection, repetition: concept of loop, loop invariant, pretest and post-test loops, initialization and updating, event and counter controlled loops. Recursion: recursive definition, recursive solution, designing recursive functions, limitations of recursion.

Unit 2

Files and streams, file input output. Arrays - 1D numeric, searching and sorting, 2D numeric arrays: problems with matrices. Pointers: introduction, compatibility, arrays and pointers, Dynamic memory allocation, array of pointers, pointer arithmetic.

Unit 3

Strings: fixed length and variable length strings, strings and characters, string input output, array of strings, string manipulation functions, sorting of strings. Enumerated types, Structures: Structure vs array comparison, complex structures, Structures and functions, Union, binary input output, Command line arguments.

TEXTBOOK:

Behrouz A. Forouzan and Richard F. Filberg, "Computer Science A structured programming approach using C", Third Edition, Cengage Learning, 2006.
REFERENCES:

1.Brian W. Kernighan, Dennis M. Ritchie, "The C Programming Language", Second Edition, Prentice Hall, 1988.
2.Eric S. Roberts, "Art and science of C", Addison Wesley, 1995.

3.Jeri Hanly and Elliot Koffman, "Problem solving and program design in C", Fifth Edition, Addison Wesley (Pearson), 2007.

Outcomes:

CO1	Apply computational thinking principles and algorithmic building blocks to understand, define, and solve problems
CO2	Design algorithms and implement solutions for problems
CO3	Represent, organize, manipulate and interpret data
CO4	Trace computational states and analyze techniques/ strategies for given solutions

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1												3	2
CO2	1	1	1										3	2
CO3	1	2	2										3	2
CO4	2	3	2										3	2
15CSE102	1.25	2	1.667										3	2

15MEC101 ENGINEERING DRAWING - CAD II 2 0 2 3

Sections of Solids: Introduction, Section planes, Sectional views, apparent shapes and true shapes of sections of right regular prisms, cylinders, pyramids and cones.

Development of lateral surfaces: Introduction, Development of lateral surfaces of prisms, cylinders, pyramids and cones and their frustums & truncations.

Isometric Projection: Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projection of prisms, pyramids, cylinders, cones and simple Machine parts.

Orthographic Views of 3 dimensional solids.

Course Outcomes

15MEC101.1	Construct sectional views of prisms, cylinder and pyramids to view the apparent shape and true shapes of the solid geometry.
15MEC101.2	Construct lateral surfaces of prisms, cylinder, pyramids, cone and truncated solid geometry.
15MEC101.3	Construct isometric projection drawings of prisms, cylinder, pyramids, cones and simple machine parts.
15MEC101.4	Construct orthographic views of solid geometry and simple machine parts.
15MEC101.5	Change orthographic views ofsolid geometry and simple machine parts into isometric view.
15MEC101.6	Change isometric views ofsolid geometry and simple machine parts into orthographic view.

TEXTBOOK:

Bhat N.D. and Panchal V.M., "Engineering Drawing Plane and Solid Geometry", 42e, Charoatar Publishing House, 2010

REFERENCES:

1. *James D. Bethune, "Engineering Graphics with AutoCAD", Pearson Education, 2014*
2. *K. R. Gopalakrishna, "Engineering Drawing", 2014, Subhas Publications*
3. *Narayan K. L. and Kannaiah P, Engineering Drawing, SciTech Publications, 2003*

15MEC102 ENGINEERING MECHANICS 3 0 0 3

Unit 1

Principles of Statics: Introduction to vector approach - free body diagrams - forces in plane - forces in space - concurrent forces - resolution of forces - equilibrium of particle.

Statics of rigid bodies in two dimension: Moment of a force about a point - moment of a couple - equivalent force - couple system. Rigid body equilibrium: Beams - support reactions.

Unit 2

Friction - block friction, ladder friction. Analysis of trusses - Method of joints, method of sections.

Centroid of lines, areas - composite areas. Second Moment of area - polar moment of inertia - mass moment of inertia - radius of gyration.

Unit 3

Dynamics of particles: Kinematics of particles - rectilinear motion - relative motion- position, velocity and acceleration calculations in cylindrical coordinates.Dynamics of rigid bodies: General plane motion - translation and rotation of rigid bodies - Chasle's theorem.

Course Outcomes

15MEC102.1	Determine rectangular components of a force
15MEC102.2	Obtain the equivalent force - couple system of a given system
15MEC102.3	Analyze the equilibrium state of a particle and rigid body
15MEC102.4	Estimate the moment of inertia of composite area about centroidal or any arbitrary axis
15MEC102.5	Determine the velocity and acceleration of a particle in rectangular and cylindrical coordinate systems and angular velocity of rigid bodies in general plane motion.

TEXTBOOKS:

1. *Hibbeler, R.C., "Engineering Mechanics - Statics", 12/e, Pearson Education Pvt. Ltd., 2007.*
2. *Beer, F. P. & Johnston, E. R., "Vector Mechanics for Engineers - Statics and Dynamics", 8/ e, McGraw Hill International Book Co., 2008.*

REFERENCES:

1. *Meriam, J. L., "Dynamics",5/e, John Wiley & sons,2003*
2. *Shames, I. H, "Engineering Mechanics - Statics and Dynamics", 4/e., Prentice-Hall of India Pvt. Ltd., 2003.*
3. *Dubey, N. H. "Engineering Mechanics" McGraw Hill*

15CSE180 Computer Programming Laboratory 0 0 2 1

Objectives:

- The laboratory intends to provide hands-on experience on the structured programming paradigm.
- This laboratory facilitates students to apply the structured programming principles to solve problems

Contents:

Solving simple problems with operators, programs on conditional control constructs, programs on loops (while, do-while and for), programs using user-defined functions and library functions, programs on files, arrays (single and multi-dimensional), programs using DMA, programs on strings,

structures.

Outcomes:

CO1: Develop solutions for problems systematically using structured logic approach.
CO2: Develop computer programs for a given problem scenario.
CO3: Make use of the programming constructs effectively while developing computer programs.
CO4: Develop modular solutions for a given scenario.

CO-PO Mapping:

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

TEXT BOOKS/REFERENCES:

Behrouz A. Forouzan*Computer*and *Science*Richard*AStructuredProgramming*F.Filberg, *Approach*"Third *U*
Edition, Cengage Learning, 2006.

15CUL111 Cultural Education II 2 0 0 2

Objectives:

The students will be able to deepen their understanding and further their knowledge about the different aspects of Indian culture and heritage.

Keywords:

Education,Personality, Oneness, Bhagavadgita

Contents:

To the world from India, Education system in India, Insights from Mahabharata, The human personality India"s scientific system for personality refinement,–The hand book for human life

Examples of Karmayoga in modern India, Chanakya"sions guid with Amma.

Outcomes:

CO1: Get an overview of India and her contribution to the world in the field of science and literature.

CO2: Understand the foundational concepts of ancient Indian education system and practices associated with them.
CO3 : Learn the important concepts of Vedas, Bhagavad-Gita and Yogasutras and their relevance to daily life
CO4 : Familiarize themselves with the inspirational characters and anecdotes from the epics and Indian history
CO5 : Gain a rational understanding of the underlying principles of Indian spirituality

CO-PO Mapping:

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

TEXT BOOKS/REFERENCES:

1. The Vedas - Sri ChandrasekharendraSaraswati
2. A Concise history of Science in India - D. M. Bose, S. N. Sen. B. V. Subbarayappa

15MEC201 ENGINEERING THERMODYNAMICS 3 0 0 3

Unit 1

Introduction and importance of thermodynamics, different approaches in the study of thermodynamics, SI units, basic concepts and definitions – system, surroundings, types of systems, properties. Pressure measurement, thermodynamic equilibrium, quasi static process, cyclic process, and thermodynamic energy interactions - evaluation of work type interaction, heat interaction, energy and forms of energy, history of laws of thermodynamics.

First law for closed system, analysis of closed systems. Concept of Zeroth Law, thermometry, temperature scales.

Open systems - Conservation of Mass applied to control volume, application of steady state flow process for typical Work and Heat transfer devices. Throttling process, application of throttling process.

Unit 2

Second Law of Thermodynamics – statement of Kelvin-Planck and Clausius, Heat Engines, Heat Pump, Refrigerators – Reversible and Irreversible processes, the Carnot Cycle, Carnot engine and Carnot theorems.

The inequality of Clausius and thermodynamic Temperature scale, concept of entropy, Entropy change in different processes, principle of increase in entropy for closed systems.

Unit 3

Thermodynamic properties of fluids, Pure Substance, phase-change process of pure substance, P-V-T surface, T-v, p-v and other diagrams, specific internal energy and enthalpy and other properties and steam tables.

Perfect gas, equation of state, specific heats, characterization of thermodynamic processes. Real gas models - Van der waals equation, compressibility chart.

Thermodynamic property relations: Introduction, important mathematical relations, cyclic rule, Maxwell relations, enthalpy, entropy, internal energy and specific heat relations; Clausius-Clapeyron equation, Joule Thomson coefficient and inversion line.

Course Outcomes

15MEC201.1	Evaluate the deviation of a real gas from ideal gas behavior based on compressibility chart and best known equations of state
15MEC201.2	Solve energy balance problems for closed and open systems for pure substances, ideal gases, liquids and solids
15MEC201.3	Examine the possibility of a thermodynamic process based on first and second law of thermodynamics and increase of entropyprincipe
15MEC201.4	Determine the expressions for the thermal efficiencies and coefficients of performance for reversible heat engines, heat pumps, and refrigerators by modelling thermodynamic cycles
15MEC201.5	Evaluate the performance of power plants, automobiles, refrigeration and air-conditioning units
15MEC201.6	Establish relationship between measurable and derivable properties

TEXTBOOK:

Cengel Y. A. and Boles M. A. 'Thermodynamics - an Engineering Approach' - Tata McGraw hill - 2014 - 8th Edition

REFERENCES:

1. *Sonntag R. E., Borgnakke C. and Van Wylen, G. - "Fundamentals of Thermodynamics" - John Wiley and Sons - 2008 - 7th Edition*
2. *Saad M. A. - 'Thermodynamics: Principles and Practice' - Prentice Hall, New Jersey - 1998 - 2nd Edition*

3. John R. Howell and Richard D. Buckius - 'Fundamentals of Engineering Thermodynamics' - McGraw Hill - 1987 - International Edition

15MEC202 MACHINE DRAWING 2 0 2 3

1. DRAWING STANDARDS

Code of practice for Engineering Drawing, BIS specifications - Welding symbols, riveted joints, keys, fasteners – Reference to handbook for the selection of standard components like bolts, nuts, screws, keys etc.

2. 2-D DRAWINGS

Limits, Fits – Tolerancing of individual dimensions - Specification of Fits - Manual, Preparation of production drawings and reading of part and assembly drawings.

3. CAD PRACTICE (USING APPLICATION PACKAGES)

Drawing, Editing, Dimensioning, Plotting Commands, Layering Concepts, Hatching, Detailing, Assembly, basic principles of GD & T (geometric dimensioning & tolerance).

4. ASSEMBLY DRAWING (MANUAL & USING APPLICATION PACKAGES)

Manual parts drawing and preparation of assembled views given part details for components followed by practicing the same using CAD packages.

5. PREPARATION OF BILL OF MATERIALS AND TOLERANCE DATA

SUGGESTED ASSEMBLIES:

Detailed drawings of following machine parts are given to students to assemble and draw the sectional or plain elevations / plans / and side views with Dimensioning and bill of materials.

Sleeve & Cotter joint, Spigot & Cotter joint, Knuckle joint, Stuffing Box, Screw Jack, Foot step bearing, Universal Coupling, Plummer Block, Swivel Bearing, Simple Eccentric, Machine Vice, Protected type flanged coupling, Connecting Rod, Tail Stock.

Course Outcomes

15MEC202.1	Interpret and Make use of standards and conventions to draw machine components and assembly.
15MEC202.2	Apply limits and tolerances to assemblies and Judge on the appropriate fit.
15MEC202.3	Develop solid models of machine components and assembly, and Construct sectional and orthographic views of components.
15MEC202.4	Make use of CAD packages for solid modeling of machine parts and Create bill of materials.

TEXTBOOKS:

1. K. L. Narayana - 'Machine Drawing' - New Age International publishers - 2010 - 4th Edition
2. K. C. John - 'Textbook of Machine Drawing' - PHI - 2009 - 1st Edition

REFERENCE BOOKS:

1. Junnarkar N. D. - 'Machine Drawing' - Pearson Education - 2004
2. P. S. Gill - 'A Textbook of Machine Drawing' - S.K. Kataria & Sons - 2013 Edition
3. N. D. Bhat, V M Panchal - 'Machine Drawing' - Charotar Publication House - 2014
4. R. K. Dhawan - 'A Textbook of Machine Drawing' S. Chand - 2nd Revised Edition

15MEC203 MATERIAL SCIENCE AND METALLURGY 3 0 0 3

Unit 1

Structure of Crystalline Solids - Interatomic Bonding - Crystal Systems - UNIT cells - Metallic Crystal Structures - Miller indices - Crystallographic planes and directions - Linear and Planar Atomic Densities - Imperfections in Solids: Point – Linear - Interfacial defects.

Elastic, Anelastic and Plastic behaviour. Mechanical properties - stress-strain curves for ductile and brittle alloys. Ductility – Resilience -toughness. Hardness testing. Dislocations and plastic deformation. Slip phenomenon. Slip in single crystals.

Unit 2

Strengthening mechanisms - grain boundary hardening, solution hardening, work hardening. Ductile and Brittle Fracture - fracture mechanics. Impact testing. Ductile - brittle transition. Fatigue and creep properties. S-N Curves Fatigue and creep testing.

Constitution of alloys-solid solution, intermetallic compound, Hume-Rothery rule. Phase diagram-phase rule, lever principle, isomorphous, eutectic, peritectic and eutectoid reactions. Iron-Carbon phase diagram, equilibrium and non-equilibrium cooling in solid state, isothermal transformation, martensite and bainite reactions.

Unit 3

Heat treatment of steels: annealing, normalizing, hardening and tempering. Heat treatment of tool and die steels. Hardenability, its testing and simple problems related to materials selection. Surface hardening of steels - carburizing, nitriding, carbo-nitriding, induction method.

Classification of cast iron and steels - properties, microstructures and uses of cast irons, plain carbon, alloy, stainless, heat resistant, tool and die steels. Composition, properties, microstructures and uses of non-ferrous alloys - brass,

bronze, aluminium, magnesium, nickel and zinc alloys.

Course Outcomes

15MEC203.1	Understand the concepts of four major elements structure properties, performance and processing related to metallurgy and materials
15MEC203.2	Analyze the various modes of imperfactions and failure in solids and methods to strength it.
15MEC203.3	Classify the various phase diagrams and analyze the phase transformations from it.
15MEC203.4	Interpret the effect of mechanical properties on various heat treatment processes

TEXTBOOK:

Calllister W. D. - 'Materials Science and Engineering' - John Wiley & Sons – 2010 - 8th Edition

REFERENCES:

1. *Avner S. H. - 'Physical Metallurgy' – McGraw Hill Education – 2000 - 2nd Edition*
2. *Shackelford J. F. - 'Introduction to Materials Science for Engineers' - Prentice Hall 2014 - 8th Edition*
3. *Javed Hashemi, Smith F. W. - 'Foundations of Materials Science and Engineering' – McGraw Hill Education - 2010 - 5th Edition.*
4. *Dieter G. E. - 'Mechanical Metallurgy' - TATA McGraw Hill - 2013 - 3rd Edition.*

15MEC204 MECHANICS OF SOLIDS 3 0 0 3

Unit 1

Simple Stress and Strain
Introduction, Properties of Materials, Stress, Strain, Hook's law, Poisson's Ratio, Stress – Strain Diagram for structural steel and nonferrous materials, Principles of superposition, Total elongation of tapering bars of circular and rectangular cross sections. Elongation due to self – weight, Thermal stresses.

Composite section, Volumetric strain, expression for volumetric strain, Elastic constants, relationship among elastic constants, Thermal stresses (including thermal stresses in compound bars). Strain Energy & Impact loading.

Compound Stresses
Introduction, Stress components on inclined planes, General two-dimensional stress system, Principal planes and stresses and Mohr's circle of stresses.

Unit 2

Torsion of circular shafts
Introduction – Pure torsion-torsion equation of circular shafts, Strength and stiffness, Torsional rigidity and polar modulus, Power transmitted by shaft of solid and hollow circular sections.

Bending moment and shear force in beams
Introduction, Types of beams loadings and supports, Shearing force in beam, Bending moment, Sign convention, Relationship between loading, shear force and bending moment, Shear force and bending moment equations, SFD and BMD with salient values for cantilever beams, simply supported beams and overhanging beams considering point loads, UDL, UVL and Couple. Bending and shear stresses in beams.

Unit 3

Deflection of beams
Introduction – Definitions of slope, deflection, Elastic curve-derivation of differentialequation of flexure, Sign convention Slope and deflection for standard loading classes using Macaulay's method for prismatic beams and overhanging beams subjected to point loads, UDL and Couple.

Thick and Thin Cylinders and shells
Analysis of thincylindrical shells and analysis of thick cylindrical shells using Lame's equation.

Elastic stability of columns
Introduction – Short and long columns, Euler's theory on columns, Effective length slenderness ration, radius of gyration, buckling load, Assumptions, derivations of Euler's Buckling load for different end conditions, Limitations of Euler's theory, Rankine's formula and problems.

Course Outcomes

15MEC204.1	Apply the principles of equilibrium, superposition, and compatibility to estimate the stress-strain behavior of linear elastic solids under axial and torsional loading
15MEC204.2	Construct shear force and bending moment diagrams, to estimate the deflection and stress distribution in beams of various cross sections
15MEC204.3	Analyze stresses at inclined planes and construct Mohr's circle to predict the principal and maximum shear planes
15MEC204.4	Determine longitudinal and circumferential stresses in thin and thick cylinders subjected to internal and external pressures
15MEC204.5	Apply Euler's and Rankine's formulae to determine the buckling load of columns under different end conditions

TEXTBOOKS:

1. *R. C. Hibbeler, - 'Mechanics of Materials' - Prentice Hall - 2013 - 9th Edition*
2. *James M. Gere -'Mechanics of Materials' - CENGAGE Learning Custom Publishing - 2012 - 8th Edition*

REFERENCES:

1. Ferdinand Beer & Russell Johnstan - 'Mechanics of Materials' - TATA McGraw Hill - 2003 - S.I. Units
2. Egor.P. Popov - 'Engineering Mechanics of Solids' - Pearson Edu. India - 1998 - 2nd Edition
3. Mubeen - 'Mechanics of Solids' - Pearson India - 2012 - 2nd Edition,
4. W. A. Nash, Schaum's Outline Series - 'Strength of Materials' - 2007 - 4th Edition

15EEE205 ELECTRICAL AND ELECTRONICS ENGINEERING 3 0 2 4

Unit 1

Electrical Engineering
Introduction to Electrical Power System - different sources of electrical energy (conventional / alternate), Ideal Independent Current and Voltage Sources. Reference Directions and Symbols; Resistance, Inductance and Capacitance, Seriesparallel combination of R, L and C Components.Ohm's law, Kirchhoff's law, Energy and Power, Voltage Divider and Current Divider Rules, Network Analysis by Mesh Currents, Nodal analysis.
Faraday's law of Electromagnetic Induction; Magnetic Circuit Elements; Analysis of magnetic Circuits, Self and Mutual Inductances. Generation of alternating current, Sinusoidal voltage; Instantaneous, Average and rms values of periodic functions; Peak factor, form factor, Phasor representation of sinusoids, Real and Reactive Power, Power factor
Introduction to Three Phase Systems; Balanced 3-Phase STAR and DELTA connections of Load, Three phase power

Unit 2

Classification and Applications of Electrical MachinesDC Motor, Basic principle of operation, Different types of DC motors, Voltageequation of a motor, significance of back emf, Speed, Torque, Torque-Speed characteristics, Output Power, Efficiency. 3-Phase Induction Motor - Introduction: Principle of operation, rotating magneticfield, types of I.M, Slip, Rotor Speed, Torque-Slip Relation.Single Phase Transformer - Principle of Operation, Voltage transformation ratio,emf equation, working of single phase auto-transformer, Three Phase Transformer
Connections, Star-delta, star-star.

Unit 3

Electronics Engineering
Introduction to semiconductors and doping: Intrinsic and extrinsic semiconductors, PN junction diode characteristics: forward and reverse bias – breakdown – barrierpotential Rectifiers: half wave and full wave, Zener diode – design of regulatorsand Characteristics.Introduction to BJT: BJT characteristics curves and region of operation, common emitter, common base configurations, MOSFET characteristics.Introduction to Operational amplifier: inverting and non-inverting amplifier.Introduction to logic gates: Boolean Algebra Theorems, De Morgan's theorem. Logic gates, NOT Gate, AND Gate, OR Gate, XOR Gate, NAND Gate, NOR Gate, X-NORGate. Microcontrollers: Introduction to Microcontrollers, 8051, Microcontroller, Architectureand an example of Microcontroller, based stepper motor control system (only Block Diagram approach).

Course Outcomes

15EEE205.1	Understand different components and parameters in electric circuit
15EEE205.2	Formulate electric circuits based on fundamentals laws

15EEE205.3	Illustrate the construction and operation and characteristics of electromagnetic devices
15EEE205.4	Understand the characteristics of diodes transistors and Operational Amplifiers
15EEE205.5	Develop rectifiers, regulators and amplifiers using various electronic devices
15EEE205.6	Understand the functional feature of microcontroller and stepper motor control application

TEXTBOOKS:

1. Edward Hughes - 'Electrical Technology' - Pearson Education Asia - 7th Edition, - 2011
2. A. P. Malvino - Electronic Principles - Tata McGraw Hill - 7th Edition - 2007
3. Stephen Brown and Zvonko Vranesic – 'Digital Logic Design' - Tata McGraw Hill - 2nd Edition

REFERENCES:

1. V N Mittle & Arvind Mittle - 'Basic Electrical Engineering' – McGraw Hill - 2nd Edition, 2014
2. Vincent Del Toro - 'Electrical Engineering Fundamentals' - Prentice Hall of India Private Limited - 2nd Edition - 2003
3. S. K. Bhattcharya - 'Basic Electrical and Electronics Engineering' - Pearson - 2012
4. D. P. Kothari & I. J. Nagrath - 'Theory and Problems of Basic Electrical Engineering" - Prentice Hall of India - 2000
5. David A Bell – 'Electronic Devices and Circuits' - Oxford University Press - 5th Edition – 2008
6. William Gothmann H. - 'Digital Electronics - An Introduction to Theory and Practice', Prentice Hall of India, 1977

15MAT204 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS 2 1 0 3

Unit 1

Laplace Transform: Laplace Transforms, Inverse Transforms, Linearity, Shifting, Transforms of Derivatives and Integrals, Differential Equations, Unit Step Function, Second Shifting Theorem, Dirac's Delta Function. Differentiation and Integration of Transforms.

Unit 2

Convolution, Integral Equations, Partial Fractions, Differential Equations, Systems of Differential Equations. (Sections: 6.1 to 6.7)

Fourier Series: Fourier series, Half range Expansions, Parseval's Identity, Fourier Integrals, Fourier integral theorem. Sine and Cosine Integrals. (Sections: 11.1 -11.3)

Unit 3

Fourier Transforms: Sine and Cosine Transforms, Properties, Convolution theorem. (Sections: 11.1 -11.3, 11.7-11.9)

Partial Differential Equations: Basic Concepts, Modeling; Vibrating String, Wave Equation, Separation of Variables, Use of Fourier Series, Heat Equation; Solution by Fourier Series. (Sections: 12.1-12.5)

Course Outcomes

15MAT204.1	Understand the concepts of Laplace and Fourier transforms and its properties to transform a function from time domain to the frequency domain.
15MAT204.2	Obtain the Laplace and Fourier transform and its inverse transform of impulsive, discontinuous and some complicated periodic signals.
15MAT204.3	Solve the initial value problems' using Laplace and Fourier transforms on signals arising by changing over to frequency domain.
15MAT204.4	Define the Fourier series for periodic functions and determine the Fourier coefficients.
15MAT204.5	Understand the formation of partial differential equations and apply some standard methods to obtain its solutions.
15MAT204.6	Apply Fourier series technique to solve the heat, wave and Laplace equations.

TEXTBOOK:

Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Ninth Edition, 2012.

REFERENCE BOOKS:

1. *Advanced Engineering Mathematics by Dennis G. Zill and Michael R.Cullen, Second edition, CBS Publishers, 2012.*
2. *Larry C. Andrews and Bhimson. K. Shivamoggi, The Integral Transforms for Engineers, Spie Press, Washington, 1999.*
3. *J. L. Schiff, The Laplace Transform, Springer, 1999.*

15MEC281 MATERIALS TESTING AND METALLURGY LAB. 0 0 2 1

Mechanical testing of materials: Experiments to determine Young's modulus, yield strength, ultimate tensile strength of ductile and brittle materials. Shear and impact test on materials, determination of Brinell's, Rockwell and Vicker's hardness, micro hardness, fatigue and flexural strength of materials.

Study of Metallurgical Microscope, study of microstructure of engineering materials, Study of effect of Heat Treatment on properties of mild steel, Jominy end quench test, Nondestructive testing of materials.

Course Outcomes

15MEC281.1	Determine tensile properties of rods and thin wires made of ductile materials
15MEC281.2	Compare the hardness, impact strength and modulus of different materials
15MEC281.3	Determine modulus of elasticity of timber and modulus of rigidity of spring
15MEC281.4	Prepare the specimens and characterize the microstructures of different ferrous and non-ferrous metals.
15MEC281.5	Understand heat treatment procedures and their effect on the properties of steel.
15MEC281.6	Measure the hardness and hardenability of materials.

15AVP201/	**AMRITA VALUES PROGRAMME I/**	**1 0 0 1**
15AVP211	**AMRITA VALUES PROGRAMME II**	**1 0 0 1**

Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

Courses offered under the framework of Amrita Values Programmes I and II

Message from Amma's Life for the Modern World
Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

Lessons from the Ramayana
Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

Lessons from the Mahabharata
Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

Lessons from the Upanishads

Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, SatyakamaJabala, Aruni, Shvetaketu.

Message of the Bhagavad Gita

Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Concept of Avatar - Relevance of Mahabharata for modern times.

Life and Message of Swami Vivekananda

Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji's life.

Life and Teachings of Spiritual Masters India

Sri Rama, Sri Krishna, Sri Buddha, Adi Shankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi.

Insights into Indian Arts and Literature

The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

Yoga and Meditation

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

Kerala Mural Art and Painting

Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage . Learning Mural painting through the theory and practice workshop is the objective of this course.

Course on Organic Farming and Sustainability

Organic farming is emerging as an important segment of human sustainability and healthy life. Haritamritam' is an attempt to empower the youth with basic skills in tradition of organic farming and to revive the culture of growing vegetables that one consumes, without using chemicals and pesticides. Growth of Agriculture through such positive

initiatives will go a long way in nation development. In Amma's words "it is a big step in restoring the lost harmony of nature".

Benefits of Indian Medicinal Systems

Indian medicinal systems are one of the most ancient in the world. Even today society continues to derive enormous benefits from the wealth of knowledge in Ayurveda of which is recognised as a viable and sustainable medicinal tradition. This course will expose students to the fundamental principles and philosophy of Ayurveda and other Indian medicinal traditions.

Traditional Fine Arts of India

India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is 'Únity in Diversity" and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

Science of Worship in India

Indian mode of worship is unique among the world civilisations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realisation of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

Outcomes:

CO1: Understanding the impact of *itihasas* on Indian civilization with a special reference to the *Adiparva* of Mahabharata

CO2: Enabling students to importance offighting*adharma* for the welfare of the society through Sabha and Vanaparva.

CO3: Understanding the nuances of dharma through the contrast between noble and ignoble characters of the epic as depicted in the Vana, Virata, Udyoga and Bhishma parvas.

CO4: Getting the deeper understanding of the Yuddha Dharma through the subsequent Parvas viz., Drona, Karna, Shalya, Sauptika Parvas.

CO5: Making the students appreciative of spiritual instruction on the ultimate triumph of dharma through the presentations of the important episodes of the MB with special light on Shanti, Anushasana, Ashwamedhika, Ashramavasika, Mausala, Mahaprasthanika and Swargarohana Parvas.

CO-PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2

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

15MEC211 FLUID MECHANICS AND MACHINERY 4 0 0 4

Unit 1

Introduction and Basic concepts of Fluid Mechanics. Continuum assumption. Fluid properties such as density, specific volume, specific weight, specific gravity. Pressure, vapor pressure, cavitation, viscosity, Newton's law of viscosity. Models for non-Newtonian fluids. Surface Tension and capillarity. Coefficient of compressibility. Machnumber. Hydrostatics. Pressure distribution in a static fluid - Pascal's law and hydrostatic law. Absolute, gauge and vacuum pressures. Static pressure measurement. Manometry.

Hydrostatic Force on plane surfaces and curved surface.

Buoyancy. Archimedes principle. Stability of floating bodies, Meta centric height.

Eulerian and Lagrangian description of fluids, local and convective acceleration. Flow visualization – streamlines, streak lines, pathlines, time lines, contour and vector plots.

Flow kinematics - vorticity and rotationality.

Unit 2

Reynold's Transport Theorem. Governing equations for mass, linear and angular momentum and energy in the integral form. Applications of these equations. Laminar and turbulent flow regimes.

Bernoulli's equation. Limitations. Applications of Bernoulli's equation. Hydraulic and energy grade lines.

Major energy losses in pipes. Darcy Weisbach equation. Introduction to Moody's chart. Minor energy losses in pipes. Series and parallel pipe connections. Equivalent pipe.

Laminar flow in circular pipes - average and maximum velocities, shear stress distribution, Pressure drop computation - Hagen Poiseuille Law.

Flow rate measurement for closed conduits - Venturimeter, Orificemeter, Pitot tube, rotameter, other electrical and mechanical flow measuring systems.

Unit 3

Dimensional Analysis and modelling. Significance. Buckingham's Pi Theorem. Similitude, types of similitude. Model testing.

Classification of pumps. Positive displacement pumps. Reciprocating pumps. Centrifugal Pump: working principle.

Characteristic curves. Pump selection. Velocity triangles. Pump performance parameters, performance curves. Cavitation, NPSH and specific speed.

Hydraulic turbines. Classification. Impulse and reaction machines - Pelton, Francis and Kaplan Turbines. Velocity Triangles. Performance characteristics.

Course Outcomes

15MEC211.1	Solve practical problems involving fluid properties and hydrostatic pressure, and predict the stability of floating bodies
15MEC211.2	Evaluate fluid kinematic properties to classify types of fluid flow using flow visualization techniques
15MEC211.3	Apply the governing equations for mass, momentum and energy based on Reynolds Transport Theorem and utilize them in practical problems
15MEC211.4	Estimate the pumping power by considering major and minor losses in flow through pipes
15MEC211.5	Apply dimensional analysis for fluid problems based on Buckingham-Pi Theorem and utilize it for model testing of fluid machineries
15MEC211.6	Analyze the performance characteristics of centrifugal pumps and hydraulic turbines

TEXTBOOK:

Cengel Y. A. and Cimbala J. M. - 'Fluid Mechanics (Fundamentals and Applications)' - McGraw Hill, India - 2014- 3rd Edition

REFERENCES:

1. *White F. M. - 'Fluid Mechanics' - McGraw Hill India Pvt. Ltd – 2011 - 7th Edition*
2. *Fox and McDonald - 'Fluid Mechanics' - John Wiley - 2013 - 8thEdition*
3. *Panton R. L. - 'Incompressible Flow' - Wiley India, 2013 - 4th Edition*

15MEC212 KINEMATICS OF MACHINES 3 0 2 4

Unit 1

Basics of Mechanisms

Definitions – Link, Kinematic pair, Kinematic chain, Mechanism and Machine - Degreeof Freedom – Mobility - Kutzbach criterion (Gruebler's equation) - Grashoff's law - Kinematic Inversions of four-bar chain and slider crank chain - Mechanical Advantage - Transmission angle. Description of common Mechanisms - Offset slider mechanism as quick return mechanisms, Pantograph, Straight line generators (Peaucellier and Watt mechanisms), Steering gear for automobile, Hooke's joint, Toggle mechanism, Ratchets and escapements - Indexing Mechanisms, Steering gear mechanisms such as Davis and Ackermann Steering gear.

Unit 2

Kinematic Analysis

Analysis of simple mechanisms (Single slider crank mechanism and four bar mechanism) - Graphical Methods for

displacement, velocity and acceleration, velocity and acceleration polygons, Instantaneous Centre of Velocity, Kennedy Theorem, Klein's Construction; Shaping machine mechanism - Coincident points – Coriolis acceleration, Analytical method of analysis of slider crank mechanism and four bar mechanism. Approximate analytical expression for displacement, velocity and acceleration of piston of reciprocating engine mechanism.

Unit 3

CAMS

Classifications - Displacement diagrams - Parabolic, Simple harmonic and Cycloidal motions - Graphical construction of displacement diagrams and layout of plate cam profiles - circular arc and tangent cams.

GEARS

Classification of gears - Gear tooth terminology - Fundamental Law of toothed gearing and involute gearing - Length of path of contact and contact ratio - Interference and undercutting - Gear trains - Simple, compound and Epicyclic gear trains - Differentials.

Unit 4 (Practicals)

- To study various types of kinematics links, pairs, chains and mechanisms
- To study inversions of a 4-Bar mechanism
- To study the inversions of single mechanism
- To study the inversions of double slider crank mechanism
- To plot joint angle, velocity and acceleration of coupler link against crank rotation for a four-bar mechanism.
- To plot slider displacement, velocity and acceleration of slider against crank rotation for slider crank mechanism
- To study various types of gears – helical, cross helical, worm, bevel gear, rack and pinion.
- To study various types of cam and follower arrangements.
- To Study various types of gear trains – Simple, Compound, reverted, Epicyclic and Differential.
- To Develop a prototype of a four-bar mechanism
- To Develop a prototype of a Geneva mechanism

Course Outcomes

15MEC212.1	Classify mechanisms and Solve for mobility
15MEC212.2	Perform kinematic analysis of mechanisms
15MEC212.3	Construct cam profiles for a given motion
15MEC212.4	Analyze different types of gear trains
15MEC212.5	Develop and perform kinematic analysis of mechanisms using software

TEXTBOOK:

Rattan S. S. - 'Theory of Machines' - McGraw Hill IndiaPvt. Ltd. - 2014 – 4th Edition

REFERENCES:

1. *Thomas Bevan - 'Theory of Machines' - CBS Publishers and Distributors - 2005 - 3rd Edition*
2. *Ghosh A. and Mallick A. K. - 'Theory of Mechanisms and Machines' - Affiliated East-West Press Pvt.Ltd. New Delhi - 2008.*
3. *Shigley J. E. and UickerJ. J. - 'Theory of Machines and Mechanisms' - Oxford Publishers*

- 2014 - SI units Edition

4. Rao J. S. and Dukkipati R. V. - 'Mechanism and MachineTheory' - New Age Publishers, New Delhi - 2008

5. John Hannah and Stephens R. C. - 'Mechanics of Machines' - 1999 - Viva low-Priced Student Edition

6. Sadhu Singh - 'Theory of Machines' - Pearson Education - 2011 - 3rd Edition

15MEC213 MANUFACTURING PROCESS I 3 0 0 3

Unit 1

Metal casting processes: Introduction to Metal casting - Pattern, core and Mould making - Moulding, sand properties and testing - Principles of gating and riser design - Melting furnaces - Casting processes - sand, die, gravity, centrifugal castings, shell mould and Investment casting. Fettling and cleaning of casting - Inspection of casting and Casting defects.

Unit 2

Metal forming processes: mechanics of forming processes and forming operations
– rolling, forging, drawing, deep drawing, bending, extrusion, punching and blanking
– high energy forming processes – defects in metal forming – problems.

Unit 3

Metal joining processes: Principles of welding – fusion, resistance and solid state welding – soldering, brazing and adhesive bonding, arc welding, resistance welding, gas welding, thermit welding, ultrasonic welding, electron beam welding, laser beam welding and explosive welding – weld defects and inspection.

Powder metallurgy - production of metal powders - characteristics of metal powders - compaction - sintering – applications.

Surface modification processes - diffusion coating – electroplating – anodizing - conversion coating - hot dipping - ceramic and diamond coating.

Course Outcomes

15MEC213.1	Select a suitable casting process for a specific application.
15MEC213.2	Recommend a suitable metal forming process for a specific application.
15MEC213.3	Classify various welding process and select a suitable welding process for a given application.
15MEC213.4	Identify the various defects in manufacturing process

TEXTBOOK:

Serope Kalpakjian and Steven R. Schmid – 'Manufacturing Engineering and Technology' - Prentice Hall - 2013 - 7th Edition

REFERENCES:

1. Roy A. Lindberg - 'Processes and Materials for Manufacture' - Prentice Hall of India Private limited - 2000

2. *Dieter G. E. - 'Mechanical Metallurgy' - Tata McGraw Hill - 2013 - 3rd Edition*
3. *Amitabh A. Ghosh and Asok Kumar Maltil - 'Manufacturing Science' - Affiliated East-West, Press Private Limited - 2010*

15MAT214 PROBABILITY AND STATISTICS 2 1 0 3

Unit 1

Probability Concepts: Review of probability concepts - Bayes' Theorem.

Random Variable and Distributions: Introduction to random variable – discrete and continuous distribution functions - mathematical expectations – moment generating functions and characteristic functions. Binomial, Poisson, Geometric, Uniform, Exponential, Normal distribution functions (MGF, mean, variance and simple problems) – Chebyshev's theorem

Unit 2

Sampling Distributions: Distributions of Sampling Statistics, Chi-square, t and F distributions (only definitions and use). Central Limit Theorem.

Theory of estimation: Point Estimation, Unbiased estimator - Maximum Likelihood Estimator - Interval Estimation.

Unit 3

Testing of Hypothesis: Large and small sample tests for mean and variance – Tests based on Chi-square distribution.

Course Outcomes

15MAT214.1	Understand the basic concepts of probability and probability modeling.
15MAT214.2	Gain knowledge about statistical distributions and their properties
15MAT214.3	Get in-depth knowledge about statistical distributions and their real time applications.
15MAT214.4	Understand some approximation theorems on probability and distributions.
15MAT214.5	Know the importance of estimating the parameters of probability models.
15MAT214.6	Ability to make decisions under uncertainties using statistical testing of hypotheses

TEXTBOOK:

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

REFERENCE BOOKS:

1. J. Ravichandran, "Probability and Random Processes for Engineers", First Edition, IK International, 2015.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 8th Edition (2007), Pearson Education Asia.
3. Sheldon M Ross, Introduction to Probability and Statistical Inference, 6th Edition, Pearson.
4. A. Papoulis, and Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", Fourth Edition,

McGraw Hill, 2002.

15MEC285 FLUID MECHANICS AND MACHINES LAB. 0 0 2 1

Calibration of flow measuring devices: Notches, Orifice meter, Venture meter, Verification of Bernoulli's equation, Reynolds apparatus and Meta centric height of a floating body. Experiments to study frictional losses in pipes, losses in bends and elbows.

Performance test on different types of pumps, Impact of jet on vanes, Performance test on different types of turbines.

Course Outcomes

15MEC285.1	Calibrate flow measuring devices
15MEC285.2	Compute the major and minor losses in flow through pipes
15MEC285.3	Assess the stability of a floating body based on buoyancy
15MEC285.4	Study the performance of hydraulic turbines and pumps

15SSK221 SOFT SKILLS I 1 0 2 2

Soft skills and its importance: Pleasure and pains of transition from an academic environment to work - environment. Need for change. Fears, stress and competition in the professional world. Importance of positive attitude, self motivation and continuous knowledge upgradation.

Self-confidence: Characteristics of the person perceived, characteristics of the situation, characteristics of the perceiver. Attitude, values, motivation, emotion management, steps to like yourself, positive mental attitude, assertiveness.

Presentations: Preparations, outlining, hints for efficient practice, last minute tasks, means of effective presentation, language, gestures, posture, facial expressions, professional attire.

Vocabulary building: A brief introduction into the methods and practices of learning vocabulary. Learning how to face questions on antonyms, synonyms, spelling error, analogy, etc. Faulty comparison, wrong form of words and confused words like understanding the nuances of spelling changes and wrong use of words. Listening skills: The importance of listening in communication and how to listen actively.

Prepositions, articles and punctuation: A experiential method of learning the uses of articles and prepositions in sentences is provided.

Problem solving level I: Number system; LCM &HCF; Divisibility test; Surds and indices; Logarithms; Ratio, proportions and variations; Partnership;

Problem solving level II: Time speed and distance; work time problems;

Data interpretation: Numerical data tables; Line graphs; Bar charts and Pie charts; Caselet forms; Mix diagrams; Geometrical diagrams and other forms of data representation.

Logical reasoning: Family tree; Deductions; Logical connectives; Binary logic; Linear arrangements; Circular and complex arrangement; Conditionalities and grouping; Sequencing and scheduling; Selections; Networks; Codes; Cubes; Venn diagram in logical reasoning; Quant based reasoning; Flaw detection; Puzzles; Cryptogrithms.

TEXTBOOKS:

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3. *Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
4. *The Hard Truth about Soft Skills, by Amazone Publication.*
5. *Quantitative Aptitude by R. S. Aggarwal,S. Chand*
6. *Quantitative Aptitude – Abijith Guha, TMH.*
7. *Quantitative Aptitude for Cat - Arun Sharma. TMH.*

REFERENCES:

1. *Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova.*
2. *More Games Teams Play, by Leslie Bendaly, McGraw Hill Ryerson.*
3. *The BBC and British Council online resources*
4. *Owl Purdue University online teaching resources*
5. *www.the grammarbook.com - online teaching resources www.englishpage.com- online teaching resources and other useful websites*

15MEC301 DESIGN OF MACHINE ELEMENTS I 3 0 0 3

Unit 1

Introduction:

Design definition, Classification, General considerations, Design Procedure, Basic requirements of machine elements, Design Codes and Standard, Fits and Tolerance, Surface finish, Preferred numbers, Engineering Materials – Review of Mechanical properties of Engineering Materials, Material selection.

Design for Strength:

Design for Static Loading: Simple Stresses - tensile Stress, Compressive Stress and Shear Stress, Compound Stresses - Torsional Stress and Bending Stress, Types of Loading, Simple and Compound Stresses, Working Stress, Factor of Safety, Factors Influencing selection of FOS, Eccentric Loading, Combined Loading, Theories of Failure,

Design for Dynamic Loading: Impact load, Impact energy, Impact stress, Resilience, Toughness.

Stress Concentration: Stress Concentration, Stress Concentration Factor, Determination of Stress Concentration factor, Methods of Reducing Stress Concentration,

Unit 2

Variable and Cyclic Loads: Fatigue Load, Stress Cycle, Fluctuating loading, Reversed Loading, Repeated Loading, Endurance Strength, Endurance Limit, S-N Curves, Modifying Factors: Size effect, Surface effect, Stress Concentration effects, Goodman and Soderberg relationship; Stresses due to Combined Loading.

DESIGN OF SHAFTS: Design for strength and Rigidity with Steady loading, ASME & BIS codes for Power Transmission shafts, Shafts subjected to Combined Twisting Moment and Bending Moment, Shafts under Fluctuating loads and Combined loads.

KEYS AND COUPLINGS: Keys and Splines, Design of keys, Design of Rigid and Flexible couplings.

Unit 3

MECHANICAL JOINTS:

Riveted Joints: Types, Rivet Materials, Failures of Riveted Joints, Boiler Joints - longitudinal and circumferential.

Welded Joints: Types, Strength of Butt and Fillet welds, Eccentrically loaded Welded Joints

POWER SCREWS: Types of Screw Threads used for Power Screws, Torque required to Raise and Lower the load, Efficiency and Self-locking, Design of Screw Jack. Design of screws for C-Clamp and machine vice.

Course Outcomes

15MEC301.1	Apply theories of failure to estimate the allowable loads in machine elements
15MEC301.2	Analyze steady and variable stresses induced in machine elements for different applications
15MEC301.3	Select materials and design machine elements for practical mechanical systems
15MEC301.4	Design welded and riveted joints and analyze for failure
15MEC301.5	Design screw jack and screws for C clamp and machine vice

TEXTBOOKS:

1. Robert L. Norton, Machine Deign - 'An Integrated Approach' - Pearson Education - 2011 - 2nd Edition

2. Bhandari V. B. - 'Design of Machine Elements' - Tata McGraw-Hill Education - 2010 - 3rd Edition

3. 'Design Data: Data Book of Engineers' by PSG College Kalaikathir Achchagam - Coimbatore, 2012.

REFERENCES:

3. Shigley J. E. and Mische C. R. - 'Mechanical Engineering Design' - McGraw Hill Education (India) Private Limited - 2011 - 9th Edition

4. U. C. Jindal - 'Machine Design' - Pearson Publications - 2010 - 1st Edition

15MEC302 DYNAMICS OF MACHINES 3 0 0 3

Unit 1

Static and Dynamic Force Analysis

Static force analysis of mechanisms - D' Alembert's principle - Inertia force andInertia torque - Dynamic force analysis - Dynamic Analysis in Reciprocating Engines - Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque.

Flywheels

Turning moment diagrams - Flywheels of engines and punch press.

Unit 2

Balancing of rotating masses and Reciprocating masses

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine - Primary and secondary unbalanced forces - Balancing Multi-cylinder Engines - Firing order - Balancing machines.

Unit 3

Control Mechanisms Governors

Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors - Characteristics - Effect of friction - Controlling Force - Quality of governors - effect of friction.

Gyroscope

Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in Automobiles, Airplanes and Ships

Course Outcomes

15MEC302.1	Analyze mechanisms using the principles of statics and dynamics and determining joint forces and torques.
15MEC302.2	Estimate the magnitude and position of balancing masses for unbalanced rotating and reciprocating parts.
15MEC302.3	Construct turning moment diagrams for two and four stroke engines to evaluate the flywheel mass.
15MEC302.4	Analyze the effect of gyroscopic couple on automobiles, ships, and airplanes.
15MEC302.5	Analyze and design centrifugal governors

TEXTBOOKS:

1. *Rattan S. S. - 'Theory of Machines' - McGraw Hill India Pvt. Ltd. - 2014 - 4th Edition*
2. *Ghosh A. and Mallick A. K. - 'Theory of Mechanisms and Machines' - Affiliated East West Press Pvt. Ltd., New Delhi - 2008*

REFERENCES:

1. *Thomas Bevan – 'Theory of Machines' - CBS Publishers and Distributors - 2005 - 3rd Edition*
2. *Shigley J. E. and Uicker J. J. - 'Theory of Machines and Mechanisms' Oxford Publishers 2014 - SI units Edition*
3. *Rao J. S. and Dukkipati R. V. - 'Mechanism and Machine Theory'- New Age Publishers, New Delhi - 2008*
4. *John Hannah and Stephens R. C. – 'Mechanics of Machines' – 1999 - Viva low-Priced Student Edition*

5. Sadhu Singh - 'Theory of Machines' - Pearson Education - 2011 - 3rd Edition

15MEC303 HEAT POWER ENGINEERING 3 0 0 3

Unit 1

Combined first law and second law of open systems, reversible steady flow work, available energy, irreversibility, exergy and second law efficiency.

Vapour power cycles: Simple Rankine Cycle, reheat cycle, regenerative cycles

Steam nozzles: Steam flow through nozzles. Nozzle efficiency. Supersaturated or metastable expansion of steam in a nozzle. General relationship between area, velocity and pressure in nozzle flow.

Steam turbines: Impulse and Reactions turbine, compounding principles.

Unit 2

Internal combustion engines: Stoichiometry, enthalpy of formation and enthalpy of combustion, adiabatic flame temperature, Otto and Diesel cycles. Spark ignition engines and compression ignition engines. Indicator diagrams. Combustion phenomenon in S.I & C.I. engines. Diesel knock. Octane and Cetane number, Supercharging, Testing and performance of IC engines.

Air compressors: Design of reciprocating compressors. Effect of clearance and volumetric efficiency. Adiabatic, isothermal and mechanical efficiencies. Multistage compressor. Optimum intermediate pressure.

Unit 3

Gas turbines: Gas turbine cycles. Methods to improve efficiency of gas turbines. Jet propulsion.

Refrigeration systems: Air refrigeration systems. Vapour compression system. Vapour absorption system. Refrigerants.

Air conditioning systems: Psychrometry, Air-conditioning equipment, components and control, cooling load calculations.

Course Outcomes

15MEC303.1	Apply energy balance, entropy balance and exergy balance in a system to determine heat, work, entropy generation and reversible work
15MEC303.2	Evaluate the combustion properties of reacting mixtures
15MEC303.3	Evaluate efficiency of gas power and vapour power cycles
15MEC303.4	Improve the performance of the system using concepts of regeneration, reheating, intercooling, multistage compression and expansion in gas turbines
15MEC303.5	Apply energy conversion principles to engineering devices like IC engine, compressor, refrigeration and air-conditioning system for determining efficiency and coefficient of performance

15MEC303.6	Examine the operation of a steam nozzle and work output of the steam turbine using velocity triangles.

TEXTBOOKS:

1. *Cengel, Y. A. and Boles M. A. - 'Thermodynamics and Engineering Approach' - Tata McGraw Hill, 2014 - 8th Edition*
2. *Kurt C. Rolle - 'Thermodynamics and Heat Power' - Merril Publishing Company, A.I.T.B.S. Publishers and Distributors, Delhi - 2001*

REFERENCES:

1. *Sonntag R. E., Borgnakke C. and Van Wylen, G. - 'Fundamentals of Thermodynamics', John Wiley and Sons - 2004*
2. *Rajput R. K.. - 'Thermal Engineering' - Laxmi Publications (P) Ltd., New Delhi - 2013 - 9th Edition*
3. *Pandya and Shah - 'Heat Engines' - Charotar Book Distributors – 2005 - 10th Edition*

15MEC304 MANUFACTURING PROCESS II 3 0 0 3

Unit 1

Theory of metal cutting: Types of metal cutting processes, Mechanism of chip formation - Forces and temperature in metal cutting, Tool life - Machinability and surface finish: Cutting tool materials and cutting fluids. Tool wear.

Cylindrical Surface Machining: Basics of turning process, lathe and its accessories, operations, process parameters. Machining time calculations.

Drilling Machines: Types, operations, process parameters. Design considerations for drilling operations.Machining time calculations.

Unit 2

Flat and Profile Machining: Milling operations - Milling machines: types, operations, process parameters. Planing and shaping machines -types, operations. Gear machining processes.

Finishing Processes: Theory of grinding process - Fundamentals of abrasives – Grinding wheels- Grinding operations and machines. Super finishing processes.

Unit 3

CNC Machines: Overview, types, construction, tool and work holding devices, feedback devices, part programming - examples.

Non-Conventional machining processes: Abrasive Jet Machining, Electrical Discharge Machining, Electrochemical Machining, Ultrasonic Machining, Laser Beam Machining, Electron Beam machining. Introduction to Rapid Prototyping & Rapid Tooling, Green manufacturing.

Course Outcomes

15MEC304.1	Choose the various processes of machining and select the appropriate machine based on the shape of any given component
15MEC304.2	Analyse the mechanism of chip formation in machining and solve simple problems related to the calculation of machining time, tool life etc.
15MEC304.3	Evaluate the various machining processes such as turning, drilling, boring, shaping, slotting, milling, grinding and calculate the machining time
15MEC304.4	Choose the appropriate method of manufacture of gears depending on their geometry, application and quantity
15MEC304.5	Compare CNC with conventional machines and create simple CNC manual programs
15MEC304.6	Choose the appropriate Rapid Prototyping methods by understanding their capabilities and limitations

TEXTBOOK:

Serope Kalpakjian and Steven R. Schmid - ''Manufacturing Engineering and Technology' - Prentice Hall - 2013 - 7th Edition

REFERENCES:

1. *Hajra Choudhury S. K., Hajra Choudhury A. K., Roy N. - 'Elements of Workshop Technology' Media Promotors & Publishers Pvt. Ltd. - 2010 - Vol.II: Machine Tools, 13e*
2. *Jain R. K. and Gupta S. C. - 'Production Technology' - Khanna Publishers - 2008*
3. *Ghosh A. and Mallik A. S. - 'Manufacturing Science' - Affiliated East West Press Private Limited - 2010*
4. *'H.M.T. Production Technology: Hand book` - Tata McGraw-Hill Publishing Company Limited - 1990*

15MAT302 NUMERICAL METHODS 2 0 2 3

Unit 1

Review of Errors: Accuracy and Precision, round-off error and truncation error. (Sec. 2.2-2.4)

Roots of Transcendental and Polynomial Equations: Bisection method, Iteration methods based on first degree equation, Rate of convergence, System of nonlinear equations. (Sec. 4.2, 4.3, 5.1-5.3, 5.5)

Review of Matrix Algebra: Systems of Equations, Eigenvalues and Eigen vectors.

Solution of System of Linear Algebraic Equations: Gauss Elimination and Gauss Jordan Methods. Iteration Methods. Eigenvalues and Eigenvectors: Jacobi Method for symmetric matrices and Power Method for arbitrary matrices. (Sec. 8.2, 8.7, 10.2, 22.2)

Unit 2

Interpolation and Approximation: Lagrange and Newton interpolation for unequal intervals, Finite difference

operators, Interpolating polynomials using finite differences. (Sec. 13.1 – 13.4, 13.6)

Unit 3

Review of Ordinary Differential Equations:

Solutions of Ordinary Differential Equations: Initial value problems - Single step methods - Taylor Series Method, Second , Third and Fourth order Runge Kutta Methods. (Sec. 20.1 – 20.3, 21.2)

Lab. - Implementation of these methods: MATLAB or EXCEL or Free and Open Source Software (FOSS) tools like R-programming and Scilab.

Course Outcomes

15MAT302.1	Understand and apply different numerical methods to solve algebraic, transcendental equations and system of nonlinear equations
15MAT302.2	Understand and apply power method, Jacobi method to find eigenvalues and eigenvectors
15MAT302.3	Understand and apply concept of interpolation and inverse interpolation
15MAT302.4	Understand and implementation of methods Taylors series, Euler method, modified Euler method and RK methods to solve ODE
15MAT302.5	Implementation of numerical methods using MATLAB and writing efficient well documented MATLAB codes and present numerical methods in an informative way.

TEXTBOOK:

Steven Chapra and Raymond Canale, Numerical Methods for Engineers, McGraw Hill, 2007.

REFERENCE BOOKS:

1. *M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical methods for Scientific and Engineering Computation, New Age International Publishers, Fifth edition, 2007.*
2. *C. F Gerald and P. O Wheatley, Applied Numerical Analysis, 7th edition, Addison Wesley, 2009.*
3. *Rizwan Butt, Introduction to Numerical Analysis Using MATLAB, Jones and Bartlett Publisher, 2010.*
4. *Abdelwahab Kharab, Ronald B, An Introduction to Numerical Methods: A MATLAB Approach, Third Edition, CRC Press, 2012.*

15MEC381 MANUFACTURING PROCESS LAB. 0 0 2 1

Study of types of lathes and their accessories, selection of cutting parameters. Exercises on plain turning, step turning, taper turning, knurling & chamfering, thread cutting, plain milling, end milling, shaping machines - slab & slot cutting, study of grinding machines - surface grinding and cylindrical grinding, study of drilling machines, exercises on drilling machine - drilling, boring, reaming, counter boring, counter sinking & tapping. Measurement of cutting force.

Study of various processes, tools and equipment's used in foundry, exercises on mould preparation, foundry sand testing.

Course Outcomes

15MEC381.1	Explain the details of various manufacturing and machining processes, their evolution and need
15MEC381.2	Identify the correct machining process and develop process plan for various complex shaped geometries
15MEC381.3	Produce the required geometry with the required accuracy from the given raw material as per the process plan
15MEC381.4	Identify the influence of process variables and make technical inference about the process

15MEC382 THERMAL SCIENCES LAB. 0 0 2 1

Experiments to determine flash and fire point, viscosity, calorific values of solid, liquid and gaseous fuels, Carbon content (Carbon residue test).

Study of I.C engines, components and loading devices, Valve timing and port timing diagrams, Performance test, Heat balance sheet on Petrol and Diesel engines, to find Friction power: Morse test or Motoring test.

Study of Refrigeration and Air conditioning system - Performance Tests (COP), Study of Renewable energy systems (like Solar, Wind, Biomass etc.) - Performance tests.

Course Outcomes

15MEC382.1	Compute the property of fuels and lubricating oils using suitable tests.
15MEC382.2	Examine the nature of actual valve /port timing
15MEC382.3	Analyze the performance of internal combustion engines under various operating conditions
15MEC382.4	Measure the Coefficient of performance of refrigerator and air conditioning units

15SSK321 SOFT SKILLS II 1 0 2 2

Professional grooming and practices: Basics of corporate culture, key pillars of business etiquette. Basics of etiquette: Etiquette – socially acceptable ways of behaviour, personal hygiene, professional attire, cultural adaptability. Introductions and greetings: Rules of the handshake, earning respect, business manners. Telephone etiquette: activities during the conversation, conclude the call, to take a message. Body Language: Components, undesirable body language, desirable body language. Adapting to corporate life: Dealing with people.

Group discussions: Advantages of group discussions, structured GD – roles, negative roles to be avoided, personality traits to do well in a GD, initiation techniques, how to perform in a group discussion, summarization techniques.

Listening comprehension advanced: Exercise on improving listening skills, grammar basics: Topics like clauses, punctuation, capitalization, number agreement, pronouns, tenses etc.

Reading comprehension advanced: A course on how to approach middle level reading comprehension passages.

Problem solving level III: Money related problems; Mixtures; Symbol based problems; Clocks and calendars; Simple, linear, quadratic and polynomial equations; special equations; Inequalities; Functions and graphs; Sequence and series; Set theory; Permutations and combinations; Probability; Statistics.

Data sufficiency: Concepts and problem solving.

Non-verbal reasoning and simple engineering aptitude: Mirror image; Water image; Paper folding; Paper cutting; Grouping of figures; Figure formation and analysis; Completion of incomplete pattern; Figure matrix; Miscellaneous.

Spacial aptitude: Cloth, leather, 2D and 3D objects, coin, match sticks, stubs, chalk, chess board, land and geodesic problems etc., related problems.

TEXTBOOKS:

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3. *Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
4. *The Hard Truth about Soft Skills, by Amazone Publication.*
5. *Quick Maths – Tyra.*
6. *Quicker Arithmetic – Ashish Aggarwal*
7. *Test of reasoning for competitive examinations by Thorpe.E. TMH*
8. *Non-verbal reasoning by R. S. Aggarwal, S. Chand*

REFERENCES:

1. *Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova*
2. *More Games Teams Play, by Leslie Bendaly, McGraw Hill Ryerson.*
3. *The BBC and British Council online resources*
4. *Owl Purdue University online teaching resources*

www.the grammarbook.com - online teaching resources www.englishpage.com- online teaching resources and other useful websites.

15MEC390 / 15MEC490 LIVE-IN-LAB. 3 cr

This initiative is to provide opportunities for students to get involved in coming up with technology solutions for societal problems. The students shall visit villages or rural sites during the vacations (after 4th semester or sixth semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth or seventh semester. The objectives and projected outcome of the project should be reviewed and approved by the Dept. chairperson and a faculty assigned as the project guide. On completion of the project, the student shall submit

a detailed project report. The report shall be evaluated and the students shall appear for a viva-voce test on the project.

Course Outcomes

15MEC390.1	Using Human Centered Design Concepts to document observations and user experiences
15MEC390.2	Identify and Analyze various Challenge Indicators in the village using Participatory Rural Appraisal
15MEC390.3	Selection of one Challenge that needs to be solved
15MEC390.4	Preparing Field Journal to document the observations, interviews, measurements etc.
15MEC390.5	Recording ideas, personal thoughts and experiences as well as reflections and insights through Reflective Journal
15MEC390.6	Identify and Analyze the Social Structure, Social Change Agents, etc., to implement Sustainable Social Change Models
15MEC390.7	Collating and Analyzing Current Government Policies applicable for the rural India
15MEC390.8	Quantitative and Qualitative Data Collection, Representation and Analysis for problem identification
15MEC390.9	User Needs Assessment and Prioritization
15MEC390.10	Design a Technical Solution using Human Centered Design Concepts
15MEC390.11	Report Generation
15MEC390.12	Research Paper Submission
15MEC390.13	Poster Presentation

15MEC311 DESIGN OF MACHINE ELEMENTS II 3 1 0 4

Unit 1

BEARINGS

Lubrication, Bearings - Introduction, Viscosity, Classification, Hydrodynamic & Hydrostatic Lubrication, Pressure distribution - eccentricity and minimum film thickness, Thick & Thin film lubrication, Bearing materials,

Journal bearings (Sliding contact bearing) - Bearing characteristic numbers, Petroff's equation, Sommerfeld number, Mckee's equation, Journal bearings design.

Rolling Contact Bearings - Types, Static & Dynamic load carrying capacity, Reliability, Selection of antifriction bearings for Static & Dynamic conditions, Selection of antifriction bearings for constant and varying loads.

FLEXIBLE TRANSMISSION SYSTEM

Introduction, Classification & Application of flexible power transmission systems, Simple and Compound power drives.

Belt Drives - Flat belt drives, types, belt configuration, velocity ratio, slip, condition for maximum power transmission, length of open and cross belt drives, centrifugal tension, initial tension, selection of belts, flat belt pulleys, fast and loose pulleys, Designation of V-belt, Advantages and Disadvantages of v-belt drives, Selection of

V-belt,

Rope Drives - Types, Designation of wire rope, Length of wire rope, factor of safety, Stresses in hoisting wire ropes, Selection of wire ropes, Wire rope Sheaves and Drums.

Chain drives - Introduction,Terms used in chain drives, Classification, Conveyor chains, Power transmitting chains, Roller chains, Factor of Safety for chain drives, Selection of chain drives.

Unit 2

GEARS - Types, Applications and Gear Terminology,

Spur Gears - Law of gearing, conjugate action and interference in gears, Gear tooth profiles, involute profile, Influence of number of teeth and pressure angle, Gear tooth failure modes, beam strength of gear tooth - Lewis equation, Gear materials, Force analysis, Design for strength, Dynamic and wear load.

Helical gears – Applications, Virtual number of teeth on helical gears, Force analysis, Design of helical gears.

Bevel Gears - Nomenclature of straight and spiral bevel gears, Applications, Design of bevel gears.

Worm Gears - Nomenclature of worm gears, Applications, Design of worm gears.

GEAR BOX

Gear Boxes - types, Gear tooth loads and bearing reactions, Standard speed ratios - speed diagram, Design of multi stage, multi speed gear boxes,

Unit 3

FRICTION DRIVES

Clutches - Introduction, Principle of operation of friction clutches, Clutch materials, friction lining materials, Types of clutches, Single plate clutches, Multi-plate clutches, Axial clutches, Cone clutches, Centrifugal clutches,Selection of clutches.

Brakes - Introduction, Energy to be dissipated, Heating of brakes, Shoe or Block brakes (Single & Double), internal and external shoe brakes, self-locking brakes, Differential band brakes, Internal expanding brakes.

Course Outcomes

15MEC311.1	Select and Design suitable power transmission systems for specific applications
15MEC311.2	Select the type of bearing and Estimate the size based on load carrying capacity in rotating machines
15MEC311.3	Design friction drives for automotive applications
15MEC311.4	Design single stage and multi stage gear boxes for machine tool applications

TEXTBOOKS:

1. Robert L Norton - 'Machine Deign - An Integrated Approach' - Pearson Education - 2011 - 2nd Edition

2. *Bhandari V. B. - 'Design of Machine Elements' - Tata McGraw Hill Education - 2010 - 3rd Edition*
3. *'Design Data: Data Book of Engineers' by PSG College Kalaikathir Achchagam, Coimbatore, 2012.*

REFERENCES:

1. *Shigley J. E. and Mische C. R. - 'Mechanical Engineering Design' - McGraw Hill Education (India) Private Limited - 2011 - 9th Edition*
2. *U. C. Jindal - 'Machine Design' - Pearson Publications, 2010 - 1st Edition*

NOTE: Design of some of the above components for practical applications can be emphasized for better understanding and Continuous Evaluation of the Course.

15MEC312 HEAT TRANSFER 3 1 0 4

Unit 1

Heat transfer - basic modes of heat transfer and fundamental laws. Conduction heat transfer: energy balance, integral and differential approaches, general heat conduction equations in Cartesian, cylindrical and spherical coordinates, initial and boundary conditions. One-dimensional steady state conduction, thermal resistance networks, heat generation, variable thermal conductivity, critical insulation thickness, extended surface heat transfer, multidimensional steady conduction. Unsteady state heat conduction: lumped heat capacity, infinite and semi-infinite solids, numerical methods in conduction problems.

Unit 2

Convective heat transfer: Newton's law of cooling, Prandtl number, hydrodynamic and thermal boundary layer, forced convection, Nusselt number, empirical relations in forced convection for flat plates, cylinders and spheres, Flow over tubes and bank of tubes Internal flow and heat transfer: fully developed laminar flow in pipes, turbulent forced convection, free convection, Natural convection: dimensionless numbers, combined natural and forced convection, Phase change heat transfer: Pool boiling, convective boiling, film and drop wise condensation, empirical relations for heat transfer with phase change.

Unit 3

Heat exchangers: Types, classifications, selection, standards, parallel, counter and mixed flow, multiple passes, LMTD, correction factors, effectiveness, NTU methods. Process design and construction of double pipe and shell and tube heat exchangers.

Radiation heat transfer: electromagnetic radiation spectrum, thermal radiation, absorptivity, reflectivity, transmissivity, emissivity, black body, gray body and white body, monochromatic and total emissive power, Planck's law, Stefan-Boltzmann law, Wein's Displacement law, Radiation exchange between surfaces, view factors, radiation shields, greenhouse effect.

Course Outcomes

15MEC312.1	Analyze one-dimensional heat conduction in solids for different geometries involving heat generation
15MEC312.2	Solve one-dimensional steady and unsteady heat conduction problems to obtain the temperature distributions and rate of heat transfer
15MEC312.3	Analyze extended surfaces, and assess how efficiently and effectively they enhance heat transfer
15MEC312.4	Evaluate heat transfer coefficient associated with forced and free convection using established empirical correlations
15MEC312.5	Analyze heat exchangers based on Logarithmic Mean Temperature Difference (LMTD) and Effectiveness-NTU methods
15MEC312.6	Determine radiation heat transfer between diffuse and gray surfaces

TEXTBOOKS:

1. *Holman J. P. & Bhattacharyya S. -'Heat Transfer' - McGraw Hill Education (India) Private Limited - 2011 - 10e*
2. *Cengel Y. A. & Ghajar A. J. - 'Heat and Mass Transfer' - McGraw Hill Education (India) Private Limited - 2011 - 4th Edition*

REFERENCES:

1. *Frank P. Incropera, David P. Dewitt, Theodore L. Bergman, Adrienne S. Lavine - 'Principles of Heat and Mass Transfer' - Wiley - 2013 - 7e*
2. *Donald Q. Kern - 'Process Heat Transfer', McGraw Hill Education (India) Private Limited - 2001*
3. *Adrian Bejan - 'Heat Transfer' - Wiley India Pvt Ltd. - 2011*
4. *M. Necati Ozisik - 'Heat Transfer: A Basic Approach' – McGraw Hill Inc. US - 1994*
5. *Louis C. Burmeister 'Convective Heat Transfer' - John Wiley & Sons - 1983*

15MEC313 INTRODUCTION TO FINITE ELEMENT METHODS 3 0 2 4

Unit 1

Introduction: Equilibrium equations in elasticity subjected to body force, traction forces, stress strain relations for plane stress and plane strain, Boundary conditions, Initial conditions, Euler's Lagrange's equations of bar, beams, Principal of a minimum potential energy, principle of virtual work, Rayleigh-Ritz method, Galerkins method, Guass elimination method, Numerical integration.

Basic Procedure: General description of Finite Element Method, Engineering applications of finite element method, Discretization process; types of elements 1D, 2D and 3D elements, size of the elements, location of nodes, node numbering scheme, half Bandwidth, Stiffness matrix of bar element by direct method, Properties of stiffness matrix, Preprocessing, post processing.

Interpolation Models: Polynomial form of interpolation functions - linear, quadratic and cubic, Simplex, Complex, Multiplex elements, Selection of the order of the interpolation polynomial, Convergence requirements, 2D Pascal triangle, Linear interpolation polynomials in terms of global coordinates of bar, triangular (2D simplex) elements,

Linear interpolation polynomials in terms of local coordinates of bar, triangular (2D simplex) elements, CST element.

Higher Order and Isoparametric Elements: Lagrangian interpolation, Higher order one dimensional elements - quadratic, Cubic element and their shape functions, properties of shape functions, Truss element, Shape functions of 2D quadratic triangular element in natural coordinates, 2D quadrilateral element shape functions – linear, quadratic, Biquadric rectangular element (Noded quadrilateral element), Shape function of beam element. Hermite shape function of beam element, Numerical integration.

Unit 2

Solid Mechanics Applications: Direct method for bar element under axial loading, trusses, beam element with concentrated and distributed loads, matrices, Jacobian, Jacobian of 2D triangular element, quadrilateral, Consistent load vector.

Solution of bars, stepped bars, plane trusses, space truss, beams and frames by direct stiffness method. Solution for displacements, reactions and stresses by using elimination approach, penalty approach. Plane stress, plane strain and Axisymmetric problems. Dynamic Analysis.

Unit 3

Heat Transfer and Fluid Flow Problems: Steady state heat transfer, 1D and 2D heat conduction governing equation, boundary conditions, One dimensional element, Functional approach for heat conduction, Galerkin approach for heat conduction, heat flux boundary condition, 1D heat transfer in thin fins, heat transfer 1D and 2D problems with conduction and convection.

Fluid flow problems and Introduction to Finite Element Packages and its application to solid mechanics, fluid and heat transfer problems

Course Outcomes

15MEC313.1	Understand the basics and concept of finite element method
15MEC313.2	Develop Interpolation models for 1D, 2D and 3D elements
15MEC313.3	Formulate analysis problem by selecting a suitable element, development of stiffness, force matrices and incorporating boundary conditions.
15MEC313.4	Formulate and solve structural and thermal problems
15MEC313.5	Solve complex problems using commercial packages

TEXTBOOKS:

1. S. S. Rao - 'The Finite Element Method in Engineering' Butterworth-Heinemann Ltd. - 2010 - 5th Edition

2. K. J. Bathe - 'Finite Element Procedures' - Prentice-Hall of India - 2014 - 2nd Edition

REFERENCES:

1. O. C. Zienkiewicz - 'The FEM its basics and fundamentals' - Elsevier - 2013 - 7th Edition

2. J. N. Reddy - 'Finite Element Method' – McGraw Hill International Edition - 2005 - 3rd Edition

3. K. H. Huebner, D. L. Dewhirst, D. E. Smith and T. G. Byron - 'The Finite Element Method for Engineers' - John Wiley & Sons Inc., New York - 2001 - 4th Edition

4. Chandrupatla T. R. - 'Finite Elements in Engineering' - Pearson Edition - 2011 - 4th Edition

15MEC314 METROLOGY AND MEASUREMENTS 3 0 0 3

Unit 1

Concept of Metrology: Definition and concept of Metrology - need of Inspection - Generalized measurement system - Units and standards - measuring instruments; sensitivity, stability, range, accuracy and precision, static and dynamic response, repeatability - systematic and random errors - correction; calibration.

Linear Measurements: Vernier-caliper, Vernier depth gauge, Micrometer, Depth micrometer, Digital micrometer. Slip gauges: wringing of slip gauges and classification
- Tool maker's microscope. Dial indicators - classification and working mechanism. Limit gauges; Comparators: Mechanical, pneumatic and electrical types, applications
- Height Gauge, Bore Gauge and Feeler Gauge.

Angular Measurements: Uses of the Vernier Bevel protractor, Universal Bevel protractor and Optical Bevel protractor. Sine bars – Uses and limitations of sine bar - Taper measurements. Sources of errors in sine bars, Sine Centre and Sine tables – Auto collimator and its applications.

Unit 2

Surface Texture and Screw Thread Measurement: Elements of surface texture - Evaluation of surface finish - Peak to valley height - Talysurf, Tomlinson surface meter - Screw thread terminology - Measurement of various elements of thread; Measurement of thread angle by two wire and Three wire methods; Thread gauges and floating carriage micrometer.

Form Measurements: Measurement of Straightness, Flatness, Parallelism, squareness testing, Roundness testing - Radius Gauge, Wire Gauge, etc.

Signal Representation – Signal conditioners, filters, ADC, DAC

Unit 3

W heatstone bridge, use of bridge circuits - Displacement measurement - Potentiometer - LVDT, Piezo electric type - Velocity measurement.

Nature of Vibration, accelerometers.

Strain measurement types, mechanical strain gauge, Electrical strain gauge, selection of strain gauge.

Temperature measurement: Bimetallic thermometer, Platinum resistance thermometers, Thermocouples and Pyrometers – Pressure fundamentals; Elastic transducers, thermal conductivity gauges, Vacuum pressure measurement, Flow measurement - Ultrasonic flow meter - turbine type meters - Hot wire anemometers.

Course Outcomes

15MEC314.1	Understand the concept of Metrology, Quality control, Quality Assurance and TQM
15MEC314.2	Explain the working principle of instruments used for linear and Angular measurements.
15MEC314.3	Identify the various methods used for measuring surface roughness and thread measurement.
15MEC314.4	Illustrate the construction and working principle of measuring Gear Nomenclature and geometric features of parts.
15MEC314.5	Discuss the instruments used for measurement of Displacement, Rotary, Speed and Vibration.
15MEC314.6	Perceive the various instruments used for measurement of Strain, Temperature, Pressure and Flow.

TEXTBOOKS:

1. *J. F. W. Gayler, and C. R. Shotbolt - 'Metrology for Engineers' ELBS -1990*
2. *JONES' - 'Instrument Technology' Volume - 1, Mechanical Measurement' - Edited by B. E. Noltingk - ELBS - 4th Edition*

REFERENCES:

1. *I. C. Gupta - 'Text Book of Engineering Metrology' – Dhanpat Rai, Publishing Company - 2011 - 7th Edition*
2. *Alan S. Morris - 'The Principles of Measurements and Instrumentation' - Prentice-Hall of India - 2001*
3. *R. K. Jain - 'Engineering Metrology' Khanna Publishers, Delhi - 2009 - 5th Edition*
4. *Gupta S. C. - 'Engineering Metrology' - Dhanpatrai Publications - 2010*
5. *Dr. D. S. Kumar - 'Mechanical Measurements & Control' - Metropolitan Book Co. Private Ltd. - ISBN 81-200 0214-8*
6. *Bechwith-Marangoni-Lienhard - 'Mechanical Measurements' - Pearson Education Asia - 2011 - 6th Edition Reprint.*

15MEC385 HEAT TRANSFER AND THERMAL ANALYSIS LAB. 0 0 2 1

HEAT TRANSFER

To determine of thermal conductivity of metal rod and composite wall, heat transfer coefficient in free and forced convection. Performance test on extended surfaces, heat exchangers.Experiment on Transient conduction and radiation heat transfer.

THERMAL ANALYSIS

Introduction to the Software package, Analysis of flow through pipes, elbows and nozzles,Analysis of flow over different objects using CFD software,Analysis of conduction, convection and radiation problems using FEM package

Course Outcomes

15MEC385.1	Determine the thermal conductivity of insulating materials

15MEC385.2	Determine the convective heat transfer coefficient in free and forced convective conditions
15MEC385.3	Find the Rating of a heat exchanger
15MEC385.4	Estimate the radiative properties
15MEC385.5	Analyze flow and heat transfer characteristics for simple configurations using CFD

15MEC386METROLOGY AND MEASUREMENTS LAB. 0 0 2 1

METROLOGY LAB

LINEAR AND ANGULAR MEASUREMENTS: Slip gauges, Micrometers, Verniers, Dial gauges and Surface plates – Comparators: Mechanical, Electrical, Pneumatic andOptical comparator. Angular measuring instruments - Sine bar, Angle gauges, Spirit level, Auto collimators.

MEASUREMENT OF SURFACE FINISH AND MEASURING MACHINES: Surface finish: Definitions - Types of Surface texture: Surface roughness, Measurement of run out and concentricity, Optical projection comparator - Tool makers microscope.

MEASUREMENT OF SCREW THREADS AND GEARS: Internal / External Screw thread: Terminology, Measurement of various elements of threads - Thread micrometer method, Gear Terminology, Measurement of various elements.

MEASUREMENTS LAB

Calibration of Pressure Gauge, Thermocouple, LVDT, Load cell. Measurement of load, torque, speed, angular displacement. Study of strain gauge rosettes, determination of modulus of elasticity using strain gauges. Study of stress concentration using photo-elasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression.

Course Outcomes

15MEC386.1	Analyze the measurements using process control charts
15MEC386.2	Measure surface roughness, tool nomenclature, threads and gear tooth thickness using appropriate instruments
15MEC386.3	Measure various physical quantities using appropriate instruments.
15MEC386.4	Choose appropriate instruments to measure physical parameters such as Temperature, Pressure, Displacement, Strain, Force, Torque, and Speed.
15MEC386.5	Evaluate the performance characteristics of speed measuring sensors like Photo electric, Capacitive, Inductive, stroboscope and optical encoder
15MEC386.6	Calibrate measuring instruments such as pressure gauge, thermocouple, LVDT, and Load cell
15MEC386.7	Determine stress concentration on test specimens using Photo elastic Polariscope

15SSK331 SOFT SKILLS III 1 0 2 2

Team work: Value of team work in organisations, definition of a team, why team, elements of leadership, disadvantages of a team, stages of team formation. Group development activities: Orientation, internal problem solving, growth and productivity, evaluation and control. Effective team building: Basics of team building, teamwork parameters, roles, empowerment, communication, effective team working, team effectiveness criteria, common characteristics of effective teams, factors affecting team effectiveness, personal characteristics of members, team structure, team process, team outcomes.

Facing an interview: Foundation in core subject, industry orientation / knowledge about the company, professional personality, communication skills, activities before interview, upon entering interview room, during the interview and at the end. Mock interviews.

Advanced grammar: Topics like parallel construction, dangling modifiers, active and passive voices, etc.

Syllogisms, critical reasoning: A course on verbal reasoning. Listening comprehension advanced: An exercise on improving listening skills.

Reading comprehension advanced: A course on how to approach advanced level of reading, comprehension passages. Exercises on competitive exam questions.

Problem solving level IV: Geometry; Trigonometry; Heights and distances; Co-ordinate geometry; Mensuration.

Specific training: Solving campus recruitment papers, national level and state level competitive examination papers; Speed mathematics; Tackling aptitude problems asked in interview; Techniques to remember (In mathematics). Lateral thinking problems. Quick checking of answers techniques; Techniques on elimination of options, estimating and predicting correct answer; Time management in aptitude tests; Test taking strategies.

TEXTBOOKS:

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3. *Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
4. *The Hard Truth about Soft Skills, by Amazone Publication.*
5. *Data Interpretation by R. S. Aggarwal, S. Chand*
6. *Logical Reasoning and Data Interpretation – Niskit K Sinkha*
7. *Puzzles – Shakuntala Devi*
8. *Puzzles – George J. Summers.*

REFERENCES:

1. *Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova.*
2. *More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.*
3. *The BBC and British Council online resources*

4. Owl Purdue University online teaching resources
www.the grammarbook.com - online teaching resources www.englishpage.com- online teaching resources and other useful websites.

15MEC401 ADVANCED FLUID MECHANICS 3 0 0 3

Unit 1

Differential analysis of fluid flow. Conservation of mass - the continuity equation. The stream function. The stream function in Cartesian coordinates. The stream function in cylindrical coordinates. The differential linear momentum equation - Cauchy's equation. The Navier- Stoke's equation. Derivation of Navier-Stoke's equation for incompressible, isothermal flow. Differential analysis of fluid flow problems.

Unit 2

The boundary layer equations. Displacement thickness. Momentum thickness. Turbulent flat plate boundary layer. Boundary layers with pressure gradients.

Drag and lift. Friction and pressure drag. Drag coefficients of common geometries. Parallel flow over flat plates. Flow over cylinders and spheres. Lift.

Unit 3

Compressible Flow. Stagnation properties. One dimensional isentropic flow. Isentropic flow through nozzles. Shock waves and expansion waves. Duct flow with heat transfer and negligible friction (Rayleigh flow). Adiabatic duct flow with friction.

Course Outcomes

15MEC401.1	Evaluate fluid kinematic properties to classify types of fluid flow and flow visualizations technique
15MEC401.2	Solve practical flow fields with appropriate assumptions using governing equations of motion and apply boundary layer theory in the development of fluid mechanics applications
15MEC401.3	Examine lift and drag force associated with fluid flow over common geometries
15MEC401.4	Apply the thermodynamics concepts in relation to compressible flows and derive relationships between various compressible flow parameters
15MEC401.5	Analyze the consequences of compressibility in gas flow and evaluate the effects of friction and heat transfer on compressible flows
15MEC401.6	Predict the occurrence of shocks and calculate property changes across a shock wave

TEXTBOOKS:

1. Fox and McDonald - 'Fluid Mechanics' - John Wiley - 2011 - 8th Edition
2. White F. M. - 'Fluid Mechanics' - McGraw Hill International Edition - 2010 - 7th Edition

REFERENCES:

1. *Panton R. L. - 'Incompressible Flow' - Wiley India, 2013 - 4th Edition*
2. *Cengel Y. A. and Cimbala J. M. - 'Fluid Mechanics (Fundamentals and Applications)' - The McGraw Hill, India - 2013 - 3rd Edition*

15MEC402 CONTROL ENGINEERING 3 0 0 3

Unit 1

Introduction: Concept of automatic controls, open and closed loop systems, concepts of feedback, requirement of an ideal control system.

Modeling of Systems: The control system, Mathematical models of physical systems - Introduction, Differential equations of physical systems – Mathematical Model: Mechanical System (both translation and rotational), Electrical systems (servos, D.C. Motors, A.C. Servomotors), Hydraulic systems (liquid level and fluid power systems), Thermal systems, Integrating devices, Hydraulic servomotor, temperature control system, error detectors.

Block Diagrams: Transfer Functions definition, function, block representation of system elements, reduction of block diagrams, Basic properties and gain formula to block.

Unit 2

System Response: First order and second order system response to step, ramp and sinusoidal inputs, concepts of time constant and its importance in speed of response

Stability analysis: Concepts of stability, Necessary conditions for Stability, Routh-stability criterion, Relative stability analysis; Effect of proportional, integral and derivative control actions, steady state errors in unity feedback control systemsRoot–Locus Techniques: Introduction, The root locus concepts, Construction of root loci, lead compensation, lag compensation and lag-lead compensation

Unit 3

System Analysis using Logarithmic plots: Bode attenuation diagrams, Stability Analysis using Bode diagrams, Simplified Bode Diagrams.

Control system analysis in state space: Introduction to the state concepts, state equation of linear continuous data system. Matrix representation of state equations, controllability and observability, Kalman and Gilberts test

Course Outcomes

15MEC402.1	Develop mathematical models for control systems
15MEC402.2	Analyze the models using standard test signals in time and frequency domain
15MEC402.3	Examine the stability and relative stability of control system in time and frequency domain
15MEC402.4	Design and implementation of feedback control systems for industrial application

TEXTBOOKS:

1. *K. Ogata - 'Modern Control Engineering - Prentice Hall (India) - Pearson Education - 2009 - 5th Edition*
2. *Francis. H. Raven - 'Automatic Control Systems' – McGraw Hill - 1995 - 5th Edition*

REFERENCES:

1. *B. C. Kuo - 'Automatic Control Systems' - Wiley - 2009 - 9th Edition*
2. *Schaum's Series - 'Feedback and Control Systems' – McGraw Hill Education - 2013 - 2nd Edition*
3. *I. J. Nagarath & M. Gopal - 'Control Systems' - New age International Publishers.*
4. *Norman Nise- 'Control Systems Engineering' - Wiley and Sons - 2015 - 7thEdition*
5. *Rihard C. Drof and Robert. H. Bishop Addison - 'Modern Control Systems' – Wesley – 2010 - 12th Edition*

15MEC403 INDUSTRIAL ROBOTICS 3 0 0 3

Unit 1

Evolution of robotics. Robot anatomy - Design and control issues. Manipulation and Control - Sensors and Vision.

Coordinate frames. Mapping: Mapping between rotated frames - Mapping between translated frames - Mapping between rotated and translated frames - Description of objects in space - Transformation of vectors – Rotation - translation combined with rotation - translation of vectors - composite transformation - Inverting a homogenous transform - Fundamental rotational matrices.

Unit 2

Direct Kinematic Model – Mechanical structure and notations - Description of links and joints - Kinematic modeling of manipulator - Denavit-Hartenberg Notation - Kinematic Relationship between adjacent links - Manipulator Transformation Matrix.

Inverse Kinematic Model – Manipulator Workspace – Solvability - Solution techniques - Closed form solution.

Unit 3

Imaging components - image representation - picture coding - object recognition and categorization - visual inspection. Robot cell - design and control layouts. Industrial Applications – Material Handling, Process, Assembly, Inspection. Non-Industrial Applications.

Course Outcomes

15MEC403.1	Identify the components of a robot and distinguish the types of robot configurations
15MEC403.2	Compare, evaluate and choose sensors/drives for robot to be designed
15MEC403.3	Construct kinematic model of a given manipulator and evaluate whether the inverse kinematic model is solvable
15MEC403.4	Examine the need for vision system to be used in a robotic system

15MEC403.5	Choose and apply appropriate image processing technique for object recognition to be used in robotic system
15MEC403.6	Design and develop a robotic system for a given industrial application

TEXTBOOK:

Fu, K. S., Gonzalez, R. C. and Lee C. S. G. - 'Robotics: Control, Sensing, Vision, and Intelligence' – McGraw Hill, New York, NY - 1987

REFERENCE BOOKS:

1. *Mittal R. K. and Nagrath, I. J. - 'Robotics and Control' - Tata McGraw Hill Publishing Company Limited, New Delhi - 2004.*
2. *Craig, J. - 'Introduction to Robotics: Mechanics and Control' - Prentice Hall - 2004 - 3rd Edition*
3. *Peter Corke - 'Robotics, Vision and Control: Fundamental Algorithms in MATLAB' - Springer - 2009*

15MEC404 MECHANICAL VIBRATIONS 3 0 0 3

Unit 1

Introduction: Types of vibrations, Simple Harmonic Motion (SHM), principle of super position applied to Simple Harmonic Motions. Beats, Fourier theorem and simple problems.

Un-damped free vibrations: Single degree of freedom systems. Un-damped free vibration-natural frequency of free vibration, stiffness of spring elements, effect of mass of spring, Compound Pendulum.

Damped free vibrations: Single degree freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping, Logarithmic decrement.

Unit 2

Forced Vibration: Single degree freedom systems, steady state solution with viscous damping due to harmonic force. Solution by Complex algebra, Reciprocating and rotating unbalance, vibration isolation - transmissibility ratio. Due to harmonic excitation and support motion, Whirling of Shafts - Whirling of shafts with and without air damping, Discussion of speeds above and below critical speeds.

Vibration measuring instruments & Vibration Control: Vibration exciters, vibrometer and accelerometer, free & forced vibration tests, vibration isolation, vibration absorbers.

Unit 3

Systems with two degrees of freedom: Introduction, principle modes and Normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, Free vibration in terms of initial conditions. Geared systems. Forced

Oscillations - Harmonic excitation.

Multi degree of freedom systems: Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley's equation. Orthogonality of principal modes, Method of matrix iteration - Method of determination of all the natural frequencies using sweeping matrix and Orthogonality principle. Holzer's method, Stodola method. Rayleigh's method.

Course Outcomes

15MEC404.1	Classify different types of vibrations and develop mathematical models of vibrating systems
15MEC404.2	Analyze free and forced vibrations of single degree of freedom systems
15MEC404.3	Estimate the natural frequencies and mode shapes of multi degree of freedom systems
15MEC404.4	Design of vibration isolators and absorbers to control vibrations

TEXTBOOKS:

1. *W. T. Thomson and Marie Dillon Dahleh - 'Theory of Vibration with Applications' - Pearson Education - 2007 - 5th Edition*
2. *S. S. Rao - 'Mechanical Vibrations' - Pearson Education Inc. - 2011 - 5th Edition*

REFERENCES:

1. *V. P. Singh, - 'Mechanical Vibrations' – Dhanpat Rai & Company Pvt. Ltd. - 2014 - 3rd Edition*
2. *S. Graham Kelly - 'Mechanical Vibrations' - Schaum's Outline Series - Tata McGraw Hill - 2011 - Special Indian Edition*
3. *Leonanrd Meirovitch - 'Elements of Vibrations Analysis' - Tata McGraw Hill - 2007 - Special Indian Edition*

15ENV300 Environmental Science and Sustainability 3 0 0 3

Outcomes:

ENV300.1	CO1: Integrate facts and concepts from ecological, physical and social sciences to characterize some common socio-environmental problems.
ENV300.2	CO2: Develop simple integrated systems and frameworks for solving common interconnected socio-environmental problems.
ENV300.3	CO3: Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
ENV300.4	CO4: Identify the ethical underpinnings of socio-environmental issues in general.

CO-PO Mapping:

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

ENV 300.1		1		1		2	3			2		1			
ENV 300.2	1		1				3			2		1			
ENV 300.3							3	2	1	2		1			
ENV 300.4							3	3		2		1			

This course is the first step in preparing students to play their role as responsible citizens in a sustainable world. In their professional life, it will empower them to or corporate sustainability efforts.

All four COs of this course strongly map with PO7 (Environment and Sustainability). In terms of the pedagogic approach, the whole course involves classroom activities, interaction and communication in oral and written form. Hence all the COs moderately map with PO10. This multidisciplinary course also brings out the necessity of lifelong learning beyond the boundaries of the classroom, curriculum and disciplines and hence all COs weakly map with PO12.

CO1 pertains to characterizing real-world socio-environmental problems by integrating facts and concepts from ecological, physical and social sciences. This is important because, socio-environmental problems often span different disciplines including, science, engineering, and humanities. CO1 maps moderately with PO6 (Engineer and Society) since environmental problems almost invariably have social and other dimensions. CO1 also weakly maps with PO2 (Problem Analysis) and PO4 (Investigating Complex Problems). The mapping is weak since, the course does not specifically focus on engineering problems even though it involves the identification and analysis of socio-environmental issues, drawing from various disciplines and arriving at conclusions. CO1 also weakly maps with PSO1 (Chemical Engineering Fundamentals) in the context of sustainability-related aspects of chemical engineering unit operations and processes.

CO2 pertains to developing solutions to socio-environmental problems. Such solutions must be integrated solutions (synthesis) due to the interconnected nature of socio-environmental problems. Engineering knowledge and the analysis of technical problems is only a part of such solutions, which involve many other aspects. As a result, CO2 maps weakly with PO1 (Engineering Knowledge) and PO2 (Problem Analysis). Similarly, it maps weakly with PSO2 (Chemical Engineering Problem Solving) and PSO3 (Design and Analysis).

CO3 pertains to students being able to identify their roles as responsible actors with respect to the environment and society. It moderately maps with PO8 (Ethics) since being and ethical actor is an important part of being a responsible actor. CO3 weakly maps with PO9 (Individual and Team Work) since a number of class activities involve working in teams, while there is substantial individual work in the course allowing students to play both roles. The two roles played by the students in the classes are reflective of the roles they would play in the real socio-environmental context. CO3 weakly with PO12 (Lifelong Learning) since being a lifelong learner is an important aspect of playing-environmentalone‟sactorin aroledynamic contextas . Itamapsresponsi weakly with PSO1 (Chemical Engineering Fundamentals) in the context of the ethical implications of chemical processes and operations.

CO4 pertains to identifying the ethical issue at the root of socio-environmental problems. It strongly maps with PO8 (Ethics). CO4 also brings out the the need for discipline, and college years and embrace learning about different

fields including ethics and philosophy during one‟s life.

15MEC481 COMPUTER INTEGRATED MANUFACTURING LAB. 0 0 2 1

CNC Part Programming using CAM packages, Simulation of Turning, Drilling and Milling Operations through Manual Part Programming.

Robot Programming using Teach Pendent and Offline Programming to Perform Pick and Place, Stacking of Objects.

Logical Circuits - Pneumatic and Electro-Pneumatic Circuits, Study of PLC and PLC based Electro-Pneumatic Sequencing Circuits, Visual Inspection of Objects by Computer Vision Technology.

Course Outcomes

15MEC481.1	Develop the CNC part program for various machining processes.
15MEC481.2	Develop robot programming for pick-and-place and stacking of objects.
15MEC481.3	Design and simulate various pneumatic and electro–pneumatic circuits.
15MEC481.4	Develop and simulate the PLC program for various industrial applications

15MEC482 MACHINE DYNAMICS AND CONTROL LAB. 0 0 2 1

Experiments on balancing of reciprocating and rotating masses. Determination of gyroscopic couple, study of governors. Experiments on free vibrations: Bifilar, trifilar, compound pendulums. Damping: damping, and critical damping coefficients, logarithmic decrement, coulomb damping, Natural frequencies of coupled, pendulum. Determination of critical speed of shafts.

Experiments on level, position and speed control. Study of time response of I and II order systems. Analysis of control systems using software packages – exercise on root locus and bode plots.

Course Outcomes

15MEC482.1	Demonstrate and Interpret the concepts of natural frequency, damping, critical speeds in translational and rotating vibrational systems
15MEC482.2	Determine moment of inertia and center of gravity of complex objects
15MEC482.3	Construct the characteristic plots for different types of governors
15MEC482.4	Evaluate the working of a gyroscope and Measure the gyroscopic couple
15MEC482.5	Analyze and Solve for the balancing of rotating and reciprocating masses
15MEC482.6	Analyze the time domain features of a given control system using standard test signal
15MEC482.7	Assess the stability and relative stability of control system
15MEC482.8	Design and develop a PID controller for a given application

15MEC495 PROJECT PHASE I 2 cr

The students are required to freeze the area of their project work and conduct the literature surveys during Phase-I of the project, under the guidance of any faculty in the department. The students are expected to work on a topic in the field of Mechanical Engineering. They will be evaluated based on the presentations made by them and a report submitted at the end of the semester by a committee of examiners appointed by the Chairman of the Department.

Course Outcomes

15MEC495.1	Identify a research topic their area of interest in mechanical Engineering
15MEC495.2	Conduct thorough literature review, identify gaps and define objectives and scope of work
15MEC495.3	Develop methodology for prototype/model/experimental setup necessary for the project
15MEC495.4	Document technical report and orally present the project work

15MEC411 OPERATIONS RESEARCH 3 0 0 3

Unit 1

Linear programming: Formulations - graphical solutions, simplex method, duality, Transportation model, Assignment model-travelling salesman problem.

Unit 2

Decision theory: Decision trees. Game theory - two persons zero sum, mixed strategies; 2 x n and m x 2. Network models - project networks - CPM/PERT, project scheduling, crashing networks and cost considerations, resource levelling and smoothing, shortest route problem, minimal spanning tree problem, maximal flow problem.

Unit 3

Sequencing model - 2 machines n jobs, m machines n jobs-n jobs 2 machines.

Inventory models - deterministic and probabilistic models, Queuing models-poison arrival and exponential service times, single server, multi-server. Simulation: Monte Carlo simulation - simple problems.

Course Outcomes

15MEC411.1	Formulate operations research models to optimize resources and maximize profit
15MEC411.2	Formulate and solve the transportation and assignment problems and infer solutions
15MEC411.3	Analyze the project with appropriate technique to manage the resources and minimize the cost
15MEC411.4	Solve operational problems by applying different decision making methods
15MEC411.5	Evaluate the performance of various queuing and sequencing models
15MEC411.6	Choose the appropriate inventory models to optimize inventory

TEXTBOOK:

Wagner, H. M. - 'Principles of Operations Research - Prentice Hall, New Delhi - 1998

REFERENCES:

1. *J. K. Sharma. - 'Operations Research Theory and Applications' - Macmillan India Ltd, New Delhi - 2013 - 5th Edition*
2. *Taha H. A. - 'Operations Research: An Introduction' - Prentice Hall, New Delhi - 2010 - 9th Edition*
3. *Ravindra A., Phillips, D. J. and Solberg, J. J. - 'Operations Research - Principles and Practice' - John Wiley & Sons - 2005.*
4. *Hadley G - 'Linear Programming' - Narosa Book Distributors Private Ltd. - 2006*

15MEC499 PROJECT PHASE II 10 cr

The project should be focused on the synthesis of knowledge gained over the past seven semesters and Phase-I of the project. The project should be relevant to Mechanical Engineering which could involve theoretical and / or computational and / or fabrication and/ or experimental work. Students are required to submit a report at the end of the semester. Evaluation will be done during the course of the project as well as at the end of the semester by a committee of examiners appointed by the Chairman of the Department.

Course Outcomes

15MEC499.1	Identify a research topic and conduct thorough literature survey and define objective and scope of work
15MEC499.2	Develop methodology (design) for conducting theoretical/experimental study
15MEC499.3	Plan, manage and execute experimental work to obtain results with a concern for safety, industry and environment.
15MEC499.4	Organize, analyze results and draw conclusions through group discussion.
15MEC499.5	Document technical report and orally present findings

ELECTIVES

15MEC230 AIRCRAFT SYSTEMS AND ENGINEERING 3 0 0 3

Unit 1

Aircraft industry overview: Evolution and history of light, Types of Aerospace industry, Key Players in aerospace Industry, Aerospace Manufacturing, Industry supply Chain, Prime Contractors, Tier 1 Suppliers, Key Challenges in Industry Supply Chain, OEM Supply Chain Strategies, Mergers and Acquisitions, Aerospace Industry Trends, Advances in Engineering / CAD / CAM / CAE Tools and Materials Technology, Global and Indian Aircraft Scenario.

Introduction to Aircrafts: Basic Components of an Aircrafts, Structural Members, Aircraft Axis System, Aircraft

Motions, Control Surfaces and High Lift Devices.

Types of Aircrafts - Lighter than Air / Heavier than Air Aircrafts. Conventional Design Configurations based on Power Plant Location, Wing Vertical Location, Intake Location, Tail Unit Arrangements, Landing Gear Arrangements. Unconventional Configurations - Biplane, Variable Sweep, Canard Layout, Twin Boom Layouts, Span Loaders, Blended Body Wing Layout, STOL and STOVL Aircraft, Stealth Aircraft. Advantages and Disadvantages of this Configuration.

Unit 2

Introduction to Aircraft Systems: Types of Aircrafts Systems. Mechanical Systems. Electrical and Electronic System. Auxiliary Systems.

Mechanical System: Environmental Control Systems (ECS), Pneumatic Systems, Hydraulic Systems, Fuel Systems, Landing Gear Systems, Engine Control Systems, Ice and Rain Protection Systems, Cabin Pressurization and Air Conditioning Systems, Steering and Break Systems, Auxiliary Power unit.Mechanical Systems: Avionics, Flight Controls, Autopilots and Flight Management Systems, Navigation Systems, Communication, Information Systems, Radar Systems.

Unit 3

Basic Principles of Flight: Significance of Speed of Sound, Air Speed and Ground Speed, Properties of Atmosphere, Bernoulli`s Equation, Forces on the Air Plane, Air Flow Over the Wing Section, Pressure Distribution over a wing Section, Generation of Lift, Drag, Pitching Moments, Types of Drag, Lift Curve, Drag Curve, Lift / Drag Ratio Curve, Factors affecting Lift and Drag,Center of Pressure and it's Effects. Aerofoil Nomenclature, Types of Aerofoil, Wing Section - Aerodynamic Center, Aspect Ratio, Effects of Lift, Drag, Speed, Air Density on Drag.

Basics of Flight Mechanics: Mach Waves, Mach Angles, Sonic and Supersonic Flight and its Effects. Stability and Control: Degree of Stability – Lateral, Longitudinal and Directional Stability and Controls of Aircraft. Effects of Flaps and Slats on Lift Coefficients, Control Tabs, Stalling, Landing, Gliding Turning, Speed of Sound, Mach Numbers, Shock Waves. Aircraft Performance and Maneuvers: Power Curves, Maximum and Minimum Speeds of Horizontal Flight, Effects of Changes of Engine Power, Effects of Altitude on power Curve, Forces Acting on an Aeroplane during a Turn, Loads during a Turn, Correct and Incorrect Angles of a Bank, Aerobatics, Inverted Maneuvers, Maneuverability.

TEXTBOOKS:

1. *Kermode A. C. - 'Flight without Formulae' - Pearson Education - 2008 - 5th Edition*
2. *Kermode A. C. – 'Mechanics of Flight' - Pearson Education - 2012 - 12th Edition*

REFERENCES:

1. *Shevell - 'Fundamentals of Flight' - Pearson Education - 1988 - 2nd Edition*
2. *John D. Anderson - 'Introduction to Flight' - McGraw Hill - 2005*
3. *Ian Mior and Seabridge A. - 'Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration' - Wiley - 2008*

15MEC231 AUTOMOTIVE CHASSIS DESIGN3 0 0 3

Unit 1

Clutch Design Calculation: Design of single plate clutch, multi plate clutch, design of centrifugal clutch, cone clutch, energy dissipated, torque capacity of clutch, design of clutch components, design details of roller and sprag type of clutches.

Gear Box: Performance of vehicle, total resistance to motion, traction and tractive effort, acceleration, calculation of gear ratio, design of three speed gear box, design of four speed gear boxes.

Unit 2

Vehicle Frame and Suspension: Study of loads, moments and stresses on frame members, computer aided design of frame for passenger and commercial vehicles, computer aided design of leaf springs, coil springs and torsion bar springs.

Unit 3

Front Axle and Steering Systems: Analysis of loads, moments and stresses at different sections of front axle, determination of loads at kingpin bearings, wheel spindle bearings, choice of bearings, determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering.

Final Drive and Rear Axle: Design of propeller shaft, design details of final drive gearing, design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings.

TEXTBOOK:

Heldt P. M. - 'The Automotive Chassis' - Literary Licensing – 2012.

REFERENCES:

1. *Steeds W. 'Mechanics of Road Vehicles' - Illiffe Books Ltd., London -1990*
2. *Giles J. G. - 'Steering, Suspension and Tyres' - Illiffe Books Ltd., London - 1988*
3. *Steeds N. and Garret - 'Motor Vehicle' - Illiffe Books Ltd., London - 2000*
4. *Giri N. K. - 'Automobile Mechanics' - Khanna Publisher, New Delhi - 2002*
5. *Heldt P. M. - 'Torque Converter' - Chilton Book Co., New York -1982*
6. *Averns D. - 'Automobile Chassis Design' - Illiffe Books Ltd. – 1992*

15MEC232 AUTOMOTIVE TECHNOLOGY 3 0 0 3

Unit 1

Vehicle and Engine Construction - Chassis, Frame and Body Construction, Engine Types, Construction Details and multi-cylinder engines, Valve Arrangements, Valve Drives, Engine Cooling and Lubrication, Air Supply System, Carburetors, Electronic Fuel Injection Systems, Exhaust Systems.

Power Drive Line: Clutch - Types and Construction, Fluid Coupling, Transmissions - Manual, Semi and Automotive Transmission, Continuously Variable Transmission, Overdrives, Torque Converter, Propeller Shaft, Differential and Axles, Front and All Wheel Drive Vehicles.

Unit 2

Running Systems: Steering Geometry and Types, Steering Linkages, Power and Power Assisted Steering, Types of Front Axle, Suspension Systems, Suspension Design Consideration Active Suspension, Braking Systems - Hydraulic, Pneumatic Brakes and Power Brakes, Anti-Lock Brake system - Wheels and Tyres, Electrical and Electronic Systems: Electrical Systems – Storage, Charging, Starting and Ignition and Lighting Systems, Electronic Controls for Engine and Vehicle Body, Electronic Dashboard Instruments, Electronic and Computer Controlled Transmissions, Intelligent Transportation Systems. Onboard diagnosis system, Safety and Security systems.

Unit 3

Performance of Automobiles: Design Aspects - Ergonomics, Seating and Packaging, Vehicle Body Aerodynamics, Forces and Couples, Traction and Tractive Effort, Power for Propulsion, Cornering Properties, Stability of Vehicle, Dynamics of Vehicles.

Future Automobiles: Automobile Air Pollution, Pollution Control Norms, Alternate Power Units for Automobiles - Use of Natural Gas, LPG and Hydrogen in Automobiles as Fuels, Fuel Cells, Electric and Hybrid Vehicles. Indian Traffic Rules.

Course Outcomes

15MEC232.1	Recognize the Requirements and Functions of automobile systems and components
15MEC232.2	Explain Constructional Features of automotive systems and components
15MEC232.3	Sketch and describe assembly, disassembly & predict trouble shooting.
15MEC232.4	Analyze and Estimate design of components in a drive train Justify proper usage of material
15MEC232.5	Describe the significance & Obtain Basic knowledge in automotive emissions & combustion process & suggest remedies
15MEC232.6	Explain the electrical and electronics systems, Predict Trouble Shooting and practical problems
15MEC232.7	Explore the possibilities of alternative fuel usage in automobiles

TEXTBOOKS:

1. *Heisler H. - 'Advanced Engine Technology' - SAE - 2012*
2. *William H. Crouse, Donald Anglin – 'Automotive Mechanics' - McGraw Hill Education (India) Private Limited- 2006 - 10th Edition*

REFERENCES:

B. Garrett T. K., Newton K., and Steeds W. - 'Motor Vehicles' - Butterworth Heinemann - 2001

C. Fenton J. - 'Handbook of Automotive Body and System Design' - Professional Engineering Publishing, UK - 2005

D. Giri N. K. - 'Automobile Mechanics', Khanna Publishers, New Delhi - 2006 - 8th Edition

E. Bishop R. - 'Intelligent Vehicle Technology and Trends' - AR Tech House Inc. - 1999

15MEC233 CONDITION MONITORING AND DIAGNOSTIC MAINTENANCE **3 0 0 3**

Unit 1

Basic Concepts: Machinery failures, basic maintenance strategies, factors influencing maintenance strategies, machine condition monitoring, transducer selection and location, PC interfacing and virtual instrumentation. Vibration signatures of faults in rotating and reciprocating machines; detection and diagnosis of faults.

Unit 2

Instrumentation and Signal Processing: Types of sensors in condition monitoring: vibration, acoustics and noise, acoustic emission, temperature, ultrasonic and infra-red sensors - Signal processing: basic signal and systems concepts, time domain analysis, frequency domain analysis, time-frequency analysis, wavelets and wavelet packets.

Unit 3

Pattern Recognition: Feature extraction and feature selection methods, feature reduction using PCA - discriminant functions and decision boundaries, decision trees, maximum likelihood and nearest neighbour classification - Bayesian theory, neural networks, fuzzy logic and support vector machines (SVM) in classification.Application and case studies of condition monitoring: Bearings, gear boxes, engines, structural health monitoring, machine tool condition monitoring etc.

Course Outcomes

15MEC233.1	Select the proper maintenance strategies and condition monitoring techniques for identification of failure in a machine.
15MEC233.2	Acquire and Process sound and vibration signals in a dynamic mechanical system
15MEC233.3	Predict the faulty component in a machine by analyzing the acquired vibration signals
15MEC233.4	Build a classifier model for machine learning based fault diagnosis of rotating machines

TEXTBOOKS:

1. *Balageas D., Fritzen C P. and Guemes A. - 'Structural Health Monitoring' - Published by ISTE Ltd., USA - 2006*
2. *Clarence de Silva - 'Vibration and Shock Handbook'- CRC Taylor & Francis - 2005*

REFERENCE BOOKS:

1. *Collacot - 'Mechanical Fault Diagnosis and Condition Monitoring'- Chapman - Hall - 1987*
2. *Davies - 'Handbook of Condition Monitoring - Techniques and Methodology' – Springer -1998*
3. *Norton M. and Karczub D. – 'Fundamentals of Noise and Vibration Analysis for Engineers' – Cambridge University Press - 2003 - 2nd Edition*
4. *Duda R. O., Peter Hart E., and Stork D. E. - 'Pattern Classification' - Wiley India - 2007 - 2nd Edition*

5. Strang G. and Nguyen T. - 'Wavelets and Filter Banks' - Wellesley-Cambridge Press -1996

15MEC234 DESIGN FOR MANUFACTURE AND ASSEMBLY 3 0 0 3

Unit 1

Design Impact on Cost, Design for "X" - DFM approach, DFM Framework, Material and Process Evaluation, General DFM Guidelines, Machining and Casting Guidelines and Examples, Minimize Finishing Requirements. Computer applications for DFMA.

Design features to facilitate machining: datum features - functional and manufacturing. Component design - machining considerations, redesign for manufacture, examples. Form design of castings and weldments.

Unit 2

Tolerance Analysis: Process capability, process capability metrics, Tolerance - cost aspects, feature tolerances, geometric tolerances, relationship between attainable tolerance grades and different machining process. Cumulative effect of tolerances - sure fit law, normal law and truncated normal law.

Interchangeable part manufacture and selective assembly - control of axial play - introducing secondary machining operations, laminated shims - examples.

Unit 3

Datum Systems: Degrees of freedom, grouped datum systems - computation of translational and rotational accuracy - geometric analysis and applications.

True Position Theory: Co-ordinate and conventional method of feature location, tolerance and true position tolerance, virtual size concept, floating and fixedfasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging - examples.

Principles of Design for Assembly, Minimize Part Count, Standardization and Minimize Part Variety, Design guidelines for manual assembly, DFA analysis, DFA index, Design for Automated Assembly. Introduction to usage of DFMA software.

TEXTBOOKS:

1. *Boothroyd G., Dewhurst P. and Knight W. - 'Product Design for Manufacture and Assembly' - Marcel Dekker, New York - 2012 - 4th Edition*
2. *Peck H. - 'Designing for Manufacture' - Pitman Publications - 1983*

REFERENCES:

1. *Spotts M. F. - 'Dimensioning and Tolerance for Quantity Production'- Prentice Hall Inc. -1983*
2. *Wade O. R. - 'Tolerance Control in Design and Manufacturing' - Industrial Press Inc., New York - 1967*
3. *Creveling C. M. - 'Tolerance Design - A Hand Book for Developing Optimal Specifications' - Addison Wesley Longman, Inc, - 1997*

15MEC235 FRACTURE MECHANICS 3 0 0 3

Unit 1

Introduction to Fracture Mechanics: Failures in structures - types and causes, historical perspective, fracture mechanics approach to design -energy criterion, stress intensity approach, time dependent crack growth and damage tolerance, effect of material properties on fracture.

Linear Elastic Fracture Mechanics (LFEM): Stress concentration effect of flaws, Griffith energy balance, the energy release rate, instability and resistance curve(R-curve), stress analysis of cracks, relationship between stress intensity factor and energy release rate (K and G), crack tip plasticity, mixed mode crack initiation and propagation.

Unit 2

Elastic Plastic Fracture Mechanics (EPFM): Crack-Tip-Opening Displacement (CTOD), the J contour integral and its determination, relationships between J and CTOD, crack-growth resistance curves, J-controlled fracture.

Fracture mechanism in metals and non-metals: Ductile fracture, cleavage, the ductile-brittle transition, intergranular fracture, fracture in polymeric materials, and fracture in ceramic and ceramic composites.

Unit 3

Applications: Introduction to fracture toughness testing of metals and non-metals for determination of fracture parameters, Application of fracture mechanics concepts in the analysis of fatigue crack growth.

Computational fracture mechanics: Overview of numerical methods for fracture mechanics problems, traditional methods in computational fracture mechanics – point matching and energy methods, the energy domain integral, finite element implementation, design of finite element mesh, linear elastic convergence study, analysis of growing cracks.

TEXTBOOK:

Anderson T. L. - 'Fracture Mechanics: Fundamentals and Applications' - CRC Press - 2012 - 5th Edition

REFERENCES:

1. *Ramesh K. - 'E-book on Engineering Fracture Mechanics' - IIT Madras - 2006*
2. *Janssen M., Zuidema and Wanhill R. J. H. – 'Fracture Mechanics' - VSSD (Delft University of Technology) - 2006 - 2nd Edition*
3. *Kumar P. - 'Elements of Fracture Mechanics' - Wheeler Publishing - 1999*
4. *Dahlberg T. and Ekberg S. - 'Failure Fracture Fatigue: An Introduction' - Overseas Press (India) - 2006*
5. *Suresh S. - 'Fatigue of Materials' - Cambridge University Press - 1998 - 2nd Edition*

15MEC236 MATERIALS SELECTION IN MECHANICAL DESIGN 3 0 0 3

Unit 1

Overview of materials properties - modulus, tensile. Fatigue, creep strengths, toughness, hardness, fracture toughness, damping capacity, thermal, oxidation, corrosion and wear resistances.

Materials property charts. Materials families and classes - metals, ceramics, glasses, polymers, elastomers, composites, foams, natural.

Unit 2

Basis of materials selection. Design of components - functions, constraints, objectives and free variables. Selection process - translation, screening, ranking, supporting information. Illustration of the principles with examples - heat sink, overhead electrical transmission line, tie rod, light stiff beam. Multiple constraints and objectives - case studies. Design of hybrid materials - case studies.

Unit 3

Case studies in materials selection for various applications - oar, table leg, flywheel, kiln walls, passive solar heating, heat exchangers, bearings, springs, pressure vessel.

Principles of process selection and classification - casting, forging, moulding, fabrication, welding, joining, machining, powder processing, composite processing. Illustration of the principles with case studies.

Multiple constraints and objectives - case studies.Design of hybrid materials - case studies.

TEXTBOOK:

Ashby M. F. - 'Materials selection in mechanical design' - Butterworth Heinemann - 2010 - 3rd Edition

REFERENCE:

ASM Handbook - 'Materials Selection and Design' - 1997

15MEC237 MECHATRONICS 3 0 0 3

Unit 1

Introduction to Mechatronics systems - Measurement Systems - Control Systems - Micro Processor based controllers. Sensors and Transducers - Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid flow and Liquid level Temperature, Light sensors - selection of sensors. Pneumatic and Hydraulic actuation systems – Directional Control Valves - Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and pawl – Belt and Chain Drives – Bearings.

Unit 2

Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – D.C Motors – A.C Motors – Stepper Motors. Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Transnational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems. Continuous and discrete process

Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control – Micro Processors Control.

Unit 3

Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analogs Input / Output – Selectionof a PLC Problem. Stages in designing Mechatronics Systems – Traditional and Mechatronic Design - Possible Design Solutions. Case Studies of Mechatronics Systems, Pick and place robot – automatic Car Park Systems – Engine Management Systems.

Course Outcomes

15MEC237.1	Select different types of sensors and actuators used in mechatronics system
15MEC237.2	Analyze various components of control system
15MEC237.3	Demonstrate the functions of various control structures
15MEC237.4	Develop a PLC program for industrial application

TEXTBOOK:

W. Bolton - 'Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering' - Prentice Hall - 2013 - 5th Edition

REFERENCES:

1. *Michael B. Histand and David G. Alciatore - 'Introduction to Mechatronics and Measurement Systems', McGraw Hill - 2000 - International Editions*
2. *Bradley D. A., Dawson D., Buru N.C. and. Loader A.J - 'Mechatronics' - Chapman and Hall - 1993*
3. *Dan Necsulesu - 'Mechatronics' - Pearson Education Asia - 2002*
4. *Lawrence J. Kamm - 'Understanding Electro : Mechanical Engineering - An Introduction to Mechatronics' - Prentice Hall of India Pvt, Ltd. - 2000*
5. *Nitaigour Premchand Mahadik - 'Mechatronics' - Tata McGraw Hill Publishing Company Ltd. 2003*

15MEC238 MICRO-ELECTRO MECHANICAL SYSTEM 3 0 0 3

Unit 1

Definition of MEMS. MEMS devices. Silicon as a MEMS material - mechanical properties of silicon. Mechanical components in MEMS. Design concepts of mechanical components. Working Principles of Microsystems. Engineering Science for Microsystems design and Fabrication. Scaling laws – Scaling in geometry, rigid body dynamics, electrostatic forces, electromagnetic forces, electricity-fluid mechanics and heat transfer.

Unit 2

Materials for MEMS and Microsystems. Fabrication technologies – Photolithography - Ion implantation – diffusion

– oxidation – CVD - Physical Vapor Deposition – Etching.

Micro manufacturing - Bulk and surface micro machining - LIGA.

Unit 3

Microsystems Design - Design considerations - Process design - Mechanical Design
– CAD - Micro system packaging – Levels – Bonding – Interfaces - Assembly – Selection of Packaging Materials.

Course Outcomes

15MEC238.1	Interpret the fundamentals of scaling laws in microsystems
15MEC238.2	Select the materials and suitable manufacturing process for MEMS design
15MEC238.3	Design the microsystem for a suitable application
15MEC238.4	Develop the packages for microsystem

TEXTBOOK:

Tai–Ran Hsu - 'Mems & Microsystems Design and Manufacturing' - John Wiley & Sons - 2008 - 2nd Edition

REFERENCES:

1. *Marc J Madou - 'Fundamentals of Microfabrication' - CRC Press - 2002 - 2nd Edition*
2. *Mohamed Gad-el-Hak – 'The MEMS Handbook' - CRC Press - 2002*

15MEC239 MODELING AND SIMULATION OF ENGINEERING SYSTEMS3 0 0 3

Unit 1

Fundamental Concepts in Mathematical Modelling: Abstraction – linearity and superposition – balance and conservation laws and the system – boundary approach.

Lumped – Element Modeling: Mechanical systems - Translational, rotational. Hydraulic systems. Thermal systems. RLC Electrical Systems.

Modeling of First–order and Second–order Systems: Governing equations for free and forced responses – transient response specifications – experimental determination – Laplace transform. Time Domain, Frequency Domain and State Space.

Unit 2

Frequency response of Linear, Time invariant systems – frequency response of first–order and second–order systems – state space formulations of systems problems relating frequency response to pole location – transient response-poles and frequency response.

Unit 3

Feedback systems: Systems with feedback – block diagrams – properties of feedback systems – relative stability - phase and gain margins.

Course Outcomes

15MEC239.1	Develop mathematical models for engineering systems in different domains and derive analogies
15MEC239.2	Analyze first and second order systems using Laplace Transform techniques.
15MEC239.3	Analyze first and second order systems in time and frequency domain.
15MEC239.4	Develop block diagrams and estimate relative stability, gain margin and phase margin for feedback systems
15MEC239.5	Simulate mathematical models of engineering systems using simulation software

TEXTBOOK:

Cha P. D., Rosenberg J. J. and Dym C. L. - 'Fundamentals of Modeling and Analyzing Engineering Systems'- Cambridge University - 2000

REFERENCES:

1. *Woods Robert L. and Kent L.- 'Modeling and Simulation of Dynamic Systems'- Prentice Hall - 1997*
2. *Mukherjee A. and Karmakar R. - 'Modeling and Simulation of Engineering Systems through Bondgraphs' - Narosa - 2000*
3. *Frederick C. - 'Modeling and Analysis of Dynamic Systems' - Wiley - 2001 - 3rd Edition*

15MEC240 OPTIMIZATION TECHNIQUES IN ENGINEERING 3 0 0 3

Unit 1

Introduction to Optimization: Engineering application of Optimization – Statement of an Optimization problem - Optimal Problem formulation - Classification of Optimizationproblem. Optimum design concepts: Definition of Global and Local optima – Optimality criteria - Review of basic calculus concepts – Global optimality.

Linear programming methods for optimum design: Review of Linear programming methods for optimum design – Post optimality analysis - Application of LPP models in design and manufacturing.

Unit 2

Optimization algorithms for solving unconstrained optimization problems – Gradient based method: Cauchy's steepest descent method, Newton's method, Conjugate gradient method.

Optimization algorithms for solving constrained optimization problems – direct methods – penalty function methods – steepest descent method - Engineering applications of constrained and unconstrained algorithms.

Unit 3

Modern methods of Optimization: Genetic Algorithms - Simulated Annealing - Ant colony optimization - Tabu search – Neural-Network based Optimization – Fuzzy optimization techniques – Applications. Use of Matlab to solve optimization problems.

Course Outcomes

15MEC240.1	Formulate the engineering problems as an optimization problem.
15MEC240.2	Apply necessary and sufficient conditions for a given optimization problem for optimality
15MEC240.3	Select appropriate solution methods and strategies for solving an optimization problem
15MEC240.4	Interpret and analyse the solution obtained by optimization algorithms
15MEC240.5	Justify and apply the use of modern heuristic algorithms for solving optimization problems

TEXTBOOK:

Rao S. S. - 'Engineering Optimization, Theory and Practice' - New Age International Publishers - 2012 - 4th Edition

REFERENCES:

1. *Deb K. - 'Optimization for Engineering Design Algorithms and Examples' – PHI - 2000*
2. *Arora J. - 'Introduction to Optimization Design' - Elsevier Academic Press, New Delhi - 2004*
3. *Saravanan R. - 'Manufacturing Optimization through Intelligent Techniques' - Taylor & Francis (CRC Press) - 2006*
4. *Hardley G. -'Linear Programming' - Narosa Book Distributors Private Ltd. - 2002*

15MEC241 PRESSURE VESSEL DESIGN 3 0 0 3

Unit 1

Introduction to Pressure Vessels, Design Philosophy, Structural Integrity - Failure modes and theories - Working loads and allowable stresses - Fatigue, fracture and buckling.

Stress categorization - Primary, secondary and peak.

Design of Cylindrical Shells - ASME equations - Thin shell equations - Thick shell equations - Buckling of cylindrical shells.

Unit 2

End Closures - ASME equations for various types of heads – Hemispherical, flat, ellipsoidal, torispherical, and conical heads.

Discontinuity Stresses - Discontinuity stresses - Beams on elastic foundation, Cutouts and Reinforcements – Stress concentrations around a hole – Reinforcements.

Fatigue Assessment - Exemption from fatigue analysis - S-N curves - Design curves - Cumulative damage - Fatigue evaluation.

Unit 3

Bolted Flanges - RF and FF flanges - Gasket loading behavior - Application of ASME equations for flange analysis and bolt design.

Design of Supports - Lug support - Support skirts - Saddle support.

TEXTBOOKS:

1. *Harvey J. F. - 'Theory and Design of Pressure Vessels' - Van Nostrand - 1991*
2. *Chattopadhyaya S. - 'Pressure Vessels - Design and Practice' - CRC Press - 2005*

REFERENCES:

1. *Brownell and Young -Process Equipment Design' - Wiley Publishing Ltd. - 1959*
2. *Ellenberger P. - 'Pressure Vessels: ASME Code Simplified' - McGraw Hill Company - 2004 - 8th Edition*

15MEC242 THEORY OF ELASTICITY 3 0 0 3

Unit 1

Analysis of Stress and Strain: Stress at a point; stress tensor; stress transformations; principal stresses; octahedral stress; geometrical representation of stress at a point; equations of equilibrium.

Infinitesimal affine transformation for deformation; strain tensor; principal strains; strain-displacement relations for finite and infinitesimal strains; compatibility conditions. Constitutive Equations:General theory; generalized Hooke's law for anisotropic and isotropic materials.

Unit 2

Equations of Elasticity: Common equations of elasticity theory like Mitchel-Beltrami and Navier equations, formulation of the general elasticity problem; boundary conditions.

Unit 3

Solution of Some Special Boundary Value Problems: Simplifications; two-dimensional problems in rectangular and polar coordinates; Airy's stress function; a few problems like stress concentration around a circular hole and Boussinesq problem.

A few representative three-dimensional problems; torsion and bending of non-circular prismatic bars (Saint-Venant's solution); membrane analogy, Simple Plate bending.

Course Outcomes

15MEC242.1	Apply principles of elasticity theory to estimate stresses and strains in isotropic and non-isotropic materials using a tensorial approach
15MEC242.2	Formulate and solve boundary value problems in solid continua using stress and displacement based solution strategies
15MEC242.3	Formulate and solve planar problems using Airy stress function in rectangular and polar co-ordinates

15MEC242.4	Solve specific three-dimensional problems based on torsion, bending of non-circular prismatic bar, membrane analogy, and simple plate bending

TEXTBOOKS:

1. *Timoshenko S. P. and Goodier J. N. - 'Theory of Elasticity'- McGraw Hill International Editions, 1970 - 3rd Edition*
2. *L. S. Srinath - 'Advance Mechanics of Solids' - McGraw Hill Education - 2009 - 3rd Edition*

REFERENCES:

1. *Hartog, J. P. D. - 'Advanced Strength of Materials'- Dover Publications Inc, - 1987*
2. *Boresi A. P., Schmidt R. J. and Sidebottom O. M. - 'Advanced Mechanics of Materials' - John Wiley & Sons Inc. - 1993 - 5th Edition*
3. *Durelli A. J., Phillips E. A. and Tsao C. H. - 'Introduction to the Theoretical and Experimental Analysis of Stress and Strain' – McGraw Hill, New York - 1958.*

15MEC243 TOOL DESIGN 3 0 0 3

Unit 1

Design of Jigs: Introduction - Location Principles – Six Point Location Principle – Locators – Clamping Principles – Clamping Devices – Drill Jigs – Drill Bushes – Drill Jig Types – Design and Development of Jigs for given components.

Unit 2

Design of Fixtures: Milling Fixtures – Milling Methods – Milling Fixture Types – Turning fixtures – Broaching Fixtures – Grinding Fixtures – Assembly, Inspection and Welding Fixtures – Modular Fixtures – Design and Development of Fixtures for given components.

Unit 3

Design of Dies: Power presses types and construction details, die cutting operation, cutting action in die and punch, center of pressure, clearance and its significance, cutting forces, methods of reducing cutting forces, methods of punch support, strippers, stock stops, guide pilots, knockout, design of blanking and piercing dies. Design Concepts and description of the components of progressive dies. Design of progressive dies. Design of compound dies. Design of combination dies.

Drawing Dies: Metal flow and factors affecting drawing, blank size calculations, drawing force, single and double acting drawing dies, design and development of drawing dies for different components.

Bending and Forming Dies: Spring back, bend allowance; calculation of development length, bending force calculations types of bending dies. Curling dies.

Forging process and forging dies. (Introductory Treatment)

TEXTBOOKS:

1. *P. H. Joshi – 'Jigs and Fixtures Design Manual' - McGraw Hill - 2002*
2. *Kempster M. H. A. - 'An Introduction to Jig and Tool Design' - Viva Books Pvt. Ltd. - 2002*
3. *Paquin and Crowley – 'Die Design Fundamentals' - Industrial Press, New York – 1979*

REFERENCE BOOKS:

1. *John G. Nee - 'Fundamentals of Tool Design' - Society of Manufacturing - 1998 - 4th Edition*
2. *'Production Techno1ogy Hand Book' - HMT - Tata McGraw Hill*
3. *E. K. Henriksen – 'Jig and Fixture Design Manual' - Industrial Press, New York - 1973*
4. *Donaldson, Lecain and Goold – 'Tool Design' - McGraw Hill, New York - 1976*

15MEC246 AUTOMOTIVE ELECTRONICS 3 0 0 3

Unit 1

Introduction: Automotive component operation - Electrical wiring terminals and switching, Multiplexed wiring systems - Circuit diagrams and symbols. Charging Systems and Starting Systems: Charging systems principles alternations and charging circuits - New developments requirements of the starting system - Basic starting circuit.

Ignition systems: Ignition fundamentals, Electronic ignition systems. Programmed ignition distribution - direct ignition spark plugs. Electronic Fuel Control Basics of combustion - Engine fuelling and exhaust emissions - Electronic control of carburetion - Petrol fuel injection - Diesel fuel injection.

Unit 2

Instrumentation systems: Introduction to instrumentation systems - Various sensors used for different parameters sensing - Driver instrumentation systems - vehicle condition monitoring - trip computer different types of visual display.

Electronic control of braking and traction: Introduction - control elements and control methodology - Electronic control of Automatic Transmission: Introduction - Control of gear shift and torque converter lockup - Electric power steering - Electronic clutch.

Unit 3

Engine management systems: Combined ignition and fuel management systems - Exhaust emission control - Digital control techniques - Complete vehicle control systems - Artificial intelligence and engine management – use of microprocessor in Automotives.

Lighting and security systems: Vehicles lighting Circuits - Signaling Circuit Central locking and electric windows security systems - Airbags and seat belt tensioners - Miscellaneous safety and comfort systems.

Course Outcomes

15MEC246.1	Select automotive electronic subsystems
15MEC246.2	Categorize various sensors and actuators used in automotive systems

15MEC246.3 Analyze the advantages of electronic vehicle control over conventional system

TEXTBOOK

Denton T. - 'Automobile Electrical and Electronic Systems' - Edward Arnold Publications - 2001

REFERENCES

1. *Knowles D. - 'Automotive Electronic and Computer controlled Ignition Systems' - Don, Prentice Hall, Englewood Cliffs, New Jersey - 1988*
2. *William T. M. - 'Automotive Electronic Systems' - Heiemann Ltd., London - 1978*
3. *Ronald K. J. - 'Automotive Electronics Handbook' - McGraw Hill, Inc, - 1999*

15MEC247 COMBUSTION ENGINEERING 3 0 0 3

Unit 1

Thermodynamics of Combustion: Properties of mixtures - Combustion stoichiometry - Heat of reaction and formation - adiabatic flame temperature - chemical equilibrium.

Chemical Kinetics: Elementary reactions: Rate of reactions and their functional dependence - chain reactions, Pre-Ignition kinetics, Global reactions, Nitrogen Oxide kinetics, Soot kinetics.

Unit 2

Combustion of gaseous and vaporized fuels: Laminar premixed flames - laminar flame theory - Turbulent premixed flames - Mechanism of flame stabilization - Explosion limits - Mechanism of flame quenching - Flammability and ignition - diffusion flames - flame propagation - Gaseous combustion system.

Unit 3

Combustion of liquid fuels: Spray formation - size distribution - fuel injectors, spray dynamics - vapourisation of single droplets - spray combustion system.

Combustion of solid fuels: Solid fuel combustion mechanism - Drying of solid fuels - Devolitilisation of solid fuels - Fuel-bed combustion – suspension burning - fluidized bed combustion.

TEXTBOOKS:

1. *Borman G. L. and Ragland K. W. - 'Combustion Engineering' - McGraw-Hill - 2005*
2. *Turns S. R. - 'An Introduction to Combustion' – McGraw Hill - 1996*

REFERENCES:

1. *Kuo K. K. - 'Principles of Combustion' - John Wiley & Sons - 1984*
2. *Sharma S. P. and Chandramohan - 'Fuels and Combustion' - Tata McGraw Hill Publishing Company Limited - 1984*
3. *Heywood J. B. - 'Internal Combustion Engine Fundamentals' – McGraw Hill - 1993*

15MEC248 COMPUTATIONAL FLUID DYNAMICS 3 0 0 3

Unit 1

Introduction & conservation laws of fluid motion: Models of the fluid flow, Substantial derivative, Divergence of the velocity, Laws of Conservation - Continuity Equation, momentum Equation, Energy Equation, Dimensionless forms of Equations, Simplified Mathematical Model, Mathematical Classification of flows, Physical Boundary conditions.

Basics of numerics: Components of the Numerical solution Methods – Mathematical model, Discretization method, Co-ordinates and Basic Vector systems, Numerical Grid, Finite approximations, Solution Method, Convergence criteria. Properties of Numerical Solution Methods – Consistency, Stability, Convergence, Conservativeness, Boundedness, Realizability. Discretization Approaches – FEM, FDM, FVM.

Unit 2

Finite difference method: Approximation of the first Derivative – Taylor series expansion, Polynomial Fitting, Compact Schemes, Non-Uniform Grids. Approximation of the second derivative, Approximation of the mixed derivative, Explicit and Implicit approaches, Errors and Analysis of stability.

Spectral analysis and grid generation: Spectral Analysis of numerical Schemes, Higher order methods, High accuracy compact schemes. General transformation of the equations, Matrics and Jacobians, Stretched grids, Boundary fitted Co-ordinate systems, Elliptic grid generation, unstructured grids.

Unit 3

Computational heat transfer: Steady one & two dimensional heat conduction, Unsteady one-dimensional heat conduction, over-relaxation and under-relaxation. One dimensional steady convection and Diffusion.

Computational Fluid Flow: Solution methods for incompressible flows - collocated and staggered grid, Pressure correction equations, SIMPLE and SIMPLER Algorithm. Examples in simple geometries such as flow in channel, lid driven cavity flow andvalidation. Solution methods for compressible flows - Importance of conservation and upwinding. Simple artificial dissipation methods, pressure-correction methods for arbitrary Mach numbers. Applications to inviscid compressible flows.

Course Outcomes

15MEC248.1	Numerically solve 1-D, steady and unsteady diffusion problems
15MEC248.2	Numerically solve 1-D, steady advection-diffusion problems.
15MEC248.3	Understand governing equations for a flow phenomenon and define proper boundary conditions to obtain numerical solution
15MEC248.4	Apply CFD software to model relevant engineering flow problems.

TEXTBOOK:

1. *Ferziger J. H. and Peric M. - 'Computational Methods for Fluid Mechanics' - Springer - 2013 - 3rd Edition.*
2. *Anderson J. D. - 'Computational Fluid Dynamics: The Basics with applications' – McGraw Hill - 2007*

REFERENCES:

1. *Sengupta T. K. - 'Fundamentals of Computational Fluid Dynamics' - Universities Press - 2004*
2. *Patankar S. V. - 'Numerical Heat transfer and Fluid Flow' - Taylor & Francis Publications - 1980*

15MEC249 DESIGN OF THERMAL SYSTEMS 3 0 0 3

Unit 1

System Design Fundamentals: Basic design Principles - Workable and Optimal systems - Matching of system components - Economic analysis – Depreciation - Gradient present worth factor.

Mathematical Modeling for Simulation: Mathematical models, Principles, Types, Equation fitting, Information Flow Diagram, Workable Systems, Optimal Systems.

Unit 2

Modeling Thermal Equipment: Modeling of heat exchangers, evaporators, condensers, absorption and rectification columns, compressor, pumps - simulation studies - information flow diagram - solution procedures.

Unit 3

Thermal Systems Optimization: Objective function formulation - Constraint equations - Mathematical formulation - Calculus method - Dynamic programming - Geometric programming - Linear programming methods - solution procedures.

Dynamic Behaviour of Thermal System: Steady state simulation - Laplace transformation - Feedback control loops - Stability analysis - Non-linearities.

Course Outcomes

15MEC249.1	To formulate fluid system problem mathematically and solve it using numerical simulation
15MEC249.2	To formulate and design thermal systems using sequential and simultaneous approaches
15MEC249.3	To model and control the dynamic behavior of fluid-thermal systems
15MEC249.4	To simulate fluid-thermal systems using software like pipeline network, ASPEN etc

TEXTBOOKS:

1. *Stoecker W. F. - 'Design of Thermal Systems' – McGraw Hill -1980*
2. *Stoecker W. F. – 'Refrigeration and Air Conditioning' - Tata McGraw Hill Publishing Company Limited -1985*

REFERENCES:

1. *'ASHRAE Guide & applications' - ASHRAE, USA -1985*
2. *Fanger P. O. - 'Thermal Comfort' – McGraw Hill, USA - 1972*

3. *Kapur J. N. - 'Mathematical Modelling' - Wiley Eastern, New York - 1980*
4. *McQuiston F. C. and Parker T. D. - 'Heating, Ventilating and Air conditioning, Analysis and Design' - John Wiley, USA - 1988*

15MEC250 FLUID POWER DRIVES AND CONTROLS 3 0 0 3

Unit 1

Basic principles - Hydraulic Principles. Hydraulic Actuators – Linear, Rotary - Selection – Characteristics.

Hydraulic Valves: Pressure, Flow, Direction Controls - proportional control valve. Fluid power symbols. Hydraulic circuits: Reciprocating, Quick return, Sequencing, synchronizing and other industrial circuits etc.

Unit 2

Design of Hydraulic circuits: Selection and sizing of components - calculation of frictional head loss - equivalent length for various components - actuator load calculation - pump sizing.

Unit 3

Pneumatic system fundamentals: FRL, actuators and valves. Logic Circuits - Position - Pressure Sensing, switching, electro-pneumatic systems.

Design of Pneumatic circuits using Karnaugh maps. Cascade-Step counter. Combination methods.

PLC programming – Microprocessors - Principles of Low Cost Automation - Case studies.

TEXTBOOK:

Esposito A. - 'Fluid Power with Applications' - Pearson Education - 2005 - 5th Edition

REFERENCES:

1. *Michael J., Pinches and Ashby J. G. - 'Power Hydraulics' - Prentice Hall - 1989*
2. *Parr A. - 'Hydraulics and Pneumatics' – Jaico - 1999.*
3. *Pease D. A., and Pippenger J. A. - 'Basic Fluid Power' - Prentice Hall - 1987*
4. *Majumdar - 'Oil Hydraulics and Pneumatics' - Tata McGraw Hill Publishing Company Limited - 2005*

15MEC251 FUNDAMENTALS OF NUCLEAR ENGINEERING 3 0 0 3

Unit 1

Principles of nuclear energy: Introduction - Atomic structure - Energy from Nuclear reactions - Nuclear Fission and Fusion – radioactivity - Decay rates and Half Lives - Neutron Flux - Reaction rates.

Neutron diffusion theory: Diffusion equation - Solution of Diffusion Equation – Thermal Diffusion Length – Diffusion In Multiplying Systems - Slowing Down of Neutrons - Neutron Transport Equation and its approximation.

Unit 2

Components of nuclear reactors: Nuclear Fuel rod – Coolant-control rod – Moderator - Cladding – Reflectors - Shielding Materials - reprocessing of spent Fuels - Nuclear Waste treatment systems.

Power reactor systems: Pressurised water reactors - Boiling water reactors - Gas cooled and High temperature Gas cooled reactors - Pressurised Heavy water reactors - Fast breeder reactors - LMFBR & GCFBR.

Unit 3

Fuel management and reactor safety: fuel burnup - Core Management - control Management - Conversion ratio - Breeding ratio - Doubling Time - Biological effects of radiation – Radiation Hazards - Nuclear reactor Safety.

TEXTBOOKS:

1. *El Wakil M.M. - 'Power Plant Technology' – McGraw Hill - 2010 - 5th Edition*
2. *Glarstone S. - 'Principles of Nuclear reactor Engineering' - D Van Nostrand - 1982*

REFERENCE:

Stephenson R. - 'Introduction to Nuclear Engineering' – McGraw Hill - 1982

15MEC252 GAS DYNAMICS AND JET PROPULSION 3 0 0 3

Unit 1

Basic concepts: Energy and momentum equations of compressible fluid flows - Stagnation states - Mach waves and Mach cone - Effect of Mach number on compressibility. Isentropic flows: Isentropic flow through variable area ducts.

Isentropic Flow: Nozzle and Diffusers, compressors and turbines - Use of Gas tables. Flow through ducts: Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - Variation of flow properties - Use of tables and charts - Generalized gas dynamics.

Unit 2

Normal and oblique shocks: Governing equations - Variation of flow parameters across the normal and oblique shocks - Prandtl Meyer relations – Expansion of supersonic flow, Use of table and charts - Applications.

Unit 3

Jet propulsion: Theory of jet propulsion - Thrust equation - Thrust power and propulsive efficiency - Operation principle - cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo-prop engines – Aircraft combustors.

Space propulsion: Types of rocket engines - Propellants - Ignition and combustion - Theory of rocket propulsion – Performance study - Staging - Terminal and characteristic velocity - Applications - Space flights.

Course Outcomes

15MEC252.1	Apply the thermodynamics concepts in relation to compressible flows and derive relationships between various compressible flow parameters

15MEC252.2	Develop understanding of isentropic compressible flows in variable area ducts and apply in design of static components like nozzles and diffusers
15MEC252.3	Analyze and solve for compressible flow characteristics with friction and heat transfer
15MEC252.4	Develop relationship for shocks and determine their characteristics under various conditions
15MEC252.5	Determine performance parameters of aircraft and rocket propulsion engine

TEXTBOOKS:

30. *John D. Anderson Jr. - 'Modern Compressible Flow with historical perspective' - McGraw Hill Publishing company - International Edition - 1990 - 2nd Edition*
31. *Yahya S. M. - 'Compressible Flow' - Tata McGraw Hill India - 2009*

REFERENCES:

1. *Balachandran P. - 'Fundamentals of Compressible Fluid Dynamics' - PHI Learning India Private Ltd. - 2009*
2. *Cohen H., Rogers G. E. and Saravanamuttoo - 'Gas Turbine Theory' – Longman - 1980*
3. *Sutton G. P. - 'Rocket Propulsion Elements' - John Wiley, New York - 1986.*
4. *Shapiro A. H. - 'Dynamics and Thermodynamics of Compressible Fluid Flow - Vol.I' - John Wiley, New York - 1953*
5. *Radhakrishnan E. - 'Gas Dynamics' – Prentice-Hall of India Pvt. Ltd - 2004*

15MEC253 INTERNAL COMBUSTION ENGINES AND POLLUTION CONTROL 3 0 0 3

Unit 1

Spark Ignition engines: Mixture requirement - Feedback control carburettors - Fuel injection systems. Stochiometric combustion - combustion with excess air-equivalence ratio.

Stages of combustion: Normal and Abnormal combustion – Knock Combustion chambers. Simple thermodynamic analysis of SI engine combustion.

Unit 2

Compression ignition engines: Nature of combustion in IC engines - Direct and Indirect injection systems - Air motion - Combustion Chambers - Spray penetration and evaporation. Supercharging - Turbo charging. Thermodynamic analysis of CI engine combustion. Wankel Engine: Operation & applications. Hybrid vehicles.

Thermo chemistry: Pollutant formation, Instrumentation to measure pollutants - Pollutant calculation - Effect of air-fuel ratio.

Unit 3

Emission standards: EGR on engine emissions - Emission standards - Emission control devices. Thermal & catalytic exhaust clean–up catalysts - automotive catalytic converters - Engine modifications to reduce emissions. Heat release

analysis of IC engines.

Alternate Fuels: Engine modifications for alternate fuels (liquid and gaseous fuels), homogenous charge compression ignition engines.

TEXTBOOKS:

1. *Heywood J. B. - 'Internal Combustion Engine Fundamentals' - McGraw-Hill - 1998*
2. *Obert E. F. - 'Internal Combustion Engines and Air pollution' - Harper and Row - 1973*

REFERENCES:

1. *Ferguson C. R. - 'Internal Combustion Engines' - John Wiley - 1989*
2. *Ganesan V. - 'Internal Combustion Engines' - Tata McGraw Hill Publishing Company Limited, New Delhi - 1998*
3. *Degobert P. - 'Automobiles and Air Pollution' - SAE - 2002*
4. *Campbell A. S. - 'Thermodynamic Analysis of Combustion Engines' - John Wiley - 1979*

15MEC254 PETROLEUM REFINERY ENGINEERING 3 0 0 3

Unit 1

Origin, Extraction and Testing of petroleum.

Petroleum - Origin, nature, composition, classification, exploration, drilling, transportation and storage. Petroleum processing - Nature of crude from India, Indonesia, Burma and Middle East countries, classification of crude, evaluation of petroleum - Important properties and test methods T.B.P. and ASTM distillation.

Refining of Petroleum - Dewatering and desalting - Primary Oil refining - Treatments of crude - Topping, vacuum distillation.

Unit 2

Thermal cracking, visbreaking and coking, catalytic cracking, fluid bed and hydro cracking, reforming, chemical reforming and catalytic reforming, polymerization, alkylation, hydrogenation isomerisation, cyclization.

Treatment processes: Sweatening, desalting, hydrogen treatment, hydrodesulfurisation process, solvent extraction of kerosene, stabilization of gasoline. Lube oil manufacture - solvent dewaxing, solvent extraction, propane deasphalting, and treatment, clay treatment, hydro finishing, hydrotreatment, lube oil, additives and asphalt boiling.

UNIT 3

Petroleum products: LPG Motor spirit, aviation gasoline, kerosene, aviation turbine fuel, white spirit, and solvents, diesel fuel, gas oil, fuel oil, petroleum coke, petroleum waxes, lubricating oil and bitumen. Petrochemicals - Olefines, acetylene, propylene, butadiene, isoprene, aromatics, benzene, xylene etc. Methanol, formaldehyde, chloromethane, ethylene oxide, ethanol amine, acetone, cumene, phenol, styrene, phthalicanhyride.

TEXTBOOKS:

1. *B. K. BhaskaraRao - 'Modern Petroleum Refining Process' - Oxford IBH Publishing Company, New Delhi.*

2. *G. N. Sarkar - 'Advanced Petroleum Refining' - Khanna Publishers, Delhi - 2004*
3. *W. L. Nelson - 'Petroleum Refinery Engineering' - McGraw Hill*
4. *R. A. Meyer's, -'Hand Book of Petroleum Refining Process' - McGraw Hill*

REFERENCE:

N. K. Sinha - 'Petroleum Refining & Petrochemicals'

15MEC255 POWER PLANT ENGINEERING 3 0 0 3

Unit 1

Hydrological data - capacity and type -selection - General layout and types of hydro electric Power Plants.

General layout of diesel power plant and their components - Types of plant layouts - comparison of diesel plant with thermal plant.

Comparison and types of gas turbine power plants and their components, combined gas and steam power plants - Advantages of gas turbine plant over diesel and thermal plants.

Unit 2

General components of Nuclear reactors - types of reactors - location safety and economics of nuclear plants - comparison with thermal power plants.

Steam power plant layout and components - Modern steam generators - types - functions of super heater - Preheater - economizer and air heater.

Unit 3

Fuels and combustion - Fuel preparation and burning, grates, burners draft, combustion calculations, Boiler Trial, Fuel handling systems, Ash handling methods, Gas cleaning methods and dust collection.

Types of condensers - cooling towers - Water treatment methods economics of power plant operation - Instrumentation and control - variable load operation and economics.

Course Outcomes

15MEC255.1	Select a suitable location for a power plant
15MEC255.2	Analyze the performance of thermal power plant
15MEC255.3	Design fuel handling and ash handling methods in thermal and nuclear power plants
15MEC255.4	Design chimney, cooling towers and condensers for power plants

TEXTBOOKS:

1. *El Wakil M. M. - 'Power Plant Technology' – McGraw Hill - 2010 - 5th Edition*
2. *Nagpal G. R. - 'Power Plant Engineering' - Khanna Publishers - 1998*

REFERENCES:

1. *Morse F. T. – 'Power Plant Engineering' - D. Van Nostrand Company Inc, - 1989*
2. *Joel Weisman and Roy Eckart – 'Modern Power Plant Engineering' - Prentice Hall - 2002*

15MEC256 REFRIGERATION AND AIR CONDITIONING 3 0 0 3

Unit 1

Refrigeration cycles: Vapour Compression Cycle - Simple saturated vapour compression cycle. Thermodynamic analysis of cycles. Refrigerant Classification
– Designation - Alternate Refrigerants. Global Warming Potential & Ozone Depleting Potential aspects, vapour absorption systems.

System components: Refrigerant Compressors – Reciprocating, Open type & Hermetic type, Screw Compressors and Scroll Compressors - Construction and Operation characteristics. Evaporators - DX coil, Flooded type Chillers.

Unit 2

Expansion devices - Automatic Expansion Valves, Capillary Tuber & Thermostatic Expansion Valves. Condensing Units and Cooling Towers. Cycling controls and system balancing: Pressure and Temperature controls. Range and Differential settings.

Selection and balancing of system components - Graphical method.

Psychrometry: Moist air behaviour - Psychrometric chart - Different Psychrometric process analysis.

Unit 3

Air conditioning: Summer and Winter Air conditioning - Cooling Load Calculations - Air Distribution Patterns - Dynamic and Frictional Losses in Air Ducts - Equal Friction Method - Fan Characteristics in Duct Systems.

Course Outcomes

15MEC256.1	Identify the suitability of refrigeration systems
15MEC256.2	Select refrigerants and components like evaporator, compressor, condenser, expansion devices etc. based on operational characteristics
15MEC256.3	Design various components for refrigeration and air-conditioning applications using fundamentals of heat and mass transfer principles
15MEC256.4	Evaluate the performance of each component in an air-conditioning or refrigeration system
15MEC256.5	Calculate cooling load for given requirements

TEXTBOOK:

Stocker W. F. and Jones J. W. - 'Refrigeration & Air Conditioning' - McGraw Hill - 1985

REFERENCES:

1. Dossat R. J. - 'Principles of Refrigeration' - John Wiley - 1989

2. Goshnay W. B. - 'Principles and Refrigeration' - Cambridge University Press - 1982

3. *Prasad M. - 'Refrigeration and Air Conditioning' - Wiley Eastern -1995*

15MEC257 RENEWABLE SOURCES OF ENERGY 3 0 0 3

Unit 1

Solar energy: Solar Radiation - Empirical Equations - Solar Chart - Measurements of Solar Radiation and Sunshine. Solar Thermal Collectors - Flat Plate and Concentrating Collectors. Solar Thermal Power Plant. PV Systems and applications. Applications: Solar Desalination, Solar Pond, solar driers, Industrial Process Heat, etc.

Wind energy: Principles of wind power, site characteristics, Wind rows diagram, types of wind turbines – construction, working and performance characteristics, synchronization of wind energy with the grid.

Unit 2

Bio-energy: Methanation: Methanogenic bacteria, process of methanation, variables affecting the process, popular designs of bio gas plant – construction and working. Feed stock preparation. Application: Biomethanation of agro waste, animal waste and process industry waste – sugar industry, sago industry, etc,

Thermal: Pyrolysis, gasification process, variables affecting the process, types of gasifiers, construction and working of gasifiers. Application: Gasification of biomass, process industry waste viz. - paper mill, waste cotton mill, saw mill, etc,

Unit 3

Ocean energy: Tidal: Types of energy harnessing techniques, turbines – construction, working and performance characteristics. Ocean thermal: Open cycle, closed cycle, Components of ocean thermal power plant, working and challenges.

Fuel cells: Principle of working of Hydrogen, Carbon Monoxide, fuel cell etc.

Course Outcomes

15MEC257.1	Evaluate the performance of solar thermal energy systems
15MEC257.2	Design and performance evaluation of wind energy conversion systems
15MEC257.3	Identify a suitable bio-energy conversion method for industrial applications
15MEC257.4	Identify the challenges in ocean energy resources

TEXTBOOK:

1. El Wakil M. M. - 'Power Plant Technology' – McGraw Hill - 2010 - 5th Edition

2. Rai G. D. - 'Non-Conventional Energy Sources' - Khanna, New Delhi - 1999

REFERENCES:

1. Garg H. P. and Prakash J. - 'Solar Energy, Fundamentals and Applications' - Tata McGraw Hill Publishing

Company Limited, New Delhi -1997
2. *Golding E. W. - 'The Generation of Electricity by Wind Power' - John Wiley, NJ, USA - 1976*

15MEC258 TURBOMACHINERY 3 0 0 3

Unit 1

Definition and Classification of turbomachines - Specific Work - T-s and h-s Diagram - Incompressible and compressible flow – Losses - Total–to–Total efficiency - Total-to-Static efficiency - Effect of reheat and preheat factor. Degree of reaction. Energy transfer - Euler's equation, velocity triangles.

Dimensional analysis, Dimensionless parameters and their physical significance, specific speed, Hydraulic Pumps: Centrifugal Pumps – Some definitions - Pump output and Efficiencies - Effect of Vane angle – Cavitation - Pump Characteristics - Multistage pumps.

Unit 2

Hydraulic Turbines: Classification of hydraulic turbines - Velocity triangles. Efficiencies of draft tubes - Hydraulic turbine characteristics. Francis and Kaplan turbines - Velocity triangles - Efficiencies of Draft tubes - Turbine characteristics.

Elementary cascade theory, cascade nomenclature, compressor cascade, turbine cascade, cascade efficiency. Dimensional analysis of compressible flow machines, stalling and surging.

Unit 3

Centrifugal Compressors: Constructional details - Stage Pressure rise - Stage Pressure Coefficient - Stage Efficiency - Degree of Reaction - Various Slip factors - Introduction to Fans and Blowers, Working principle, Fan laws, Performance Characteristics.

Axial flow Compressors: general expression for degree of reaction; velocity triangles for different values of degree of reaction, Blade loading and flow coefficient, Static pressure rise, Workdone factor.

Steam and Gas Turbines: Axial turbine stages - Stage velocity triangles – Work - Single stage impulse turbine - Speed ratio - Maximum utilization Factor - Compounding of Turbines and its types, Degree of Reaction - Reaction Stages. Inward Flow radial turbine stages (IFR) - Working principle and Performance Characteristics.

Course Outcomes

15MEC258.1	Apply the concepts of energy transformation in turbo machines
15MEC258.2	Analyze the performance of different pumps and hydraulic & steam turbines
15MEC258.3	Evaluate the performance of axial and centrifugal compressors
15MEC258.4	Identify the challenges in ocean energy resources

TEXTBOOKS:

1. Dixon S. L. - 'Fluid Mechanics & Thermodynamics of Turbomachinery' - Elsevier - 2012 - 6th Edition

2. *Sayers A. T. – 'Hydraulic and Compressible flow Turbomachines' – McGraw Hill -1992*
3. *Yahya S. M. - 'Turbines, Fans and Compressors' - Tata McGraw Hill Publishing Company Limited - 2002*

REFERENCES:

1. *Douglas J. F., Gasiorek J. M. and Swaffield J. A. - 'Fluid Mechanics', - Addison-Wesley - 1999*
2. *Kadambi V. and Manohar Prasad - 'Energy Conversion - Vol.III: TurboMachinery' - New Age International Publishers - 1999*
3. *Church A. H. and Lal J. - 'Centrifugal Pumps and Blowers' - Metropolitan - 1995*

15MEC261 ADVANCED CASTING TECHNOLOGY 3 0 0 3

Unit 1

Melt processing techniques for ferrous and non-ferrous alloys such as stainless steels, nickel, titanium alloys. Vacuum melting equipment and practice.

Elementary aspects of pattern and mould design using CAD softwares. Resin-bonded mould and core making processes and machines. Special casting processes and their applications - low pressure die casting, investment casting, squeeze casting, thixo-forming. Illustrations of automotive and aerospace applications.

Unit 2

Gating and riser design - principles of fluid flow, governing equations, heat transfer applied to casting solidification, governing equations, boundary conditions for different casting methods, concept of directional solidification, gating and risers, application of simulation methods. Use of casting software in solving practical problems.

Unit 3

Casting defects and remedies. Inspection methods - visual, penetrant, magnetic, metallurgical, X - ray and Gamma ray radiography and Mechanization and Automation.

TEXTBOOK:

Jain P. L. - 'Principles of Foundry Technology' - Tata McGraw Hill, New Delhi - 2011 - 3rd Edition

REFERENCE BOOKS:

1. *Heine R. W., Loper C. R., and Rosenthal P. C. - 'Principles of Metal Castings' - Tata McGraw Hill, New Delhi - 1997 - 2nd Edition*
2. *Beeley- P. R. - 'Foundry Technology' - Butterworth Scientific, London - 2001*

15MEC262 ADVANCED MANUFACTURING PROCESSES 3 0 0 3

Unit 1

Non-traditional manufacturing processes - chemical machining – electro chemical machining - ultrasonic machining

- physical setup, metal removal rate, process parameters, process capabilities, and applications.

Non-traditional manufacturing processes - electrical discharge machining - wire EDM - abrasive flow machining - physical setup, metal removal rate, process parameters, process capabilities, and applications

Unit 2

High-speed machining: high performance machining of components. Application of HSM, improved material removal rate, surface finish and integrity, accuracy, economic considerations.

Unit 3

Modern grinding technologies, high speed and high performance grinding. Hard machining using single point tools.

Laser applications in manufacture: Cutting, welding, surface treatment, automation and in-process sensing.

TEXTBOOK:

Serope Kalpakjian and Steven R. Schmid - 'Manufacturing Engineering and Technology' - Prentice Hall – 2013 - 7th Edition

REFERENCE BOOKS:

1. *Benedict G. F. - 'Non-Traditional Manufacturing Processes' - Marcell Dekker Inc., NY - 1987*
2. *Krar S. F. and Gill A. - 'Exploring Advanced Manufacturing Technologies' -Industrial Press - 2003*

15MEC263 ADVANCED MATERIALS AND PROCESSES 3 0 0 3

Unit 1

Composite Materials: Types of metal matrices and reinforcements and their properties, bonding mechanisms, structure-property relationships, preforms, design of composites. Physical and Mechanical properties. Characterization of microstructures and macrostructures. Fabrication techniques - metal infiltration, pressure and vacuum casting methods. Case studies.

Unit 2

Aerospace Alloys: High strength Aluminium and Magnesium alloys, Nickel and Cobalt based Superalloys, Titanium alloys, their structures, structure-property relationships, heat treatment. Directional solidification and single crystal turbine blades. Case studies.

Unit 3

Smart Materials: Concept of shape memory, crystal structure, phase transformation mechanism and characteristics, properties, classification, applications.

Nanomaterials: properties, classification, characterization, materials behaviour, fabrication and applications.

Course Outcomes

15MEC263.1	Interpret the properties and structure of composite and advanced material
15MEC263.2	Identify the appropriate fabrication technique for a composite and aerospace alloys
15MEC263.3	Examine the different behaviour of materials for aerospace applications
15MEC263.4	Summarize the properties and applications of smart and nano-materials

TEXTBOOKS:

1. *Clyne T. W. and Withers P. J. - 'An Introduction to Metal Matrix Composites' - Cambridge University Press - 2003*
2. *Duerig T. W, Melton K. N., Stöckel D. and Wayman C. M. - 'Engineering Aspects of Shape Memory Alloys' - Butterworth Heinemann - 1990*

REFERENCES:

1. *'Handbook of Nanostructured Materials and Nanotechnology' - Academic Press - 2000*
2. *Wang Z. I., Liu Y. and Zhang Z. - 'Handbook of Nanophase and Nanostructured Materials: Vol 1. Synthesis' - Kluwer Academic/Plenum Publishers - 2002*
3. *Sinha A. K. - 'Physical Metallurgy Handbook' - McGraw Hill - 2002*

15MEC264 ADVANCED METROLOGY AND SENSING SYSTEMS 3 0 0 3

Unit 1

Computer Aided Inspection: High precision measurements – interfacing - software metrology - Automated visual inspection in manufacturing, contact and non - contact type inspection methods, Electrical field techniques, radiation techniques, ultrasonic - Atomic Force Microscopes (AFM), Talysurf instruments. Laser Metrology: Laser Interferometer, Alignment Telescope, laser scanners. On-line and in - process measurements - diameter, surface roughness, Micro holes, surface topography measurements, straightness and flatness measurement, speckle measurements.

Unit 2

Coordinate Measuring Machine: CMM Types, Applications - Non-contact CMM using Electro optical sensors for dimensional metrology - Non-contact sensors for surface finish measurements – Measurements / programming with CNC CMM – Performance evaluations – Measurement integration. Machine Vision: Image Acquisition and Processing - Binary and gray level images, image segmentation and labelling, representation and interpretation of colours.

Unit 3

Edge detection techniques, Normalization, Grey scale correlation – Reflectance map concepts; surface roughness and texture characterization - photogrammetry. Application of Machine Vision in inspection - Measurement of length, diameters, Surface roughness - automated visual inspection - 3D and dynamic feature extraction. On-line Quality

control: On-line feedback quality control variable characteristics - control with measurement interval, one unit, and multiple units control systems for lot and batch production.

TEXTBOOKS / RFERENCES:

1. *Marshall A. D. and Martin R. R. - 'Computer Vision, Models and Inspection' - World Scientific - 1998*
2. *Nello Zuech - 'Understanding and Applying Machine Vision' - Marcel Dekker - 2000 - 2nd Edition*
3. *John A. Bosch, Giddings, and Lewis Dayton - 'Coordinate Measuring Machines and Systems' Marcel Dekker - 1999*
4. *ASTE - 'Handbook on Industrial Metrology' - Prentice Hall - 1992*

15MEC265 ADVANCED WELDING TECHNOLOGY 3 0 0 3

Unit 1

Overview of welding processes and their classification, types of joints, edge preparation, weld symbols, weld nomenclature, bead geometry, power density, heat sources - Gaussian distribution of heat flux, welding techniques - linear and orbital. Arc characteristics. Voltage-current characteristics. Types of welding manipulators and their applications.

Advanced welding processes: submerged arc, TIG, MIG, electro-slag, ultrasonic, electron beam and laser beam welding. Case studies and applications - industrial, automotive and aerospace.

Unit 2

Thermal modeling and simulation of welding processes - governing heat transfer equations and boundary conditions for various types of welding processes. Estimation of cooling rates. Prediction of mechanical properties, micro/macro-structures of weldments and heat-affected zone. Prediction of weld defects such a crack, segregation, lack of fusion. Modeling and simulation of pulsed arc processes. Use of softwares for simulation.

Solidification behaviour of fusion weld: structural zones, epitaxial growth, weld pool shape and columnar grain structures. Weldability of metals - steels, stainless steels, aluminium, copper, nickel and titanium alloys.

Unit 3

Microstructures of weldment. Segregation of alloying elements. Impact of micro/ macro-structures and segregation on mechanical properties. Pre - and post-treatment. Effects of heat flow on residual stresses and distortion. Weldability tests.

Welding defects - causes and remedies. Methods of testing weldments - mechanical, pressure and leak testing. Inspection methods - visual, penetrant, magnetic, ultrasonic, x-ray and gamma radiography. Use of imaging techniques for online monitoring.

Course Outcomes

15MEC265.1 Understand various welding processes, Joints and Symbols

15MEC265.2	Select Power Sources and Parameters
15MEC265.3	Understand the Heat Distribution during welding
15MEC265.4	Model Heat transfer during welding
15MEC265.5	Understand the solidification process after welding
15MEC265.6	Identify welding defects

TEXTBOOKS:

1. *Khanna O. P. - 'A Text Book on Welding Technology' – Dhanpat Rai and Sons, New Delhi - 2013*
2. *Parmar R. S. - 'Welding Process and Technology' - Khanna Publishers, Delhi - 1992*

REFERENCES:

1. *Little R. L. - 'Welding and Welding Technology' - Tata McGraw Hill Publishing Company Limited, New Delhi - 1989*
2. *Grong O. - 'Metallurgical Modelling of Welding' - The Institute of Materials - 1997 - 2nd Edition*
3. *Kou S. - 'Welding Metallurgy' - John Wiley Publications, New York - 2003 - 2nd Edition*

15MEC266 CNC MACHINES 3 0 0 3

Unit 1

Introduction: Definition of automation, types of automation, Definition of NC, basic components of NC system, the NC procedure, NC Coordinate system, NC motion control systems, Interpolators – linear, circular and parabolic, applications of numerical control.

Features of CNC Machine Tools

Structure, Spindle design, spindle bearings, spindle drives, feed drives – DC servo motors, stepper motors and AC servo motors, actuation systems – recirculating ball screws and anti-friction guide ways, feed-back devices – optical rotary encoders and linear scales.

CNC Machining center developments, turning center developments, high speed CNC machine tools, automatic tool changers.

Manual Programming

Turning center programming: Axes system, ISO standards for coding, tool function, speed function, feed function, miscellaneous functions, rapid positioning, linear interpolation, circular interpolation, thread cutting, canned cycles

Unit 2

Machining center programming: axes system, tool function, speed function, feed function, miscellaneous functions, rapid positioning, linear interpolation, circular interpolation, tool length compensation, canned cycles for drilling, tapping and boring, cutter radius compensation.

Computer Aided Part Programming
APT language structure, Geometry statements, Motion statements, Post processor & auxiliary statements, MACROs, complete part programming in APT.

Unit 3
CNC Tooling
Turning tool geometry, modular tooling systems for turning, collet chucks, end mill adapters, morse taper adapters, boring heads and tapping heads, milling tooling systems, tool presetting, work holding devices - vices, grid plates, pneumatic and hydraulic clamps.

Assembly Techniques
Guide ways, ball screws and nut, feedback elements, spindle bearings.
Testing of CNC Machine Tools
Introduction, verification of technical specifications, functional aspects, verification during idle running, verification of machine tool accuracy and work piece accuracy, metal removal capability test, safety aspects.

TEXTBOOKS:

1. *Yoram Koren - 'Computer Control of Manufacturing Systems' - McGraw Hill Publishers - 2007*
2. *HMT Ltd. - 'Mechatronics' - Tata McGraw Hill Publishers - 2001*

REFERENCES:

1. *P. N. Rao - 'CAD/CAM, Principles and Applications' - Tata McGraw Hill Publishers - 2004*
2. *Mikell P. Groover and Emory W. Zimmers - 'CAD/CAM' - PHI Publishers - 2002*

15MEC267 COMPOSITE MATERIALS AND PROCESSING 3 0 0 3

Unit 1
Types of reinforcements, their mechanical properties and functions - ceramics, glass, carbon, boron, silicon carbide, metal, aramid. Forms of reinforcements - particulate, fibre, filaments, whiskers, flakes. Pre-fabricated forms - preforms, prepegs, fabrics, honeycomb.

Type of matrix, its mechanical properties and functions - polymers (thermosets and thermoplastics), metals, ceramics, glass and carbon. Basic principles in the design of composites and selection of matrix and reinforcement. Bonding mechanisms.

Unit 2
Anisotropic Behaviour and relationship between structure-mechanical properties.

Mechanical testing - tensile, compressive, Intra-laminar shear, Inter-laminar shear and fracture.

Polymer Matrix Composites: Types of thermoset and thermoplastic resins. Principles in the selection of matrix and the reinforcements. Process selection criteria. Mould and tool making. Basic manufacturing steps - impregnation,

lay-up, consolidation and solidification.

Unit 3

Manufacturing processes for polymer composites - lay-up, compression moulding, extrusion, injection moulding, sheet forming, pultrusion, hot press & autoclave techniques and filament winding. Applications - industrial, automotive and aerospace.

Metal and ceramic matrix composites - wettability of reinforcement to matrix and bonding, methods of manufacturing reinforcements with intermediate wetting layer.

Manufacturing processes for metal matrix composites: casting methods - gravity & low pressure die, investment, squeeze, spray forming, compression moulding and thixo-moulding. Manufacturing processes for ceramic matrix composites: reaction sintering, electro-deposition, spray forming, infiltration. Applications - industrial, automotive and aerospace.

TEXTBOOKS:

1. *Clyne T. W. and Withers P. J. - 'An Introduction to Metal Matrix Composites' - Cambridge University Press - 1993*
2. *Matthews F. L. and Rawlings R. D. - 'Composite Materials: Engineering and Science' - Chapman & Hall, London - 1994*

REFERENCES:

1. *Suresh S., Martensen A., and Needleman A. - 'Fundamentals of Metal Matrix Composites' - Butterworth, Heinemann - 1993*
2. *Mallick P. K. - 'Fiber-reinforced Composites: Materials, Manufacturing and Design' - Marcel Dekker – 1993*
3. *Mazumdar S. K. - 'Composites Manufacturing - Materials, Product & Process Engineering' - CRC Press - 2002*

15MEC268 METAL FORMING TECHNOLOGY 3 0 0 3

Unit 1

Fundamentals of Metal Forming: Theory of Plasticity - stress tensor – Invariants of stress strain - hydrostatic & deviator components of stress – flow curve – true stress and true strain. Yielding criteria – yield locus – octahedral shear stress and shear strains. Plastic deformations of crystals - critical resolved shear stress. Metal working: mechanics of metal working – working temperature - strain rate effects – friction and lubrication – deformation zone geometry.

Unit 2

Forging and Rolling Processes: Forging process – classification – equipment – calculation of forging loads – forging defects – residual stresses. Rolling: classification - rolling mills - rolling of bars & shapes – rolling forces – analysis of rolling – defects in rolling - theories of hot & cold rolling – torque power estimation.

Extrusion and Drawing Processes: Extrusion: classification - equipment – Analysis of extrusion process - extrusion defects – hydrostatic extrusion – tube extrusion. Drawing: Classification - rod & wire drawing equipment – analysis.

Deep drawing
– tube drawing – analysis, residual stresses.

Unit 3

Sheet Metal Forming Processes: methods – shearing and blanking – bending – stretch forming – deep drawing – forming limit criteria – defects.

Special Forming Methods: Stretch forming – press brake forming – explosive forming
– electro hydraulic forming – magnetic pulse forming – super plastic forming – electro forming – fine blanking - Isothermal forging – HERF.

TEXTBOOK:

Dieter G. E. - 'Mechanical Metallurgy' - TATA McGraw-Hill - 2013 - 3rd Edition

REFERENCES:

1. *Altan T., Oh S. I., and Gegei H. L. - 'Metal Forming Fundamentals and Applications' - ASM, USA - 1983*
2. *Hosford W. F. and Caddel R. M. - 'Metal forming - Mechanics & Metallurgy' - Prentice Hall Publishing Co. - 1990*
3. *SME - 'Tool and Manufacturing Engineers Hand Book - Vol2' - McGraw Hill NY -1984*

15MEC269 MICRO-MANUFACTURING 3 0 0 3

Unit 1

Micromachining – definition - principle of mechanical micromachining - Classification of micromachining and nanofinishing processes - Molecular dynamics simulations of machining at atomic scale.

Diamond Turn Machining (DTM) - components of DTM – requirements of DTM - material removal mechanism – molecular dynamics - tool geometry. Abrasive Jet Micromachining - erosion mechanism - powder feeding - microstructure fabrication. Ultrasonic micromachining – basic elements - mechanism of material removal - micro-hole drilling, contour machining, micro-de-burring, machining of ceramic materials. Electrochemical micromachining.

Unit 2

Micro-electric discharge micromachining – principle - Micro EDM system development - process parameters - Analytical Modeling. Laser micromachining techniques and their applications. Focused Ion Beam machining. Electro chemical spark micromachining – mechanism - equipment. Electron beam micromachining – mechanism-process parameters - applications.

Unit 3

Microfabrication - Materials for Microsystems manufacture - Substrates and Wafers, active substrate materials, silicon and silicon components. Photolithography based micro fabrication processes - Photo resist development. Additive and subtractive techniques – CVD – PVD – etching - chemical, plasma - resists removal. Large aspect ratio micro manufacturing - LIGA, Deep Reactive Ion Etching.

Micro Metrology - Scanning Electron Microscopy, optical microscopy, atomic force microscope, molecular measuring machine, Micro-CMM, Transmission electron microscope – principles - applications.

TEXTBOOKS:

1. *Madou M. J. - 'Fundamentals of Microfabrication' - CRC Press - 2009 - 2nd Edition*
2. *Jain V. K. - 'Introduction to Micromachining' - Narosa Publishing House - 2010*

REFERENCES:

1. *Ran Hsu, T. R. 'MEMS & Microsystems: Design and Manufacturing' - Tata McGraw- Hill - 2002*
2. *Mohamed Gad-el-Hak - 'The MEMS Handbook' - CRC Press - 2002*

15MEC270 MODERN PRACTICES IN PRODUCT DESIGN AND MANUFACTURE 3 0 0 3

Unit 1

Creativity & Innovation: Aesthetics – Industrial design concepts – capturing customer voice – New product development – QFD.

Computer Aided Design (CAD): The design process - product cycle - sequential and simultaneous engineering, Computer Aided Engineering, Geometric modeling, parametric design. Design for manufacturability and Assembly, Features of CAD packages – Assembly of parts – tolerance analysis – Mass property calculations - Data Exchange Formats – Selection of alterative materials for Engineering Design.

Unit 2

Computer Aided Manufacturing (CAM): CNC Technology - Functions of CNC Control in Machine Tools - Classification of CNC systems - Contouring System - Interpolators, open loop and closed loop CNC systems - CNC Controllers, Hardware features - Direct Numerical Control (DNC Systems) - Numerical control codes – Standards - Manual Programming - Canned cycles and subroutines - Computer assisted Programming – CAD/CAM approach to NC part programming. APT language - Machining from 3D models - Virtual Manufacturing, NC verification.

Unit 3

Reverse Engineering & Rapid Prototyping (RP): Conventional vs Reverse Engineering process, Basic phases, cloud point generation - Related Hardware and software. Rapid product development - RP Data formats and information workflow, characteristics of generative manufacturing processes, Industrial Rapid prototyping system - Technical characteristics and Technological capabilities of RP systems. Concept Modelers. RP process optimization. Direct and Indirect tooling. Application of RP and RT in industrial product development - Medical Models - Engineering analysis models - Art and Architecture models, scope for research.

Recent Advances in Product Development methods and strategies: Concurrent Engineering - Total approach to product development – Collaborative design - Product Data Management – PLM – CPC – Understanding of various software applicationpackages available in the market for various phases of the product life cycle – Design for

Environment – Product Costing - Design for Six sigma - Design FMEA.

TEXTBOOKS:

1. *Zeid I. - 'CAD-CAM Theory and Practices' - Tata McGraw Hill - 2012*
2. *Groover M. and Zimmers - 'CAD-CAM, Computer Aided Design and Manufacturing' - Prentice Hall of India, New Delhi, - 2013*

REFERENCES:

1. *Gebhardt A. - 'Rapid Prototyping' - Hanser Publishers, Munich - 2003*
2. *Lii L., Fuh J. Y. H. and Wong Y. S. - 'Laser Induced materials and processes for Rapid Prototyping' - Kluwer Academic Publishers - 2001*

15MEC271 NON-DESTRUCTIVE TESTING 3 0 0 3

Unit 1

Introduction: Non-Destructive testing - Relative Merits and Limitations - NDT vs Mechanical testing. Dry technique and Wet technique – Principle – Applications - Advantages and Limitations. Dyes - Developers – Cleaners. Fluorescent penetrant test. Liquid penetrant inspection.

Radiography: X-rays and Gamma rays, Properties of X-rays relevant to NDE - Absorption of rays - scattering. Types and use of Filters – screens - Geometric factors, Film type and Processing. Characteristics of films graininess, Density, Speed, Contrast. Characteristic curves. Characteristics of Gamma rays - fluoroscopy – X-ray – Radiography. Safety with X-rays and Gamma rays.

Unit 2

Ultrasonic Testing: Types of Ultrasonic Waves - Principles of wave propagation - Characteristics of ultrasonic waves - Attenuation. Production of ultrasonic waves - Couplants. Inspection methods - pulse echo, Transmission and Resonance techniques. Thickness measurement. Types of scanning. Test block - Reference blocks.

Unit 3

Techniques for Specific Purposes: Magnetic particle inspection - Principles – Applications - Magnetization methods - Magnetic particles, demagnetization. Eddy current testing - Thermal inspection Principle, Application - Instrumentation of Thermal Inspection. Holography. Acoustic Emission. Pressure and Leak Testing. Chemical Spot Testing. Spark Testing.

TEXTBOOKS:

1. *Cartz L. - 'Non-Destructive testing' - ASM International, Metals Park Ohio, US - 1995*
2. *Raj B., Jayakumar T., and Thavasimuthu M. - 'Practical Non-Destructive Testing' - Narosa, New Delhi - 1997*

REFERENCE:

ASM Metals Hand Book, 'Non-Destructive Evaluation and Quality Control' - American Society of Metals, Metals Park Ohio, USA - 1989

15MEC272 PRODUCT COST ESTIMATION 3 0 0 3

Unit 1

Cost estimation: Importance and aims of cost estimation - functions of estimation - difference between estimating and costing - importance of preparing realistic estimates - estimating procedure.

Elements of cost, Objectives - elements of costs - ladder of cost - determination of material cost - labour cost - expenses.

Unit 2

Analysis of overhead expenses, Distribution of overhead costs – depreciation - causes of depreciation - methods of calculating depreciation.

Estimation of machining time, Calculation of machining time for lathe operations-estimation of drilling time on drilling machine - estimation of time for shaping, planning, milling and grinding.

Unit 3

Costing for metal forming and fabrication processes, Estimation of cost in welding-estimation in forging shop - cost estimation of foundry work.

Course Outcomes

15MEC272.1	Identify the various cost elements involved in total cost of the product.
15MEC272.2	Apply appropriate methods for calculating depreciation.
15MEC272.3	Estimate the cost of manufacturing a component by welding, casting and forging operations.
15MEC272.4	Calculate the time taken for various machining operations.

TEXTBOOKS:

1. *Banga T. R. and Sharma S. C. - 'Mechanical Estimating and Costing including Contracting" -Khanna Publishers - 2011*
2. *O. P. Khanna - 'Mechanical Estimating and Costing' – Dhanpat Rai Publishers - 1999*

REFERENCES:

1. *Narang G. B. S and Kumar V. - 'Production and Costing' - Khanna Publishers - 2004*
2. *Adithan M. and Pabla B. S. - 'Production Engineering Estimating and Costing' - Konark Publishers (P) Ltd. - 1998*

15MEC273 QUALITY CONTROL AND RELIABILITY ENGINEERING 3 0 0 3

Unit 1

Introduction: Review of statistics and probability. Quality related costs, contemporary quality engineering philosophy, Quality systems and international standards and 6 Sigma. Control charts for variables: X-bar and R charts, X-bar and S charts;Control charts for individual measurements; Exponentially Weighted Moving Average (EWMA) and Deviation (EWMD) charts.

Unit 2

Control charts for attributes: p, np, c, and u charts Interpretation of control charts. Average Run Length (ARL) Study. Multivariate quality control. Control charts for short production runs, Modified acceptance control charts. Sensitivity analysis - Process capability analysis.

Introduction to Reliability: Concepts and definition of Reliability – Reliability mathematics – failure distributions.

Unit 3

Hazard models – hazard rate function – failure density function – conditional reliability – exponential, Rayleigh, Weibull, Normal and Lognormal distributions – two - parameter exponential and three-parameter Weibull distributions – MTTF, MTBF – design life.

Reliability of simple Systems – Series and parallel configurations – Reliability improvement – redundancy – combined series and parallel systems – High level and low level redundancy – k-out of n system – standby redundancy.

Maintainability – Factors affecting maintainability of systems – Design for maintainability - MTTR – Maintenance – spare provisioning.

TEXTBOOKS:

1. *Montgomery D. C. - 'Introduction to Statistical Quality Control' - John Wiley - 2010*
2. *Ebeling C. - 'An Introduction to Reliability and Maintainability Engineering' - Tata McGraw Hill Publishing Company Ltd. - 2004*

REFERENCES:

1. *Eugene G. L. - 'Statistical Quality Control' - McGraw-Hill - 1996*
2. *Srinath L. S. - 'Concept in Reliability with an Introduction to Maintainability and Availability' - Associated East-West - 1998*
3. *Lewis E. E. - 'Introduction to reliability Engineering' - John Wiley & Sons - 1987*
4. *Rao S. S. - 'Reliability Based Design' - McGraw Hill - 1992*
5. *Barlow R. E., Proselan R. E. and Hunter L. C. - 'Mathematical Theory of Reliability' - John Wiley, New York - 1965*
6. *Halpern S. - 'The Assurance Services, an Introduction to Reality control and Reliability' - Prentice Hall, New*

Jersey - 1977

7. *O'cconer P. D. T. - 'Practical Reliability Engineering' - John Wiley & Sons Ltd. - 2003*

15MEC274 SIMULATION MODELING OF MANUFACTURING SYSTEMS 3 0 0 3

Unit 1

Introduction: Introduction to manufacturing systems – Introduction to simulation – applications – System and System Environment – Types of Simulation - Simulation procedure – Examples of simulation.

Introduction to Simulation softwares.

Probability distributions: Review of basic probability and statistics – Probability distributions – Random number generators – Testing of Random numbers.

Unit 2

Analysis of Simulation input data: Data Collection – Statistical analysis of numerical data – Tests for Independence and Identically distributed data - Distribution fitting
– selecting a distribution in the absence of data – Modelling discrete probabilities – Demonstration of input modelling using Arena Simulation package.

Model Building of Discrete systems: Modelling Paradigms - Modelling of Structural elements and Operational elements – Modelling issues – Model Verification and Validation.

Unit 3

Applications of Simulation in Manufacturing – Manufacturing Modelling Techniques
– Modelling Material Handling system – Model building exercises using Arena - Case study.

Simulation output analysis: Design of Simulation Experiments: Determination of warm up period, Run length, Number of replications - Statistical analysis of simulation output – Terminating and Non-Terminating Simulations – Comparing alternative system designs – Variance reduction Techniques – Simulation Optimization.

TEXTBOOKS:

1. *Law A. W. and Kelton D. W. - 'Simulation Modeling and Analysis' - McGraw Hill - 2010 - 5th Edition*
2. *Kelton D. W., Sadowski R. P. and Sasowski D. A. - 'Simulation with ARENA' - McGraw Hill - 2009*

REFERENCES:

1. *Banks J., Carson J. S., Nelson B. L. and Nicol D. M. - 'Discrete Event System Simulation' - Pearson Education - 2001 - 3rd Edition*
2. *Viswanathan N. and Narahari Y. - 'Performance Modeling of Automated Manufacturing Systems' - Prentice Hall - 1998*

15MEC331 ENGINEERING ECONOMIC ANALYSIS 3 0 0 3

Unit 1

Economics: Nature and scope of managerial economics. Economic theory and managerial economics.

Cost Concepts: Types of costs - Cost functions. Cost controls: reduction – Tools & Areas. Pricing policies - methods. Capital budgeting - cost of capital. Appraising project profitability.

Unit 2

The essentials of demand and supply: The law of demand. Market demand curve. Other determinants of market demand. The law of supply. Determinants of market supply. The market mechanism.Price elasticity of demand.

Profit and revenue maximization: Optimal input combination. Total revenue maximization.

Unit 3

Market structure: Perfect competition and monopoly. Characteristics of monopolistic competition. Oligopoly.

Operations Research techniques in managerial economics: Inventory models. Theory of games. Decision theory, Risk and Uncertainty, Measuring risk, Consumer behavior and risk aversion, Decision making under uncertainty with complete ignorance

Course Outcomes

15MEC331.1	Describe the role of economics in the decision making process and evaluate the cost effectiveness of individual engineering projects
15MEC331.2	Utilize the demand and supply model to analyze real world examples.
15MEC331.3	Appraise different models of the market and its economy.

TEXTBOOKS:

Webster T. J. - 'Managerial Economics- Theory and Practice' - Elsevier - 2004

REFERENCE BOOKS:

1. *Panneerselvam, R. - 'Engineering Economics'– PHI - 2001*
2. *Varshney R. L. and Maheshwari K. L. - 'Managerial Economics' - S .Chand & Sons - 1997 - 13th Edition.*
3. *Harrison B, Smith C. and Davis B. - 'Introductory Economics' – Macmillan - 1992*

15MEC332 ENTERPRISE MANAGEMENT 3 0 0 3

Unit 1

Engineering Economics: cost concepts - types of costs - cost functions. Cost controls: reduction – tools & applications. Pricing policies – methods – problems.

Process design and improvement – process capacity – process layout – process reengineering – job design. Work standards – work measurement – work sampling
– problems.

Unit 2

Supply Chain Management – Basic Concepts, SC dynamics, push-pull boundary, integrated supply chain, logistics, customer relationship, supplier relationship – selection, rating and development, procurement, SC metrics and performance measurement - problems. Lean Manufacturing – concepts, wastes – tools viz., pull system, standardized work, takt time, kanban system, JIT, kaizen, SMED, 5S, value stream mapping, benefits of lean and implementation issues. Introduction to Six Sigma. Plant Location – globalization, factors affecting location decisions, facility location - Break-even method, rectilinear, factor-rating and centre of gravity – problems. Plant Layout – types, process layout, product layout, Systematic layout planning (SLP), Line Balancing problems. Capacity Planning – Aggregate Planning
– importance, planning process, methods – problems.

Unit 3

Role of IT in business performance improvement – e-commerce – e-purchasing – Master Production Schedule, inventory lot sizing strategies, MRP basics – MRPexplosion, Available to Promise (ATP) inventory – MRP calculations – MRP II – Scheduling – Gantt chart – Introduction to ERP – ERP software – ERP modules – ERP implementation.

Course Outcomes

15MEC332.1	Understand the concepts of cost and pricing of goods and appraise project proposals
15MEC332.2	Design and analyze manufacturing and service processes and to measure the work performed.
15MEC332.3	Understand and analyze the key issues of supply chain Management.
15MEC332.4	Understand the application of lean manufacturing tools and six sigma concepts.
15MEC332.5	Select appropriate plant location and their layout methods.
15MEC332.6	Create capacity plan, aggregate plan, schedule, ERP & MRP systems.

TEXTBOOKS:

1. *L. J. Krajewski and L. P. Ritzman - 'Operations Management: Processes and Value Chain' - PHI Pvt. Limited - 2010*
2. *R. L. Varshney & K. L. Maheshwari, 'Managerial Economics' - S Chand & Sons - 1997 - 13th Edition*

REFERENCES:

1. *W. J. Hopp and M. L. Spearman - 'Factory Physics' – McGraw Hill - 2000 - 2nd Edition*
2. *E. S. Buffa and R. K. Sariss - 'Modern Production / Operations Management' - John Wiley 1994 - 8th Edition*
3. *B. Harrison, C. Smith and B. Davis - 'Introductory Economics' – Macmillan - 1992*

15MEC333 FINANCIAL MANAGEMENT 3 0 0 3

Unit 1

Introduction: Financial Management an overview – Financial Decisions in a firm – Goal of FM – Function of the financial system.

Fundamental Valuation Concepts: Time value of money – Risk and Return.

Unit 2

Capital Budgeting: Techniques of capital budgeting investment criteria – NPV – Benefit Cost Ratio – IRR – Payback Period – ARR – Investment appraisal in Practice
– Estimation of Project cost flows.

Unit 3

Working Capital Management: Current Assets – Financing Ruling – Profit Criterion. Cash and Liquidity Management. Working Capital Financing.

Financial Analysis and Planning: Analyzing Financial Performance – Break – even analysis and Leverages – Financial Planning and Budgeting.

Mergers and Takeovers - International trade.

CO1	Apply time value concept of money and used for investment criteria decisions
CO2	Evaluate risk and return for various alternatives of an investment.
CO3	Apply the capital budgeting techniques and estimate the investment decisions
CO4	Utilize working capital management, cash and liquidity management and financial statements.

TEXTBOOK:

Chandra P. - 'Financial Management: Theory and Practice' - TMH - 2001 - 5th Edition

REFERENCES:

1. *Denzi Watson & Antony Head - 'Corporate Finance- Principles and Practice' - Pearson Education Asia, - 2002 - 2nd Edition*
2. *Terry S. Maness - 'Introduction to Corporate Finance' - McGraw Hill Book Company - 1988*
3. *Eugene F. Brigham & Louis C.Gapenski, 'Financial Management: Theory and Practice' - 2010 12th Edition*

15MEC334 INDUSTRIAL ENGINEERING 3 0 0 3

Unit 1

Work System: Elements of work, maintenance of machines, interaction, effect of working conditions and environment, physical and mental fatigue.

Productivity: Productivity, factors affecting production, Measurement of productivity.

Work Study: Definition and scope of work study; Areas of application of work study in industry; Human aspects of work study.

Method Study: Information collection, recording techniques, and processing aids; critical examination; development, installation and maintenance of improved methods.

Unit 2

Motion Economy and Analysis: Principles of motion economy; Motion analysis; Micromotion and Memomotion study; Therbligs and SIMO charts; Normal work area and design of work places; Basic parameters and principles of work design.

Work Measurement: Work measurement techniques; Calculation of standard time, work sampling and predetermined Motion time systems.

Wages and Incentive Schemes: Introduction, wage payment of direct and indirect labour, wage payment plans and incentives, various incentive plans, incentives for indirect labour

Unit 3

Plant Layout: Concept of plant layout, types of layout; factors affecting plant layout, work station design, factors considered in designing a work station.

Material Handling: Introduction and functions of material handling equipment, selection of material handling equipment for different requirements, safety requirements

.

Ergonomics: Ergonomic Design of equipment and work place. Ergonomic Design Standards - Study of development of stress in human body and their consequences. Case Studies.

Course Outcomes

" 15MEC334.1 "	Add value to the organization through appropriate industrial engineering methods and tools.
" 15MEC334.2 "	Develop an integrated system which includes people, materials, information, equipment, and environment
" 15MEC334.3 "	Apply various types of engineering work measurement techniques for analyzing the task.
"15MEC334.4 "	Apply systematic layout planning technique and work design principle based on ergonomics for effective material handling

TEXTBOOKS:

1. *Barnes R. - 'Motion and Time Study' - Design and Measurement of Work. NY: John Wiley and Sons - 1985 - 8th*

Edition

2. *'Introduction to Work Study' - International Labor Office, Geneva - 1992 - 4th Edition*

REFERENCE BOOKS:

1. *Khanna O. P. – 'Industrial Engineering and Management' – Dhanpat Rai and Sons - 2007*
2. *Mahajan M. - 'Industrial Engineering and Production Management' - Dhanpat Rai and Sons Publishers - 2005*

15MEC335 LEAN MANUFACTURING 3 0 0 3

Unit 1

Introduction to Lean and Factory Simulation: History of Lean and comparison to other methods - The 7 Wastes, their causes and the effects - An overview of Lean Principles / concepts / tools - Stockless Production.

The Tools of Lean Manufacturing: Continuous Flow - Continuous Flow Manufacturing and Standard Work Flow - 5S and Pull Systems (Kanban and ConWIP systems) - Error Proofing and Set-up Reduction – Total Productive Maintenance (TPM) - Kaizen Event examples. Toyota production systems, Ford production systems

Unit 2

Value Stream Mapping – Current state: Preparation for building a Current State Value Stream Map - Building a Current State Map (principles, concepts, loops, and methodology) - Application to the factory Simulation scenario.

Unit 3

Value Stream Mapping – Future State: Key issues in building the Future State Map

- Process tips in building the map and analysis of the customer loop, supplier loop, manufacturing loop and information loop - Example of completed Future State Maps
- Application to factory simulation – Implementation of lean practices - Best Practices in Lean Manufacturing.

Course Outcomes

15MEC335.1	Identify key requirements and concepts in lean manufacturing.
15MEC335.2	Utilize the various lean tools in industry to improve the productivity.
15MEC335.3	Predict the value addition using value stream mapping concept.
15MEC335.4	Practice lean manufacturing concepts in industries to enhance the productivity.

TEXTBOOKS:

1. *Womack J. P., Jones D.T. and Roos D. - 'The Machine that Changed the World: the Story of Lean Production' - Simon & Schuster, New York - 1996*
2. *Liker J. K. - 'Becoming Lean' - Industrial Engineering and Management Press - 1998*

REFERENCES:

1. *Womack J. P. and Jones D. T. - 'Lean Thinking' - Simon & Schuster, USA - 1996*
2. *Rother M. and Shook J. - 'Learning to See' - The Lean Enterprise Institute, Brookline, USA*

- 2003

15MEC336 MANAGERIAL STATISTICS 3 0 0 3

Unit 1

Quantitative methods: Basic terminology in probability, probability rules, conditions of statistical dependence and independence, Bayes Theorem, Discrete Random Variables review of probability distributions, measure of central tendency.

Sampling and sampling distributions: Introduction to sampling, random sampling, design of experiments, introduction to sampling distributions.

Estimation: point estimates, interval estimates and confidence intervals, calculating interval estimates of mean from large samples, using t test, sample size estimation.

Unit 2

Testing hypothesis: Introduction, basic concepts, testing hypothesis, testing when population standard deviation is known and not known, two sample tests.

Chi-square and analysis of variance: introduction, goodness of fit, analysis of variance, inferences about a population variation.

Unit 3

Regression and correlation: Estimation using regression line, correlation analysis, finding multiple regression equation, modelling techniques,

Non parametric methods and time series and forecasting: Sign test for paired data, rank sum test, rank correlation, Kolmogrov – smirnov test, variations in time series, trend analysis, cyclic variation, seasonal variation and irregular variation. Decision theory: Decision tree analysis.

TEXTBOOKS:

1. *Levin R. I. and Rubin D. S. - 'Statistics for management' - Pearson Education – 2007 - 5th Edition*
2. *Montgomery D. C. and Runger G. C. - 'Applied Statistics and Probability for Engineers' - John Wiley & Sons - 2002 - 3rd Edition*

REFERENCES:

1. *Bain.L. J. and Engelhardt M. - 'Introduction to Probability and Mathematical Statistics' - Duxbury Press - March 2000 - 2nd Edition*
2. *Hinkelmann K. and Kempthorne O. - 'Design and Analysis of Experiments : Volume I' - John Wiley & Sons, Inc. - December 2007 - 2nd Edition*

3. *Johnson R. A. and Wichern D. W. - 'Applied Multivariate Statistical Analysis' - Prentice-Hall, Inc. - December 2001 - 5th Edition*
4. *Myers R. H. - 'Classical and Modern Regression with Applications' - PWS-Kent Publishing Company - March 2000 - 2nd Edition*
5. *Devore J. L. - 'Probability and Statistics for Engineering and the Sciences' - Brooks/Cole Publishing Company - December 1999 - 5th Edition*
6. *Freund J. E. and Walpole R. E. - 'Mathematical Statistics' - Prentice-Hall Inc. - October 1986 - 4th Edition*

15MEC337 MARKETING MANAGEMENT 3 0 0 3

Unit 1

Marketing Process: Definition, Marketing process, dynamics, needs, wants and demands, value and satisfaction, marketing concepts, environment, mix. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy.

Buying Behaviour and Market Segmentation: Major factors influencing buying behaviour, buying decision process, business buying behaviour. Segmenting consumer and business markets, market targeting.

Unit 2

Product Pricing and Marketing Research: Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

Unit 3

Marketing Planning and Strategy Formulation: Components of marketing plan-strategy formulations and the marketing process, implementations, portfolio analysis, BCG, GEC grids.

Advertising Sales Promotion and Distribution: Characteristics, impact, goals, types, and sales promotions - point of purchase - unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing.

Course Outcomes

15MEC337.1	Illustrate key marketing concepts, theories and techniques for analyzing a variety of marketing situations
15MEC337.2	Identify the dynamic nature of the environment in which marketing decisions are taken and appreciate the implication for marketing strategy determination and implementation
15MEC337.3	Develop the ability to carry out a research project that explores marketing planning and strategies for a specific marketing situation
15MEC337.4	Understand the need and importance of sales promotions and make use of advertising
15MEC337.5	Illustrate the importance of modern trends in retailing and marketing logistics

TEXTBOOKS:

1. *Kolter P. - 'Marketing Management' - Pearson Education - 2014*
2. *Ramasamy and Namakumari, - 'Marketing Environment: Planning, Implementation and Control to the Indian Context' - 1990*

REFERENCES:

1. *Paul G. E. and Tull D. - 'Research for Marketing Decisions' - Prentice Hall of India - 1975*
2. *Tull D. S. and Hawkins - 'Marketing Research' - Prentice Hall of India – 1997*
3. *Kotler P. and Armstrong G. - 'Principles of Marketing' - Prentice Hall of India - 2000*
4. *Skinner S. J. - 'Marketing' - All India Publishers and Distributes Ltd. - 1998*
5. *Govindarajan, M. - 'Industrial Marketing Management' - Vikas Publishing Pvt. Ltd. - 2003*

15MEC338 OPERATIONS MANAGEMENT 3 0 0 3

Unit 1

Process Management: Process design - Process Re-engineering - Job design. Work standards – Work measurement - Work sampling.

Facility location: Plant Location - Factors affecting Location – Globalization. Layout planning – types - Designing of Process layout and Product layout.

Unit 2

Supply Chain Management: Over view – purchasing and distribution – Measures of supply chain performance - Supply chain dynamics.

Quality engineering: TQM, Six sigma concepts - Lean manufacturing, ISO standards.

Unit 3

Forecasting: Forecasting system - Judgment methods, Time series methods.

Capacity Planning: Aggregate planning: Importance – planning process. Material Requirements Planning - Inputs, Factors, Outputs. Master Production Scheduling. Scheduling – Gantt charts.

TEXTBOOKS:

1. *Krajewski L. J. And Ritzman L. P. - 'Operations Management: Strategy and Analysis' - Addison - Wesley Pearson Education Asia - 2010*
2. *Chase B. R. and Aquilano N. J. - 'Production and operations management' – McGraw Hill - 2006 - 7th Edition*

REFERENCES:

1. *Hopp W. J. and Spearman M. L. - 'Factory Physics' – McGraw Hill - 2000 - 2nd Edition*
2. *Buffa E. S. and Sariss R K. -'Modern Production / Operations Management' - John Wiley - 1994 - 8th Edition*

15MEC339 PROJECT MANAGEMENT 3 0 0 3

Unit 1

Foundations of Project Management: Project Life Cycle - Project Environment - Project Selection - Project Proposal - Project Scope - Work Breakdown Structure.

Network Scheduling: Critical Path Method, Project Evaluation & Review Technique - Planning and Scheduling of Activity Networks -Assumptions in PERT Modelling – Time-cost Trade-offs – Linear Programming and Network Flow Formulations - PERT/CPM.

Unit 2

Scheduling with limited resources: Resource Planning - Resource allocation - Project Schedule Compression - Project Scheduling Software. Precedence Diagrams - Decision CPM - Generalized Activity Networks - GERT.

Unit 3

Estimation of Project Costs: Earned Value Analysis. Monitoring Project Progress. Project Appraisal and Selection - Recent Trends in Project Management.

Course Outcomes

15MEC339.1	Appraise the selection and initiation of individual projects and its portfolios in an enterprise.
15MEC339.2	Analyse the project planning activities that predict project costs, time schedule and quality.
15MEC339.3	Develop processes for successful resource allocation, communication and risk management.
15MEC339.4	Evaluate project execution and control techniques that results in successful project completion

TEXTBOOK:

Meredith Jack R. and Samuel J. Mantel Jr. - 'Project Management- A Managerial Approach' - John Wiley - 1995

REFERENCES:

1. *Ted K. - 'Project Management, Tools, and Trade-offs' - John Wiley - 2004*
2. *Samuel J. M. and Meredith J. R. - 'Core Concepts of Project Management' - John Wiley - 2001*

15MEC340 SUPPLY CHAIN MANAGEMENT 3 0 0 3

Unit 1

Introduction: Introduction to SCM - the complexity and key issues in SCM – Location strategy – facility location decisions – single facility and multiple location models.

Logistics: Logistics Network Configuration – data collection - model and data validation - solution techniques - network configuration DSS – Transport strategy
– Service choices: single service and inter modal services – vehicle routing and scheduling models – traveling

salesman problems – exact and heuristic methods.

Unit 2

Inventory: Inventory Management and risk pooling - managing inventory in the SC. Value of Information - bullwhip effect - lead time reduction.

Supply Chain Integration: Supply chain integration - distributed strategies - push versus pull systems.

Distribution Requirements Planning – DRP and demand forecasting, DRP and master production scheduling. DRP techniques – time-phased order point – managing variations in DRP – safety stock determination - Strategic alliances - third party logistics - distribution integration.

Unit 3

Issues in SCM: Procurement and outsourcing strategies – framework of e-procurement. International issues in SCM - regional differences in logistics. Coordinated product and supply chain design - customer value and SCM.

Course Outcomes

15MEC340.1	Analyze the complexity and key issues in supply chain management
15MEC340.2	Evaluate single and multiple facility location problems, logistics network configuration, vehicle routing and scheduling models
15MEC340.3	Analyze inventory management models and dynamics of the supply chain
15MEC340.4	Develop the appropriate supply chain through distribution requirement planning and strategic alliances
15MEC340.5	Identify the issues in global supply chain management, procurement and outsourcing strategies

TEXTBOOK:

1. Simchi D. and Levi - 'Designing and Managing the Supply Chain: Concepts, Strategies and Cases' - McGraw Hill - 2002

2. Christopher M. - 'Logistics and Supply Chain Management: Strategies for Reducing Cost and Improving Service' – PH - 1999

REFERENCES:

1. Ballou M. - 'Business logistics / Supply chain management' - Pearson Education - 2003

2. Vollmann T. E. - 'Manufacturing Planning and Control for Supply Chain Management' - McGraw Hill – 2005 - 5th Edition

15MEC341 TOTAL QUALITY MANAGEMENT 3 0 0 3

Unit 1

Definition of quality - dimensions of quality. Quality planning - quality costs. Total Quality Management: historical review and principles –leadership - quality council - quality statements - strategic planning - Deming philosophy. Barriers to TQM implementation.

Unit 2

Customer satisfaction – Customer retention - Employee involvement - Performance appraisal - Continuous process improvement - Supplier partnership - Performance measures. Seven tools of quality.

Statistical fundamentals - Control Charts for variables and attributes - Process capability - Concept of six sigma - New seven management tools - Benchmarking.

Unit 3

Quality function deployment (QFD) - Taguchi quality loss function - Total Productive Maintenance (TPM) - FMEA.

Need for quality systems - ISO 9000:2000 – Elements of quality systems (such as ISO 9000:2000). Implementation of quality system – documentation - quality auditing - QS 9000-ISO 14000.

TEXTBOOK:

Besterfiled D. H. - 'Total Quality Management' - Pearson Education Asia - 2005

REFERNCES:

1. *Evans J. R, and Lidsay W. M. - 'The Management and Control of Quality' - Southwestern (Thomson Learning) - 2002 - 5th Edition*
2. *Feigenbaum A. V. - 'Total Quality Management - Vol I & II ' – McGraw Hill - 1991*

SCIENCE ELECTIVES

15CHY231 ADVANCED POLYMER CHEMISTRY 3 0 0 3

Unit 1

Newer Polymers and Polymerizations: Polymeric Liquid Crystals - Inorganic and Organometallic polymers - Synthesis and reactions of Phosphorus - Nitrogen polymers - Boron - Silicone polymers. Cyclisation versus Linear Polymerization - Molecular weight control in linear polymerization - Molecular weight distribution in linear polymerization - Molecular weight distributions in nonlinear polymerization - Multichain Polymerization - Metallocene Polymerization.

Unit 2

Solid-state irradiation polymerization - Atom transfer radical polymerization - Plasma Polymerization - Zwitterionic Polymerization - Isomerization polymerization - Polymer supported solid phase reactions - Merrifield method.

Polymer degradation and stabilization: Mechanism of different types of degradation - Commonly used antidegradants and the mechanism of their stabilization.

Unit 3

Polymer solutions: Criteria for solubility - Heat of Dissolution and Solubility parameters - Conformation of polymer

chains in solutions - Nature of polymer molecules in solution - Size and shape of macromolecules in solution - Thermodynamics of polymer solutions - Phase equilibria - Entropy and heats of mixing of polymer solutions - Effect of molecular weight on solubility - Solubility of crystalline and amorphous polymers - Flory Huggins theory of polymer solution, Equation of state theory, Flory Krigbaum theory and cluster type theory - Viscosity of dilute polymer solutions.

TEXTBOOKS:

1. *George Odian, "Principles of Polymerization", John Wiley & Sons Inc., New York, (1991).*
2. *Malcolm P. Stevens, "Polymer Chemistry", Oxford University Press, New York, (1999).*

REFERENCES:

3. *Harry R Allcock and Frederick W Lampe, "Contemporary Polymer Chemistry", 2nd edition, Prentice Hall, Inc., New Jersey, (1990).*
4. *Charles E Carraher, Jr., "Polymer Chemistry", 5th edition, Marcel Dekker Inc., New York, (2000).*
5. *Jayadev Sreedhar and Govariker, "Polymer Chemistry".*

15CHY232 BIOMATERIALS SCIENCE 3 0 0 3

Unit 1

Introduction: Bulk properties, Surface properties and characterization - polymers, silicone biomaterials, medical fibres and biotextiles - Smart polymers - bioresorbable and bioerodible materials - natural materials, metals and ceramics - physicochemical surface modification.

Biocompatibility concepts: Introduction to biocompatibility - cell material interaction – types of materials - toxic, inert, bioactive - long term effects of materials within the body - cell response.

Unit 2

Chemical and biochemical degradation of polymers - degradation of metals and ceramics - calcification of biomaterials.

Host reactions and their evaluation: Inflammation and foreign body response - adaptive immunity - systemic toxicity and hypersensitivity - blood coagulation and blood materials interactions - device related infections.

Unit 3

Biological testing of biomaterials: Invitro and invivo assessment of tissue compatibility - evaluation of blood materials interaction - microscopy in biomaterials.

Practical aspects of biomaterials: Bioelectrodes, biomedical sensors and biosensors - sterilization of implants - implant failure - implant retrieval and evaluation - legal aspects, ethical issues and regulation aspects.

TEXTBOOK:

Buddy D Ratner, Allan S Hoffman, "Biomaterials Science - An introduction to materials in Medicine", Elsevier

academic press, (2004).

REFERENCES:

3. *Jonathan Black, "Biological Performance of Materials: Fundamentals of Biocompatibility", 4th edition, CRC Press, (2006).*
4. *John D. Enderle, Susan M. Blanchard, Joseph D. Bronzino, "Introduction to Biomedical Engineering", 2nd edition, Elsevier Academic Press, 2005.*

15CHY233 CATALYTIC CHEMISTRY 3 0 0 3

Unit 1

Catalysis: Introduction, Industrial applications. Rates of reactions - equilibrium, energy of activation and the catalyst's role, Elementary reactions in catalytic transformations homogeneous and heterogeneous catalysis.

Catalysis in solutions: Acid-base catalysis - catalysis in the gas phase, catalysis in dilute aqueous solution, catalysis in concentrated strong acid solutions, catalysis by bases, catalysis by metal ions, catalysis by electron transfer, organometallic catalysis, catalysis in Ziegler Natta/Metallocene/Metathesis polymerization.

Unit 2

Catalysis by macromolecules, Phase transfer catalysis.

Catalysis by Enzymes: Introduction - kinetics of enzyme catalyzed reaction, catalysis through enzyme, organic catalysis, metalloenzyme catalysis, supported enzymes. Industrial applications of enzyme catalyst.

Catalysis by Polymers: Attachment of catalytic groups to polymer supports, Adsorption and the Kinetics of polymer-catalyzed reactions.

Unit 3

Catalysis in polymer gels, bifunctional and multifunctional catalysis, porous polymers, Applications of polymer catalysis.

Catalysis in Molecular scale cavities: Structures of crystalline solids, structure of Zeolites, catalysis by Zeolites, catalysis by Zeolites containing metal complexes and clusters. Catalysis on surfaces – surface catalysis, catalysis on metal surfaces.

TEXTBOOKS:

1. *Bruce C Gates, "Catalytic Chemistry", John Wiley & Sons, Inc. USA, (1992).*
2. *Viswanathan B, Sivasankar S, Ramaswamy A V, "Catalysis, Principles and Applications", CRC Press, (2006).*

REFERENCES:

1. *James E House, "Principles of Chemical Kinetics", Academic Press, (2007).*

2. *Kuriacose J C, "Catalysis", Macmillan India Limited, New Delhi, (1991).*

15CHY234 CHEMISTRY OF ADVANCED MATERIALS 3 0 0 3

Unit 1

Chemistry of Engineering Plastics: Preparation, properties and applications of ABS, polycarbonates, epoxy resins - polyamides - Nylon and Kevlar.

Chemistry of Carbon nanotubes: Introduction, carbon nanotubes - fabrication, structure, electrical properties – vibrational properties – mechanical properties – applications of carbon nanotubes.

Unit 2

Electron transfer studies in salt based conductors and magnets: Introduction - definitions and units - ferromagnets and ferrimagnets. One-dimensional conductors - quasi one and two-dimensional super conductor. Fullerides - paramagnetic conductors and superconductors. Electron transfer salt based ferromagnets: nitroxide, metallocene and ferric magnet-based ferromagnets - weak ferro magnets. Nanopore containment of magnetic particles - nanocarbon ferromagnets.

Unit 3

Functional electro active polymers: Conjugated polymers - synthesis, processing and doping of conjugated polymers: polyacetylene, polyaniline, polythiophene, poly (p-phenylenevinylene) - ionically conducting polymers - applications of conjugated polymers. Semi-conducting, poly ferrocene - photo resist optical fibers and sensors, photo chromic & thermo chromic materials.

Photochemistry in Electronics: Laws of absorption - quantum efficiency and quantum yield - florescence and phosphorescence – photosensitization.

High energy materials: Preparation, properties and application of ammonium nitrate (AN), NH4NO3, ammonium perchlorate (AP), NH4ClO4, ammonium dinitramide (AND), NH4N(NO2)2, hydrazinium nitroformate (HNF), N2H5C(NO2)3 etc.

TEXTBOOKS:

3. *Van Vlack, Lawrence H, "Elements of Material Science and Engineering", 6th edition, New York Addison, Wesley, (1989).*
4. *Chawla S, "A Textbook of Engineering Chemistry", Dhanpat Rai & Co, Delhi, (2001).*

REFERENCES:

2. *Mark Ratner and Daniel Ratner, 'Nano technology - A gently introduction to the next big idea', Pearson Education, (2003).*
3. *Interrante L. V. and Hampden Smith M.J, 'Chemistry of Advanced Materials', Wiley-VCH, (1988).*

CHEMISTRY OF ENGINEERING MATERIALS 3 0 0 3

15CHY235

Unit 1

Chemical materials in Electronics and Electrical Engineering: Structural correlation to behavior of conducting polymers, Semi-conducting polymers - properties of organic polymers containing metal groups such as poly ferrocene - optical fibers - definition, principle and structure - characteristics of optical fibre - photo resist optical fibre - advantages of optical fibre - liquid crystalline - peizo and pyroelectric polymers - magnetic materials, hard and soft magnets – sensors (voltametric).

Nanomaterials: Nanotubes and Nanowires, Carbon nanotubes, single walled and multiwalled, aligned carbon nanotubes, doping with boron – applications - Nanostructured polymers.

Unit 2

Chemical aspects in biotechnology - Enzymes and bio reactors - Biotechnological processes – Bio-sensors - glucose biosensors, bio-filters and bio-membranes – Bio-fertilizers, Bio-surfactants.

Chemistry of Engineering Plastics: Preparation, properties and applications of ABS, Polycarbonates, Epoxy resins - Polyamides - Nylon and Kevlar.

Photochemistry in Electronics: Photochemical reactions - laws of absorption (Grothers-Draper law - Stark-Einstein's law) - Quantum efficiency - photochemical decomposition of HI and HBr - and Quantum yield.

Unit 3

Florescence and Phosphorescence - chemiluminescence - photo sensitization.

Chemistry of Toxic Materials and Toxicology: Principles of Toxicology - Volatile poisons - Gases CO, hydrocyanic acid - H2S - PH3 - CO2 - SOx - NOx - Heavy metals - lead, arsenic, mercury, antimony, barium, bismuth, selenium, zinc, thallium - Pesticides - Food poisoning - Drug poisoning - barbiturates - narcotics - ergot - LSD - alkaloids - Radioactive Toxicology - Radiation hazards.

TEXTBOOK:

Kuriacose J C, Rajaram, "Chemistry in Engineering and Technology, Systematic Organic and Inorganic Chemistry and Chemistry of Materials (Vol 1 & 2)", Tata McGraw Hill Publishing Company Limited, 1999.

REFERENCE:

Van Vlack, Lawrence H, "Elements of Material Science and Engineering" (6th edition), New York Addison-Wesley, 1989.

15CHY236 CHEMISTRY OF NANOMATERIALS 3 0 0 3

Unit 1

Introduction: Introduction to Nanomaterials: Size dependence of properties - Surface to volume ratio and Quantum confinement. Microscopic techniques to study nano structures - SEM, AFM - TEM and STM - Raman spectroscopy.

Synthesis of Nanomaterials: Synthetic approaches: Colloidal Self-Assembly (Self-assembled monolayers - SAMs) and electrostatic self-assembly, electrochemical methods, sol-gel deposition.

Unit 2

Langmuir-Blodgett (LB) technique, chemical vapour deposition, plasma arcing and ball milling.

Carbon nanostructures: Carbon Clusters: Fullerenes, structure, synthesis, alkali doped C60 - superconductivity in C60, applications of fullerenes. Carbon nanotubes: Classification, properties, synthesis, characterization, and potential applications, growth mechanism of carbon nanotubes.

Other Nanostructures: Quantum Dots: Preparation, properties and applications of Au, CdS and CdSe quantum dots,

Unit 3

Fabrication and applications of conducting polymer nanotubes, TiO2 and metallic nanotubes.

Molecular Electronics and Machines: Molecular electronics: Working of Molecular and supramolecular switches, transistors and wires. Molecular machines: Working of Molecular motors, rotors, cars, elevators and valves.

TEXTBOOKS:

4. *Charles P Poole Jr, Frank J Ovens, "Introduction to Nanotechnology", Wiley Interscience, (2003).*
5. *Alexei Nabok, "Organic and Inorganic Nanostructure", Artech House, Inc. (2005).*
6. *Peter J F Harris, "Carbon Nanotube Science: Synthesis, Properties and Applications", Cambridge University Press, (2009).*
7. *Balzani V, Credi A, Venturi M, "Molecular devices and machines - A journey in to the Nanoworld", Wiley VCH, (2003).*

REFERENCES:

3. *Rao C N R, Muller A, Cheetham A K (Eds.), "The Chemistry of Nanomaterials: Synthesis, Properties and Applications", WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, (2004).*
4. *Zhong Lin Wang, "Characterization of nanophase materials", Wiley VCH, (2000).*
9. *Massimiliano Di Ventra, Stephane Evoy, James R Heflin, "Introduction to nanoscale science and technology", Kluwer Academic Publishers, (2004).*
10. *William A Goddard, III, Donald W Brenner, Sergey Edward Lyshevski and Gerald J. Lafrate, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, (2003).*
11. *Balzani V, Credi A, Venturi M, "Molecular devices and machines- A journey in to the Nanoworld" Wiley VCH (2003).*
12. *Bharat Bhushan, "Hand book of Nanotechnology", Springer, (2004).*

15CHY237 CHEMISTRY OF TOXICOLOGY 3 0 0 3

Unit 1

Introduction to Toxicology: Definition - scope - history - relationship to other sciences - dose-response relationship - sources of toxic compounds - Classes of Toxicants - broad overview of toxicant classes such as metals, agricultural chemicals, food additives - contaminants, toxins, solvents, drugs, and cosmetics - history, exposure route, and toxicity of the non-essential metals - cadmium, lead, and mercury - medical treatment of metal poisoning - classes of agricultural chemicals - Toxins - source, including microbial, fungal, algal, plant and animal - examples - Brief discussions - food additives and contaminants – solvents - therapeutic drugs - drugs of abuse - combustion products - cosmetics.

Unit 2

Exposure Classes, Toxicants in Air, Water, Soil, Domestic and Settings: Occupational Air, water and soil as primary media for human exposure to various classes of chemical toxicants in environmental, domestic, and occupational settings - historic and present status of air pollution and air quality - introduction to the major classes of soil and water pollutants - sources, exposure routes and potential adverse health effects - Classes of occupational toxicants - route of exposure and permissible levels - specific examples of concern.

Unit 3

Toxicant Analysis and Quality Assurance Principles: Introduction to procedures, principles and operation of analytical laboratories in toxicology. Summary of the general policies - analytical laboratory operation, analytical measurement systems, quality assurance (QA) - quality control (QC) procedures.

Environmental Risk Assessment: Environmental risk assessment procedures - particular environmental risk problem - appropriate endpoints - development of conceptual models, analyzing exposure – effects, information - characterizing exposure - ecological effects - management of risks.

Future Considerations for Environmental and Human Health: Changes in toxicology - evaluation of future risk assessment - more fundamental aspects of toxicology - in vivo and in vitro toxicity - biochemical toxicology - molecular toxicology - development of selective toxicants.

TEXTBOOK:

Ernest Hodgson, "Modern Toxicology", John Wiley & Sons, Inc., (2004).

REFERENCES:

2. *John Wright, "Environmental Chemistry", Routledge, (2003).*
3. *A K De, "Environmental Chemistry", New Age International, (2003).*
4. *Fritz Helmet, "Environmental Chemistry", Sarup and sons (Delhi), (2003).*

15CHY238 COLLOIDAL AND INTERFACIAL CHEMISTRY 3 0 0 3

Unit 1

Introduction to surfaces, interfaces and colloids: Molecular origin, Surface phenomena and structure of interfaces, Surfactants structure, colloids in action - shapes and size distribution, Types of interaction forces - Physical and Chemical interaction, Classification of physical forces - Vander Waals force, electrostatic forces.

The Adsorption Phenomena - Structure and Properties of Adsorption Layers at the Liquid-Gas Interface, Principles of adsorption thermodynamics, The Gibbs equation, Structure and properties of the adsorption layers at the air-water interface.

Unit 2

Interfaces between Condensed Phases - W etting, The interfaces between condensed phases in two-component systems, Adsorption at interfaces between condensed phases.

Thermodynamics - Adsorption, energy consideration of physical adsorption vs chemisorptions, Gibbs adsorption equation, Langmuir isotherm, BET isotherm, adsorption at solid-liquid interfaces. Emulsions - formation and stability, HLB number, PIT (Phase Inversion Temperature) foams, aerosols, Microemulsions, vesicles, micelles and membranes - applications of various colloidal systems.

Unit 3

Characterization of Colloids, Rheological properties - Classification, Interfacial rheology, Interfacial tension, Electrochemistry of interfaces - Electric double layer.

Stability of charge stabilized colloids, DLVO theory, Hamaker constant, Boltzmann distribution, Debye length, specific ion adsorption, stern layer, electrostatic, steric and electrosteric stabilization, zeta potential, surface tension, wetting and spreading, contact angle - Young's modulus, practical application - solid surfaces - surface mobility, characteristics and formation.

TEXTBOOKS:

5. D. Myers, "Surfaces, Interfaces and Colloids: Principles and Applications", 2nd Edition, Wiley-VCH, 1999.

6. T. Cosgrove, "Colloid Science: Principles, Methods and Applications", 2nd Edition, Wiley-Blackwell, 2010.

REFERENCES:

10. P. C. Hiemenz and R. Rajagopalan (Editors), "Principles of Colloid and Surface Chemistry", 3rd Edition, Academic Press, New York, 1997.

11. J. W. Goodwin, "Colloids andInterfaces with Surfactants and Polymers", John-Wiley and Sons Ltd, 2004

12. William Harde, "Colloids and Interfaces in Life Sciences", Marshell Dekker Inc. 2003

15CHY239 COMPUTATIONAL CHEMISTRY AND MOLECULAR MODELLING 3 0 0 3

Unit 1

Introduction: Stability, symmetry, homogeneity and quantization as the requirements of natural changes - Born - Haber cycle – Energetic – kinetics - Principles of spectra.

Computational techniques: Introduction to molecular descriptors, computational chemistry problems involving iterative methods, matrix algebra, Curve fitting.

Molecular mechanics: Basic theory - Harmonic oscillator – Parameterization - Energy equations - Principle of coupling - Matrix formalism for two masses - Hessian matrix - enthalpy of formation - enthalpy of reactions.

Introduction to Quantum mechanics - Schrodinger equation - Position and momentum
- MO formation - Operators and the Hamiltonian operator - The quantum oscillator
- Oscillator Eigen value problems - Quantum numbers - labeling of atomic electrons.

Unit 2

Molecular Symmetry: Elements of symmetry - Point groups - Determination of point groups of molecules.

Huckel's MO theory: Approximate and exact solution of Schrodinger equation - Expectation value of energy - Huckel's theory and the LCAO approximation - Homogeneous simultaneous equations - Secular matrix - Jacobi method - Eigen vectors: Matrix as operator - Huckel's coefficient matrix - Wheeland's method - Hoffmann's EHT method - Chemical applications such as bond length, bond energy, charge density, dipole moment, Resonance energy.

Unit 3

Self consistent fields: Elements of secular matrix - Variational calculations - Semi empirical methods - PPP self consistent field calculation - Slater determinants - Hartree equation - Fock equation – Roothaan - Hall equation - Semi empirical models and approximations.

Ab-initio calculations: Gaussian implementations – Gamess - Thermodynamic functions - Koopman's theorem - Isodesmic reactions, DFT for larger molecules - Computer aided assignments/mini projects with softwares - Introduction to HPC in Chemical calculations.

Molecular modelling software engineering - Modeling of molecules and processes - Signals and signal processing in Chemistry - QSAR studies and generation of molecular descriptors - Applications of chemical data mining - Familiarization with open source softwares useful for molecular modeling - Introduction to molecular simulation - M.D. simulation.

Course Outcome

CO01: Get to understand the structure of molecules using symmetry.
CO02: Understanding Quantum mechanical approach to calculate the energy of a system.
CO03: Applying mathematical knowledge and quantum mechanical approach in finding out the characteristics-reactivity, stability, etc., of the molecule.
CO04: To get a brief idea about molecular mechanics based chemical calculations.
CO05: To get an idea about general methodology of molecular modeling.

TEXTBOOKS:

5. *K. I. Ramachandran, G Deepa and K Namboori, "Computational Chemistry and Molecular Modeling - Principles and Applications", Springer-Verlag, Berlin, Heidelberg, 2008, ISBN-13 978-3-540-77302-3.*
6. *Donald W Rogers, "Computational Chemistry Using PC", Wiley, (2003).*
7. *Alan Hinchliffe, "Chemical Modeling from atoms to liquids", Wiley, (2005).*

REFERENCES:

2. *James B Forseman and Aeleen Frisch-Gaussian, "Exploring Chemistry with Electronic Structure Method", Inc., Pittsburgh, PA, 2nd edition, (2006).*
3. *A C Philips, "Introduction to Quantum mechanics", Wiley, (2003).*
4. *Wolfram Koch, Max C. Holthausen, "A Chemist's guide to Density Functional Theory", Wiley, VCH, 2nd edition, (2001).*

15CHY241 ELECTROCHEMICAL ENERGY SYSTEMS 3 0 0 3 AND PROCESSES

Unit 1

Background Theory: Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicator and ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler-Volmer equation - Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafel plots - exchange current density and transfer coefficients.

Unit 2

Batteries: Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air, zinc-silver oxide batteries; lithium primary cells - liquid cathode, solid cathode and polymer electrolyte types and lithium-ferrous sulphide cells (comparative account).

Secondary batteries: ARM (alkaline rechargeable manganese) cells, Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultra thin lithium polymer cells (comparative account). Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries.

Unit 3

Reserve batteries and Fuel cells: Reserve batteries - water activated, electrolyte activated and thermally activated batteries - remote activation - pyrotechnic materials. Fuel Cells:Principle, chemistry and functioning - carbon, hydrogen-oxygen, proton exchange membrane (PEM), direct methanol (DMFC), molten carbonate electrolyte (MCFC) fuel cells and outline of biochemical fuel cells.

Electrochemical Processes: Principle, process description, operating conditions, process sequence and applications of Electroforming – production of waveguide and plated through hole (PTH) printed circuit boards by electrodeposition; Electroless plating of nickel, copper and gold; Electropolishing of metals; Anodizing of

aluminium; Electrochemical machining of metals and alloys.

Course Outcomes

CO01: Understand the fundamental concepts of electrochemistry through electrode potential and reaction kinetics
CO02: Learn the application of the electrochemical principles for the functioning and fabrication of industrial batteries and fuel cells
CO03: Acquire knowledge in solving numerical problems on applied electrochemistry
CO04: Analysis and practical problem solving in fabrication of batteries and fuel cells
CO05: Application of concepts and principle in industrial electrochemical processes
CO06: Evaluation of comprehensive knowledge through problem solving

TEXTBOOKS:

2. *Derek Pletcher and Frank C. Walsh, "Industrial Electrochemistry", Blackie Academic and Professional, (1993).*
3. *Dell, Ronald M Rand, David A J, "Understanding Batteries", Royal Society of Chemistry, (2001).*

REFERENCES:

2. *Christopher M A, Brett, "Electrochemistry – Principles, Methods and Applications", Oxford University, (2004).*
3. *Watanabe T, "Nano-plating: microstructure control theory of plated film and data base of plated film microstructure", Elsevier, Oxford, UK (2004).*
4. *Kanani N, "Electroplating and electroless plating of copper and its alloy", ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).*
5. *Lindon David, "Handbook of Batteries", McGraw Hill, (2002).*
6. *Curtis, "Electroforming", London, (2004).*
7. *Rumyantsev E and Davydov A, "Electrochemical machining of metals", Mir, Moscow, (1989).*

15CHY242 ENVIRONMENTAL CHEMISTRY 3 0 0 3

Unit 1

Air and air pollution (earth's atmosphere): Regions - ozone - CFC and other chemicals - catalytic decomposition of ozone - 'ozone hole' formation - Air pollution due to gas emission from industries - Atmospheric aerosols – dust, combustion products, aerosol concentration and lifetimes - Automobile exhausts, smog and effects - Acid rain - chemistry of acid rain, roll of meteorology, greenhouse gases and global warming - air pollution due to jet engines.

Water and water pollution (hydrosphere): Physical and chemical properties of water - microbiological processes - carbon, nitrogen cycles - Water pollution - polluting agents - indices of pollution, heavy metal pollution and toxicity - BOD and COD determination - suspended solids - determination of other ions by photometric methods - Chemistry of anaerobic process, use of Effective Microorganisms.

Unit 2

Aerobic processes - wastewater treatment systems (brief description only) - anaerobic and aerobic - sewage treatment,

primary, secondary and tertiary processes - water reuse and recycle. Eutrophication of lakes, nitrogen and phosphorus in effluents - Drinking water standards - sources - fluoride and arsenic in water, purification, sterilization - chemistry of chlorination - water purification for domestic use - reverse osmosis - nano filters and membranes.

Industrial Pollution and its control: Industrial pollution and waste waters from various types of industries - environmental pollution due to paper mills, textile mills etc., and its control. Solid waste disposal - methods - solid waste from mining and

metal production and its disposal - Electrochemical treatment of pollution control, electro-coagulation and flocculation - Green chemical processes and green solvents - reaction conditions to control industrial pollution.

Unit 3

Other types of pollution: Soil pollution - agricultural pollution - use of chemical fertilizers - Organic chemicals and environment, dioxins and furans - chemistry of some of the pesticides, insecticides and herbicides, ill effects due to uncontrolled use - Bulk storage of hazardous chemicals and disasters, Radioactive pollution, radiation units, sources - exposure and damage - safety standards - radioactive wastes and their disposal - Toxicological substances, testing of toxic substance, enzyme inhibition and biochemical effects of toxic chemicals on humans.

Sampling and Measurements of Pollutants: Sampling and analysis techniques of air pollutants (brief outline only) - analysis of particulate matter and lead - Sampling and measurements of water pollutants - organic loadings, phosphates and nitrogen compounds - monitoring of water quality - water test kits, various analytical methods (brief outline only).

TEXTBOOKS:

2. *Gary W. Van Loon and Stephen J. Duffy, "Environmental Chemistry", Oxford University Press, (2000).*
3. *Ajay Kumar Bhagi and G. R. Chatwal, "Environmental Chemistry", Himalaya Publishing House, (2003).*

REFERENCES:

1. *John Wright, "Environmental Chemistry", Routledge, (2003).*
2. *A K De, "Environmental Chemistry", New Age International, (2003).*
3. *Fritz Helmet, "Environmental Chemistry", Sarup and sons (Delhi), (2003).*
4. *Clair N Sawyer, Perry L McCarty and Gene F Parkin, "Chemistry for Environmental Engineering", McGraw Hill, (1994).*
5. *Jack Barrett, "Chemistry in your Environment", Albion Publishing Ltd., (1994).*
6. *Thomas G Spiro and William M Stigliani, "Chemistry of the Environment", Prentice Hall, (2002).*
7. *Kudisia V P and Ritu, "Environmental Chemistry", Pragati Prakashan, Meerut, (2000).*

15CHY243 FUELS AND COMBUSTION 3 0 0 3

Course Objectives: To provide the basic knowledge about fuels, rocket propellants and explosives.

Course Outcomes

CO01: Understand the types of fuels and variation in their properties

CO02: Able to analyze the fuel content

CO03: Obtain knowledge in identifying a proper fuel as per the requirement

CO04: Ability to know the preparation and working of propellants and explosives

Skill: This course enables the student to gain skill in identifying fuel, analyzing and categorize the application of it.

Unit 1

Fuels - Solid fuels - Classification, preparation, cleaning, analysis, ranking and properties - action of heat, oxidation, hydrogenation, carbonization, liquefaction and gasification.

Liquid fuels – Petroleum - origin, production, composition, classification, petroleum processing, properties, testing - flow test, smoke points, storage and handling.

Secondary liquid fuels - Gasoline, diesel, kerosene and lubricating oils. Liquid fuels - refining, cracking, fractional distillation, polymerization. Modified and synthetic liquid fuels. ASTM methods of testing the fuels.

Unit 2

Gaseous fuels - Types, natural gas, methane from coal mine, water gas, carrier gas, producer gas, flue gas, blast furnace gas, biomass gas, refinery gas, LPG - manufacture, cleaning, purification and analysis. Fuels for spark ignition engines, knocking and octane number, anti knock additives, fuels for compression, engines, octane number, fuels for jet engines and rockets.

Flue gas analysis by chromatography and sensor techniques.

Unit 3

Combustion: Stochiometry, thermodynamics. Nature and types of combustion processes - Mechanism - ignition temperature, explosion range, flash and fire points, calorific value, calorific intensity, theoretical flame temperature. Combustion calculations, theatrical air requirements, flue gas analysis, combustion kinetics – hydrogen - oxygen reaction and hydrocarbon - oxygen reactions.

Rocket propellants and Explosives - classification, brief methods of preparation, characteristics; storage and handling.

TEXTBOOK:

Fuels and Combustion, Samir Sarkar, Orient Longman Pvt. Ltd, 3rd edition, 2009.

REFERENCE:

1. Fuels - Solids, liquids and gases - Their analysis and valuation, H. Joshua Philips, Biobliolife Publisher, 2008.

2. *An introduction to combustion: Concept and applications - Stephen R Turns, Tata Mc. Graw Hill, 3rd edition, 2012.*
3. *Fundamentals of Combustion, D P Mishra, 1st edition, University Press, 2010*
4. *Engineering Chemistry - R. Mukhopadhyay and Sriparna Datta, Newage International Pvt. Ltd, 2007.*

15CHY244 GREEN CHEMISTRY AND TECHNOLOGY 3 0 0 3

Objectives

1. Understand the principles of green chemistry and its contribution to the development of sustainable products
2. Possess knowledge of the migration from a hydrocarbon-based economy to carbohydrate-based economy
3. Evaluate the deficiencies of traditional process and acknowledge the invent of new processes
4. Distinctly map the culmination of academic research to industrial chemistry

Course Outcomes

CO01: Understand the evolving concept of Green Chemistry and its application to the manufacture of sustainable products

CO02: Appreciate the need for Renewable energy and Feed stock along with carbon sequestration through the fundamentals of Green Chemistry Techniques

CO03: Develop a coherence to evaluate systematic deficiencies in traditional Chemical science process and products

CO04: Undertake a purposeful Journey through the microscopic domain of academic research to the macroscopic domain of Industrial chemistry

Unit 1

Our environment and its protection, chemical pollution and environmental regulations, environmental chemistry, pollution prevention strategies, challenges to the sustainability of chemical industry, Pollution Prevention Act 1990, USA, Green Chemistry and its 12 principles, toxicity of chemicals, material safety data sheet (MSDS), concept of zero pollution technologies, atom economy, functional toxicity vs non-functional toxicity, alternative solvents, energy minimization, microwave and sonochemical reactions, renewable feed stock, carbon dioxide as a feed stock.

Unit 2

Greener strategies of the synthesis of ibuprofen synthesis, teriphthalic acid etc. phase behaviour and solvent attributes of supercritical CO2, use of supercritical carbon dioxide as a medium chemical industry, use of ionic liquids as a synthetic medium, gas expanded solvents, superheated water, etc. Synthesis of various chemicals from bio mass, polycarbonate synthesis and CO2 fixation, green plastics, green oxidations, etc.

Unit 3

Processes involving solid catalysts – zeolites, ion exchange resins, Nafion/silica nano composites and enhanced activity. Polymer supported reagents, green oxidations using TAML catalyst, membrane reactors. Green chemistry

in material science, synthesis of porous polymers, green nanotechnology.

REFERENCES:

8. Hand Book of Green Chemistry and Technology; by James Clarke and Duncan Macquarrie; Blakwell Publishing.

9. Anastas, P. T., Warner, J. C. Green Chemistry: Theory and Practice, Oxford University Press Inc., New York, 1998.

10. Matlack, A. S. Introduction to Green Chemistry Marcel Dekker: New York, NY, 2001.

15CHY245 INSTRUMENTAL METHODS OF ANALYSIS 3 0 0 3

Unit 1

Error Analysis and Sampling: Accuracy - Precision - Classification of Errors - Minimization of errors - Standard deviation - Coefficient of variance - F-test - t-test - Significant figures. Sampling - Basis of sampling, Sampling and physical state - Safety measures of sampling.

Separation Techniques: Brief out line of column, paper and thin layer chromatography - Ion exchange methods - principle and application – HPLC.

Unit 2

Gas chromatography - principle and applications – gel chromatography.

Electroanalytical techniques: Potentiometry - Potentiometric titration - determination of equivalence point - acid base, complexometric, redox and precipitation titrations - merits and demerits. Voltammetry - Cyclic voltammetry - basic principle and application - Polarography - introduction - theoretical principles - migration current - residual current - half wave potential - instrumentation - analytical applications.

Unit 3

Spectro-chemical techniques: UV-VIS spetrophotometry - principle - Beer's Law application - photometric titration - single and double beam spectrophotometer - instrumentation of IR - sample handling - IR applications - H - NMR - Instrumentation and applications - principle - instrumentation - applications of atomic absorption spectroscopy.

Thermal and Diffraction techniques: Principles and applications of DTG - DTA - DSC - X-ray - Electron Diffraction Studies - SEM, TEM.

Course Outcome

CO01: To develop an understanding of principle and working of the range of instrumental methods in analytical chemistry

CO02: To provide an understanding and skills in contemporary methods of separation and appropriate selection of instruments for the successful analysis of chemical compounds

CO03: To impart skills in the scientific method of planning, conducting, reviewing, reporting experiments and

problem solving in chemical analysis.

TEXTBOOKS:

1. *Willard H W, Merritt J R, "Instrumental Methods of Analysis", 6th edition, Prentice Hall, (1986).*
2. *Skoog Douglas A, West Donald, "Fundamentals of Analytical Chemistry", 7th edition, New York Addison, Wesley, (2001).*

REFERENCES:

1. *"Vogel's Textbook of Quantitative Chemical Analysis", 5th edition, ELBS, (1989).*
2. *Kaur. H, "Instrumental Methods of Chemical Analysis", Goel Publisher, (2001).*

15CHY246 MEDICINAL ORGANIC CHEMISTRY 3 0 0 3

Unit 1

Medicinal Chemistry: Introduction, drugs - classification of drugs - mechanism of drug action. Drug-receptor complex nomenclature - agonist, antagonist.

Physicochemical properties in relation to biological action: solubility, partition coefficient, dissociation constant, hydrogen bonding, ionization, drug shape, surface activity, complexation, protein binding, molar refractivity, bioisosterism - Stereo chemical aspects of drug action-stereo isomerism-optical isomerism.

Unit 2

Enzymes and hormones: Enzymes - nomenclature, classification and characteristics of enzymes - mechanism of enzyme action, factors affecting enzyme action, cofactors and co-enzymes, enzyme inhibition, enzymes in organic synthesis. Hormones and vitamins - representative cases.

Medicinal agents from natural products: Natural products as therapeutic agents, medicinal plants, animal products as medicine, isolation methods of alkaloids, terpenes, anti-oxidants.

Unit 3

Medicinal agents: Medicinal agents belonging to steroids, polypeptides, modified nucleic acid bases, sulphonamide and sulpha drugs, antibiotics, antifungal, antiseptics and disinfectants, anaesthetics, antihypertensive drugs, analgesics, histamine and anti-histamine agents.

TEXTBOOKS:

1. *Rama Rao Nadendla, "Principles of Organic Medicinal Chemistry", 1st edition, New age internationals (P) limited, (2005).*
2. *Thomas Nogrady and Donald F. Weaver, "Medicinal chemistry: A Molecular and Biochemical Approach", 3rd edition, Oxford university press, (2005).*

REFERENCES:

1. *Wilson C O, Gisvold O and Deorge R F, "Text book of organic, medicinal and Pharmaceutical chemistry", 7thedition, J.B.Lippincott company, Philadelphia, (1977).*
2. *Burger A, "Medicinal Chemistry", 3rdedition, Wiley Interscience, Newyork, (1970).*
3. *Graham L P, "An Introduction to Medicinal Chemistry", 3rdedition, Oxford university Press, (2005).*

15CHY247 MODERN POLYMER COMPOSITES 3 0 0 3

Unit 1

General introduction to composite materials: Concept and definition, classification of composites (CMC, MMC, PMC). Functional roles of reinforcement and matrix and importance of interface. Polymer matrix composites (PMCs): Fiber reinforced and particulate filled polymer composites. Reinforcements (glass, carbon/graphite, Kevlar), Matrices - Thermoset matrices - polyesters, epoxides, phenolics, vinyl esters, polyimides, cyanate esters - Thermoplastic matrices. Choice of reinforcements and matrices for different application needs.

Unit 2

Fiber reinforced polymer composites (FRPs): Basic rule of mixtures, stress-strain relationships. Tailoring of structural properties through laminar-sequencing and choice of fiber fractions/fiber orientations, to meet design requirements. Mechanical behavior of FRP composites: Fiber controlled and matrix dependent properties. Fibre volume fraction, tensile, shear, compressive, flexural, thermo elastic and off
– axis responses of lamina and laminates - notched strength – fracture toughness - nondestructive testing. Effect of environmental conditions on properties.

Unit 3

Composite precursors: SMCs, DMCs, BMCs prepreg materials and their choice in specific applications. Fabrication processes for FRP Composites: hand layup, spray up, vacuum bag moulding, compression moulding, filament winding, braiding, pultrusion, RTM, RIM, RRIM, RFI, autoclave moulding, injection moulding etc. Room temperature and hot curing of composites, Nanocomposites: Introduction; Nanoscale Fillers – Clay, POSS, CNT, nanoparticle fillers; Processing into nanocomposites; Modification of interfaces; Properties. Applications. Joining composite elements and repairs, Recycling of polymer composites.

TEXTBOOKS:

1. *B. Astrom, "Manufacturing of Polymer Composites", CRC Press, 1997.*
2. *P K Mallick, "Fiber-Reinforced Composites: Materials, Manufacturing, and Design", CRC Press, 2007.*

REFERENCES

1. *F. C. Campbell (Ed), Manufacturing processes for advanced composites, Elsevier, 2004.*
2. *S T Peters (Ed.), "Handbook of Composites", Springer, 1998.*

ORGANIC REACTION MECHANISMS 3 0 0 3

15CHY248

Unit 1

Introduction to organic chemistry: Lewis structure and formal charges of organic compounds - electro negativities and dipoles, resonances, aromaticity and anti aromaticity - equilibrium, tautomerism and hyper conjugation - acidity and basicity - pKa, nucleophiles and electrophiles - hydrogen bonding - different types of organic reaction - addition, substitution, elimination and rearrangement - oxidations and reductions - general principles of writing organic reaction mechanism - reactive intermediates.

Reaction of nucleophiles and bases: Nucleophilic substitution - SN1 and SN2 reactions, nucleophilic substitution at aliphatic sp2 carbon and aromatic carbon - nucleophilic addition to carbonyl compounds - addition of grignard and organo lithium reagents - reactions of nitrogen containing nucleophiles with aldehyde and ketones - aldol condensation.

Unit 2

Michael and 1,4-addition reaction - Favorskii rearrangement - benzilic acid rearrangement - reaction mechanism in basic media - Mannich reaction - enols and enolates.

Reaction involving acids and other eletrophiles: Carbocations - formation and rearrangements - cationic rearrangement involving electron deficient nitrogen atom - Beckmann rearrangement - Curtius, Lossen and Schmidt rearrangement - electrophilic additions - acid catalyzed reaction of carbonyl compounds - hydrolysis of carbocyclic acid derivatives - electrophilic aromatic substitution - carbenes and benzynes - Baeyer-Villeger reactions - Dienone-phenol rearrangement - pinacol rearrangement.

Unit 3

Radical and radical ions: Formation of radicals, radical chain processes, radical addition, reaction with and without cyclisation - fragmentation reaction - rearrangement of radicals - SRN 1 reaction - radical ions - Birch reduction - Hofmann-Loffler-Freytag reaction - Barton reaction - McMurry reaction.

Pericyclic reaction: Representative of molecular orbitals of ethylene, butadiene and hexatriene molecules - Woodward - Hofmann rules of symmetry - electrocyclic reaction, cycloadditions - diels-Alder reaction - other thermal cycloadditions - photochemical [2+2] cycloaddition - 1,3-dipolar cycloadditions - Sigmatropic reactions, notations and directions of [3,3] sigmatropic rearrangements - Cope and oxy-Cope rearrangement [2,3] sigmatropic reaction - ene reaction.

TEXTBOOK:

Jerry March, "Advanced Organic Chemistry", 4th edition, John Wiley & Sons, (1992).

REFERENCES:

1. *Carey F and Sundberg R, "Advanced Organic Chemistry - Part A & B", Kluwer, (2000).*
2. *Peter Sykes, "Organic reaction mechanism", 6th edition, Pearson education (Singapore) Pte. Ltd., (2005).*
3. *Michael B.Smith, "Organic Synthesis", 2nd edition, McGraw Hill, (2004).*

15CHY249 ORGANIC SYNTHESIS AND STEREOCHEMISTRY 3 0 0 3

Unit 1

Nomenclature of Organic compounds: Polyenes, Alkynes with and without functional groups by IUPAC nomenclature. Aromatic and Heteroaromatic systems - nomenclature of heterocycles having not more than two hetero atoms such as oxygen, sulphur, nitrogen.

Stereochemistry: Tacticity, R/S system of nomenclature of central and axial molecules.

Unit 2

Atropisomerism - isomerism of biphenyls - allenes and spiranes - ansa compounds - Geometrical isomerism, E, Z Isomerism. Asymmetric synthesis.

Conformational Analysis: Optical activity and chirality - Conformational Analysis of cyclic and acyclic system - Conformational effects on reactivity of acyclic systems only.

Unit 3

Asymmetric synthesis: Stereo selective - Stereo specific - Regioselective and Regiospecific reactions. Principle of protection of alcohol, amine, carboxyl and carbonyl groups - Functional group inter conversions - Disconnection approach - Reversal of polarity - reagents in synthesis.

TEXTBOOKS:

1. E. L. Eliel, "Stereochemistry of Carbon Compounds", McGraw Hill Book Co, (2000).

2. Jerry March, "Advanced Organic Chemistry", 4th edition, John Wiley & Sons, (1992).

REFERENCES:

1. S. Warren, "Designing Organic Synthesis", Wiley & Sons, (1998).

2. Finar I. L, "Organic Chemistry: Stereochemistry and the Chemistry of Natural Products", 5th edition, ELBS, (2000).

15CHY250 POLYMER MATERIALS AND PROPERTIES 3 0 0 3

Unit 1

Structure of polymers – thermoplastic, thermoset, rubber - Linear, branched, crosslinked, and network polymers – polymerization types – addition, condensation, mechanism, methods – bulk, solution, suspension and emulsion - crystalline, amorphous, orientation – molecular weight – intermolecular forces, solubility parameter- glass transition temperature.

Unit 2

Manufacturing, mechanical, thermal, electrical and chemical properties and applications of commodity plastics - PE, PP, PVC, PS, Engineering plastics - ABS, PC, PMMA, polyamide, polyacetal, PET, PBT, PTFE, High performance

polymer - PES, PEI, PEEK, conducting polymer.

Unit 3

Thermoset materials - PF, UF, MF, epoxy and unsaturated polyester resin, Rubber - natural rubber, synthetic rubber - SBR, PB, nitrile, chloroprene, butyl, silicone - compounding and additives.

TEXTBOOKS:

1. *J. A. Brydson, "Plastics Materials" Butterworth-Heinemann – Oxford, 7th Ed., London, 1999*
2. *Maurice Morton, "Rubber Technology", 3rd Ed, Kluwer Academic Pub, Dordrecht, Netherlands, 1999*
3. *ManasChanda and Salil K. Roy, "Plastics Technology Handbook", CRC Press, Atlanta, 2007*

REFERENCE BOOKS:

1. *D. W. Van Krevelena and P.J. Hoftyzen, "Properties of Polymer", 3rd Edition Elsevier Scientific Publishing Company Amsterdam – Oxford – Newyork. 1990.*
2. *Jozef Bicerano, "Prediction of Polymer Properties", Second Edition, Marcel Dekker Inc. New York,1995.*

15CHY251 POLYMERS FOR ELECTRONICS 3 0 0 3

Unit 1

Conducting polymers: Conducting mechanisms - Electron transport and bipolar polymers - electrodepositable resists, resins. Applications - Organic light emitting diodes, Sensors, EMI shielding, printed Circuit Boards, Artificial nerves, Rechargeable Batteries, Electromechanical Actuators and switches.

Unit 2

Photoconductive polymers: Charge carriers, charge injectors, charge transport, charge trapping. Polymers for optical data storage - principles of optical storage, polymers in recording layer.

Nonlinear optics: NLO properties and NLO effects, wave guide devices, polymer optical fibers - through plane modulators.

Unit 3

Thermosensitive polymers: Applications - Mechanical actuators and switches - Tissue culture, Drug delivery, Photo resists - Types - Chemically amplified photoresists - Applications. Magnetic polymers - structure and Applications.

Liquid crystalline polymers: Fundamentals and process, liquid crystalline displays - Applications.

TEXTBOOK:

Kiichi Takemoto, Raphael M. Ottenbrite, Mikiharu Kamachi, "Functional Monomers and Polymers", CRC Press, (1997).

REFERENCES:

1. *A B Kaiser, "Electronic properties of conjugated polymers - basics, models and applications", Springer Verlag, (1987).*
2. *J. A. Chilton and M T Goosy, "Special polymers for electronics and optoelectronics", Kluwer Academic Publishers, (1995).*

15CHY252 SOLID STATE CHEMISTRY 3 0 0 3

Unit 1

Symmetry in Crystal Systems: Types of symmetry, plane, axis and centre of symmetry, crystal systems and symmetry elements. Law of rational indices, miller indices, Weiss indices - plane systems, space lattices, unitcells - unitcell dimension, determination. Space lattice - definition and types Bravais lattice - kinds of bravais lattices, number of atoms in SC, BCC, FCC lattices, void space, Radius ratio rule and application. Crystal defects - types of defects in crystals - stoichiometric defect - schottky and frenkel defects - Non-stoichiometric defects - metal excess and metal deficiency defects, influence of defects on the properties of solids.

Unit 2

Electrical and Magnetic Properties: Development of free electron theory to band theory of solids - metals and their properties; semiconductors - extrinsic and intrinsic, Hall effect; Insulators - dielectric, ferroelectric, pyroelectric and peizoelectric properties and the relationship between them. Dia, para, ferro, ferri, antiferro and antiferri magnetic types - selected magnetic materials such as spinels, garnets and perovskites, superconductors.

Diffraction Methods: X-ray diffraction - various methods of X-ray analysis of structure-ray diffraction pattern, X-ray scattering factor. Results and uses of X-ray diffraction. Limitations of X-ray diffractions.

Unit 3

Neutron diffraction - principles, electron diffraction patterns, limitations - applications of electron diffraction - structural elucidation. Distinction between X-ray, Neutron and electron diffraction. Structure factor - definition, factors influencing structure factor. Uses of structure factor.

Fourier synthesis - definition, applications of fourier synthesis in crystal structure analysis of S-Tetrazine. Structure of Rutile, Fluorite, Antifluorite, Zinc blende, Wurtzite, diamond and graphite.

REFERENCES:

1. *Cotton F. A, Wilkinson G and Gaus P, "Basic Inorganic Chemistry", 3rd edition, John Wiley and Sons, (2003).*
2. *Shriver D. F and Atkins P. W, "Inorganic Chemistry", 3rd edition, ELBS, Oxford University Press, Oxford, (2004).*
3. *Huheey J. E, Keiter E. A and Keiter R. L, "Inorganic Chemistry", 4th edition, Addison-Wesley Pub. London, (1993).*
4. *Cotton F. A, Wilkinson G, Murillo C. A and Bochmann M, "Advanced Inorganic Chemistry", 6th edition, John Wiley and Sons, New York, (2003).*
5. *Jolly W. L, "Modern Inorganic Chemistry", 2nd edition, McGraw-Hill, Inc., (1991).*

6. Miessler G. L and Tarr D. A, "Inorganic Chemistry", 3rd edition, Pearson Education, Singapore, (2004).

15CHY331 BATTERIES AND FUEL CELLS 3 0 0 3

Course Objective: To provide sound knowledge on the application of electrochemistry in energy storage systems.

Course Outcome

CO01: Understand the fundamental concepts of electrochemistry through electrode potential and reaction kinetics
CO02: Learn the application of the electrochemical principles for the functioning and fabrication industrial batteries and fuel cells
CO03: Analysis of practical problem solving in fabricating batteries and fuel cells
CO04: Evaluation of comprehensive knowledge through problem solving

Unit 1

Background Theory: Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicator and ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler-Volmer equation - Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafel plots - exchange current density and transfer coefficients.

Unit 2

Batteries: Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air batteries; Lithium primary cells - liquid cathode, solid cathode and lithium-ferrous sulphide cells (comparative account).

Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultrathin lithium polymer cells (comparative account). Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries.

Unit 3

Fuel Cells: Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspectsof the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells.

Membranes for fuel cells: Nafion – Polymer blends and composite membranes; assessment of performance – recent developments.

Fuels for Fuel Cells: Hydrogen, methane, methanol - Sources and preparation, reformation processes for hydrogen – clean up and storage of the fuels – use in cells, advantages and disadvantages of using hydrogen as fuel.

TEXTBOOKS:

1. *Dell, Ronald M Rand, David A J, 'Understanding Batteries', Royal Society of Chemistry, (2001).*
2. *M. Aulice Scibioh and B. Viswanathan 'Fuel Cells – principles and applications', University Press, India (2006).*

REFERENCES:

1. *Kanani N, 'Electroplating and electroless plating of copper and its alloy', ASM International, Metals Park, OH and Metal Finishing Publications,Stevenage, UK (2003).*
2. *Curtis, 'Electroforming', London, (2004).*
3. *F. Barbir, 'PEM fuel cells: theory and practice', Elsevier, Burlington, MA, (2005).*
4. *G. Hoogers, 'Fuel cell handbook', CRC, Boca Raton, FL, (2003).*

15CHY332 CORROSION SCIENCE 3 0 0 3

Unit 1

Basic principles: Free energy concept of corrosion - different forms of corrosion - Thermodynamic & Kinetic aspects of corrosion: The free energy criterion of corrosion possibility - Mechanism of Electrochemical corrosion - Galvanic and Electrochemical series and their significance.

Corrosion Control: Materials selection - metals and alloys - metal purification - non metallic - changing medium.

Unit 2

Anodic and cathodic protection methods - Coatings - metallic and other inorganic coatings - organic coatings - stray current corrosion - cost of corrosion control methods.

Corrosion protection by surface treatment: CVD and PVD processes - Arc spray - Plasma spray - Flame spray.

Corrosion Inhibitors: Passivators - Vapour phase inhibitor.

Unit 3

Stress and fatigue corrosion at the design and in service condition - control of bacterial corrosion.

Corrosion protection: Automobile bodies – engines – building construction.

Course Outcome:

CO01: Development of skill in identifying the nature and type of corrosion
CO02: Understanding the mechanism of various types of corrosion
CO03: Analysing the problem and find out a solution to combat corrosion in any sort of environment.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	-	-	-	-	-	-	-	-	-	-	3	1	-	-
CO2	-	3	1	2	-	-	-	-	-	-	-	1	1	2	-	-

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

TEXTBOOKS:

1. *Fontana and Mars G, "Corrosion Engineering", 3rd edition, McGraw Hill, (1987).*
2. *Uhlig H H and Reviees R W, "Corrosion and its Control", Wiley, (1985).*

REFERENCES:

1. *ASM Metals Handbook, "Surface Engineering", Vol. 5, ASM Metals Park, Ohio, USA, (1994).*
2. *ASM Metals Handbook, "Corrosion", Vol. 13, ASM Metals Park, Ohio, USA, (1994).*
3. *Brain Ralph, "Material Science and Technology", CRC Series, Boston, New York.*

15PHY230 ADVANCED CLASSICAL DYNAMICS 3 0 0 3

Unit 1

Introduction to Lagrangian dynamics

Survey of principles, mechanics of particles, mechanics of system of particles, constraints, D'Alembert's principle and Lagrange's equation, simple applications of the Lagrangian formulation, variational principles and Lagrange's equations, Hamilton's principles, derivation of Lagrange's equations from Hamilton's principle, conservation theorems and symmetry properties.

Unit 2

Central field problem

Two body central force problem, reduction to the equivalent one body problem, Kepler problem, inverse square law of force, motion in time in Kepler's problem, scattering in central force field, transformation of the scattering to laboratory system, Rutherford scattering, the three body problem.

Rotational kinematics and dynamics

Kinematics of rigid body motion, orthogonal transformation, Euler's theorem on the motion of a rigid body.

Unit 3

Angular momentum and kinetic energy of motion about a point, Euler equations of motion, force free motion of rigid body.

Practical rigid body problems

Heavy symmetrical spinning top, satellite dynamics, torque-free motion, stability of torque-free motion - dual-spin spacecraft, satellite maneouvering and attitude control - coning maneuver - Yo-yo despin mechanism - gyroscopic attitude control, gravity-gradient stabilization.

Course Outcomes

CO1 - Able to use the Lagrangian formalism to solve simple dynamical system

CO2- Able to understand Hamiltonian formalism and apply this in solving dynamical systems

CO3- Able to apply Lagrangian formalism in bound and scattered states with specific reference to Kepler's laws and Scattering states

CO4- Able to solve problems in the Centre of Mass frame and connect it to Laboratory Frame of Reference

CO5- Understand and solve problems in rigid body rotations applying of Euler's equations.

CO-PO Mapping

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	3	3	1	1	0	0	0	0	0	0	0	1	0	0	0
CO 2	3	3	1	1	0	0	0	0	0	0	0	1	0	0	0
CO 3	3	3	3	1	0	0	0	0	0	0	0	1	0	0	0
CO 4	3	3	3	1	0	0	0	0	0	0	0	2	0	0	0
CO 5	3	3	3	2	0	0	0	0	0	0	0	2	0	0	0

TEXTBOOKS:

3. H. Goldstein, Classical Mechanics, Narosa Publishing House, New Delhi, 1980, (Second Edition)

4. H. Goldstein, Charles Poole, John Safko, Classical Mechanics, Pearson education, 2002 (Third Edition)
5. Howard D. Curtis, Orbital Mechanics for Engineering Students, Elsevier, pp.475 - 543

6. Anderson John D, Modern Compressible flow, McGraw Hill.

REFERENCE BOOKS:

3. D. A. Walls, Lagrangian Mechanics, Schaum Series, McGraw Hill, 1967.

4. J. B. Marion and S. T. Thornton, Classical dynamics of particles and systems, Ft. Worth, TX: Saunders, 1995.

15PHY233 BIOPHYSICS AND BIOMATERIALS 3 0 0 3

OBJECTIVE:

To equip the students with the knowledge on different kinds of biomaterials andother medical need, basic research, and to provide an over view of theory and practice of bio materials.

Unit 1

Quantum mechanics – Schrodinger's time dependent and independent equations – Pauli's exclusion principle – ionization energy – electron affinity – chemical binding

– electro negativity and strong bonds - secondary bonds – inter atomic potential for strong bonds and weak bonds – bond energies – spring constants – free energy – internal energy – reaction kinetics.

Definition and classification of bio-materials, mechanical properties, visco-elasticity, wound-healing process, Application of biomaterial for the human body, body response to implants, blood compatibility. Implementation problems - inflammation, rejection, corrosion, structural failure. Surface modifications for improved compatibility.

Unit 2

Bioceramics, Biopolymers, Metals, ceramics and composites in medicine: Properties, applications, suitability & modifications required for certain applications.

X-ray diffraction and molecular structure – Nuclear Magnetic Resonance – scanning tunneling microscope – Atomic force microscopy – optical tweezers – patch clamping – molecular dynamics – potential energy contour tracing –

SEM – TEM – spectroscopy methods differential thermal analysis, differential thermo gravimetric analysis – NDT methods.

Unit 3

Materials for bone and joint replacement – dental metals and alloys – ceramic – bioinert – bioactive ceramics – polymers - dental restorative materials – dental amalgams – cardiovascular materials – cardiac prosthesis; vascular graft materials

– cardiac pacemakers – cardiac assist devices – materials for ophthalmology contact lens – intraoccular materials – materials for drug delivery.

TEXTBOOKS AND REFERENCES:

4. Rodney M J Cotterill, Biophysics an introduction, John Wiley & sons Ltd., NY, 2002
5. Vasantha Pattabhi and N.Gautham, Biophysics, Alpha science International Ltd. UK, 2002.
5. Jonathan Black, Biological Performance of Materials, Fundamentals of Biocompatibility, Marcel Dekker Inc., New York, 1992.
6. D. F. Williams (ed.), Material Science and Technology - A comprehensive treatment, Vol.14, Medical and Dental Materials, VCH Publishers Inc., New York, 1992.
7. H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBS Publishers, New Delhi, 1986.

15PHY234 INTRODUCTION TO COMPUTATIONAL PHYSICS 3 0 0 3

Unit 1

Differentiation: Numerical methods, forward difference and central difference methods, Lagrange's interpolation method.

Integration: Newton - cotes expression for integral, trapezoidal rule, Simpsons's rule, Gauss quadrature method.

Unit 2

Solution of differential equations: Taylor series method, Euler method, Runge Kutta method, predictor-corrector method.

Roots of equations: Polynomial equations, graphical methods, bisectional method, Newton-Raphson method, false position method.

Unit 3

Solution of simultaneous equations: Elimination method for solving simultaneous linear equations, Gauss elimination method, pivotal condensation method, Gauss-seidal iteration method, Gauss Jordan method, matrix inversion method.

Eigen values and Eigen vectors of matrix: Determinant of a matrix, characteristic equation of a matrix, eigen values and eigen vectors of a matrix, power method.

TEXTBOOK:

Rubin H Landau & Manuel Jose Paez Mejia, "Computational Physics", John Wiley & Sons

REFERENCES:

Suresh Chandra, "Computer Applications in Physics", Narosa Publishing House, New Delhi M Hijroth Jensen, Department of Physics, University of Oslo, 2003 (Available in the Web)

15PHY238 ELECTRICAL ENGINEERING MATERIALS 3 0 0 3

Unit 1

Conducting materials: The nature of chemical bond, crystal structure Ohm's law and the relaxation time, collision time, electron scattering and resistivity of metals, heat developed in a current carrying conductor, thermal conductivity of metals, superconductivity.

Semiconducting materials: Classifying materials as semiconductors, chemical bonds in Si and Ge and it's consequences, density of carriers in intrinsic semiconductors, conductivity of intrinsic semiconductors, carrier densities in n type semiconductors, n type semiconductors, Hall effect and carrier density.

Unit 2

Magnetic materials: Classification of magnetic materials, diamagnetism, origin of permanent, magnetic dipoles in matter, paramagnetic spin systems, spontaneous magnetization and Curie Weiss law, ferromagnetic domains and coercive force, anti ferromagnetic materials, ferrites and it's applications.

Unit 3

Dielectric materials: Static dielectric constant, polarization and dielectric constant, internal field in solids and liquids, spontaneous polarization, piezoelectricity.

PN junction: Drift currents and diffusion currents, continuity equation for minority carriers, quantitative treatment of the p-n junction rectifier, the n-p-n transistor.

Course Outcomes

CO1: To understand the nature of interaction between atoms in crystalline solid materials that determines their dielectric, magnetic and electrical properties.

CO2: Analyze the relation between the macroscopic dielectric constant and the atomic structure of an insulator.

CO3: Fundamental concepts of magnetic fields required to illustrate the magnetic dipoles. This forms the basis to understand the magnetic properties of dia, para, ferro, antiferro and ferri magnetic materials.

CO4: Fundamentals concerned with conduction mechanism in metals and superconductors.

CO5: Understand the basics for classification of materials based on its conductivity, nature of chemical bonds in Si and Ge, carrier density, energy band structure and conduction mechanism in intrinsic and extrinsic semiconductors.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	1	1											1	-
CO2	2	2	2										1	-
CO3	2	2	2										2	-
CO4	2	2	2										2	-
CO5	2	2	2					2					1	-

TEXTBOOK:

A J Decker, "Electrical Engineering materials", PHI, New Delhi, 1957.

REFERENCES:

1. A J Decker, "Solid State Physics", Prentice Hall, Englewood Cliffs, N J 1957.
2. C Kittel, "Introduction to solid state Physics", Wieley, New York, 1956 (2nd edition).
3. Allison, Electronic Engineering materials and Devices, Tata Mc Graw Hill
4. F K Richtmyer E H Kennard, John N Copper, "Modern Physics", Tata Mc Graw Hill, 1995 (5th edition).

15PHY239 ELECTROMAGNETIC FIELDS AND WAVES 3 0 0 3

Unit 1

Electrostatics: Coulombs law and electric field intensity, field due to a continuous volume charge distribution, field of a line charge, field of sheet of charge, electric flux density, Gauss's law, application of Gauss's law, Maxwell's first equation.

Poisson's and Laplace's equations: The potential field of a point charge, potential field of a system of charges: conservative property, potential gradient, the dipole.

Unit 2

Poisson's and Laplace's equations, uniqueness theorem, examples of the solution of Laplace's equation, solution of Poisson's equation.

Electromagnetics: Biot Savart law, magnetic flux and magnetic flux density, scalar and vector magnetic potentials, derivation of steady magnetic field laws, Faraday's laws, displacement current, Maxwells equations in point and integral form, retarded potentials

Unit 3

Electromagnetic waves: EM wave motion in free space, wave motion in perfect dielectrics, plane wave in lossy dielectrics, Poynting vector and power consideration, skin effect, reflection of uniform plane waves, standing wave ratio.

Transmission line equations, line parameters - examples, dipole radiation, retarded potentials, electric dipole radiation.

TEXTBOOK:

William H Hayt, "Engineering Electromagnetics", Tata Mc Graw Hill, New Delhi, 2002 (5th edition).

REFRENCES:

6. David J Griffiths, "Introduction to Electrodyanamics", Prentice-Hall of India, New Delhi, 1999 (2nd edition).
7. J D Jackson, "Classical Electrodynamics", Wiley Eastern, 2004 (2nd edition).

8. B. Chakraborty, "Principles of Electrodynamics", Books and Allied Publishers, 2002

15PHY240 ELECTRONIC MATERIALS SCIENCE 3 0 0 3

Unit 1

Types of bonding in solids, Crystallography and crystalline defects: Crystallography, Directions and planes, Crystalline defects, line defects, Planar defects, Volume defects; Binary and Ternary Phase Diagrams: Lever rule and

phase rule, Eutectic, peretectic and Eutectoid systems, Applications of Phase diagrams; Basic Quantum Physics - atomic structure, Use of band theory and occupation statistics to explain existence and basic properties of metals and nonmetals. Working of Semiconductor Devices using band diagrams and their electrical characteristics: pn junctions, BJT, MOSFET.

Unit 2

Useof band theory to explain optoelectronic properties of materials and optoelectronic devices: LEDs, Solar Cells, Lasers, pin diodes, photodiodes; Magnetic properties and Superconductivity: Magnetic moments and Magnetic Permeability, types of magnetism, saturation magnetization, magnetic domains, soft and hard magnetic materials, superconductivity and its origin, Giant Magneto Resistance, Josephson effect, Energy band diagrams and Magnetism, Applications of magnetic materials - Magnetic recording materials, etc.

Unit 3

Optical Properties of Materials: Reflection, Refraction, Dispersion, Refractive Index, Snells Law, Light Absorption and Emission, Light Scattering, Luminescence, Polarization, Anisotropy,Birefringerence; Dielectric Properties of Materials: Polarization and Permittivity, Mechanisms of polarization, dielectric properties - dielectric constant, dielectric loss, dielectric strength and breakdown, Piezoelectricity, Ferreoelectricity, and Pyroelectricity, Dielectric Materials

TEXTBOOK:

S. O. Kasap, Principles of Electronic Materials and Devices, 2006, 3rd edition, Tata McGraw Hill.

REFERENCE:

D. Jiles: Introduction to the Electronic Properties of Materials, Chapman & Hall. 1994.

15PHY241 LASERS IN MATERIAL PROCESSING 3 0 0 3

Unit 1

Basic optical theory: Nature of electromagnetic radiation, interaction of radiation with matter, reflection, refraction, polarization, laser fundamentals, laser beam characteristics, beam quality (laser cavity modes), Q-switching, mode locking, continuous wave, types of lasers, energy and power.

Laser interaction with materials: Optical properties of materials, laser interaction with metals, insulators, semiconductors, polymers and biological materials.

Laser surface treatment: Introduction to laser surface hardening, laser surface melting, laser surface alloying, laser surface cladding, laser cleaning. Laser ablation: mechanisms (photothermal, photophysical and photochemical), mask projection techniques, laser micro and nano structuring.

Unit 2

Laser cutting and drilling: Mechanism for inert gas and oxygen-assisted cutting, factors controlling cut quality and kerf width. Laser assisted drilling.

Laser welding: Introduction to laser keyhole welding and contrast with conduction limited welding, applications,

Direct laser fabrication (DLF): Laser sintering & laser rapid manufacturing, comparison with rapid prototyping. Main potential and limitations of DLF for direct fabrication and for the production of novel engineering materials and structures.

Unit 3

Laser forming: Mechanisms involved, including thermal temperature gradient, buckling, upsetting. Applications in alignment and straightening and in rapid production processes.

Scope of application of laser materials processing: focused on industrial application of laser in materials processing including laser welded tailored blanks.

Laser safety: Introduction to safety procedures in the use of lasers, including wavelength effects and laser safety standards.

REFERENCES:

1. Steen, W M, Laser Material Processing (3rd Edition), Springer Verlag, 2003, ISBN 1852336986.
2. Silvast, W T, Laser Fundamentals, Cambridge University Press, 1998, ISBN 0521556171.
3. J. F. Ready, D. F. Farson. LIA Handbook of Laser Materials Processing Laser Institute of America, 2001.
4. M. von Allmen. Laser-Beam Interactions with Materials, Springer, 1987
5. D. Bauerle. Laser Processing and Chemistry, Springer, 2000
6. W. W. Duley, UV lasers: effects and applications in materials science, Cambridge University, Press, Cambridge ; New York, 1996.
7. J. Dutta Majumdar, and I. Manna, Laser Material Processing, Sadhana, Vol. 28, Year: 2003, 495-562.

15PHY243 MICROELECTRONIC FABRICATION 3 0 0 3

Unit 1

Introduction to semiconductor fabrication – scaling trends of semiconductor devices; crystal structure of semiconductor materials, crystal defects, phase diagrams and solid solubility; physics of Czochralski growth of single crystal silicon, Bridgeman method for GaAs, float zone process; diffusion science: Ficks laws of diffusion, atomistic models of diffusion, dopant diffusion mechanisms; kinetics of thermal oxidation, Deal-Grove Model, nitridation of silicon, structure and characteristics of oxides, effect of dopants on oxidation kinetics, dopant redistribution;

Unit 2

Physics of ion implantation: Coulombic scattering and projected range, nuclear and electronic stopping, channeling, implantation damage removal, dopant activation by rapid thermal annealing; principles of optical lithography – optics and diffraction, light sources and spatial coherence, physics of pattern transfer, nodulation transfer function; chemistry of lithographic processes: organic and polymeric photoresists, developing and exposure, contrast; principles of non-optical lithography: electron beam, X-ray lithography, resists, sources; etching: Chemistry of wet etching, plasma physics, chemistry of plasma etching and reactive ion etching; chemical mechanical polishing.

Unit 3

Vacuum science: Kinetic theory of gases, gas flow and conductance, vacuum pumps and seals; deposition of thin films: physics of sputtering and evaporation, step coverage and morphology of deposited films, chemical vapor deposition:

chemical equilibrium and law of mass action, gas flow and boundary layers, types of CVD, plasma assisted CVD; thermodynamics of epitaxial growth, types molecular beam epitaxy, isolation and contact formation – LOCOS and trench, silicides, metallization with Al and Cu; process Integration: CMOS, bipolar process flow.

TEXTBOOK:

Stephen Campbell, Science and Engineering of Microelectronic Fabrication, Oxford University Press, 2001

REFERENCE:

1. S K Gandhi, VLSI Fabrication Principles, John Wiley & Sons, 1994

2. Gary S May and Simon M Sze, Fundamentals of Semiconductor Fabrication, John Wiley, 2003.

3. S Wolfe, Silicon Processing for the VLSI Era, Lattice Press, 1998.

15PHY245 NUCLEAR ENERGY: PRINCIPLESAND APPLICATIONS 3 0 0 3

Unit 1

Basics: Atomic theory, nuclear composition, sizes and masses of nuclei, binding energy, radioactive decay, radioactive chains. Nuclear reactions, transmutation of elements, conservation laws, neutron cross sections, interaction of charged particles and gamma radiation with matter.

Fission and fusion: The fission process, energetic of fission, byproducts of fission, energy from nuclear fuels. Fusion reactions, electrostatic and nuclear forces, thermo nuclear reactions in plasma. Energetics of fusion. Comparison of fusion and fission reactions.

Unit 2

Neutron chain reactions and nuclear power: Criticality and multiplication, factors governing the multiplication, neutron flux and reactor power, reactor types and reactor operations. Methods of heat transmission and removal, steam generation and electric power generation, waste heat disposal.

Unit 3

Breeder reactors and fusion reactors: The concept of breeding nuclear fuel, isotope production and consumption, fast breeder reactor, breeding and uranium sources. Technical problems in the functioning of fusion reactor, requirements for practical fusion reactors, magnetic confinement, inertial confinements and other fusion concepts. Prospects of fusion power.

Radiation protection and waste disposal: Biological effects of radiation, radiation dose units, protective measures, internal exposure, and radon problem. Nuclear fuel cycle and waste classification, spent fuel storage and transportation, high level waste disposal, low level waste disposal.

TEXTBOOK:

Raymond L Murray, Nuclear Energy: An Introduction to the Concepts, Systems and Applications of Nuclear Processes, Butterworth-Heimann-Elsevier Inc (2009)

REFERENCES:

1. David Bodansky, Nuclear Energy: principles, practices and prospects, Springer Verlag
2. S K Rajput, Nuclear Energy, Mahaveer & Sons (2009)

15PHY247 PHOTOVOLTAICS 3 0 0 3

Unit 1

Introduction to semiconductors: Semiconductors: concept of electron and holes, conduction in semiconductors and concentration of charge carriers in semiconductors. Direct and indirect band gap semiconductors (quantum mechanical treatment). Extrinsic semiconductors: n-type, p-type & compensation doping, carrier concentration; PN junction - concept of bands at PN junction, junction under forward and reverse biases (conceptual).

Unit 2

Optical Processes: Optical absorption, Photoelectric Effect, Beer-Lambert law (Qualitative). Wavelength to band gap relation. Generation of electron-hole pairs. Recombination processes - direct and indirect recombination, other recombination processes - Shockley Reed Hall recombination, Auger recombination.

Solar Cell – Principle: Introduction & history of Solar cells. Constituents of solar radiations (Solar Spectrum). Separation of electrons and holes. Transport of charge carriers - diffusion & drift of carriers, continuity equation, field current, diffusion current, total charge current.

Unit 3

Solar Cell – Properties: Measurement of solar cell parameters - short circuit current, open circuit voltage, fill factor, efficiency. Optical losses, electrical losses, surface recombination velocity, quantum efficiency - external and internal, I-V characteristics of Solar cells. Fabrication and design of Solar cells. Performance enhance: Enhance absorption, Reduce series resistance, surface recombination.

Advanced Solar cell technologies (III Generation): Alternatives to conventional Si based solar cells - Thin film solar cells, Hetero junction solar cells, Tandem solar cells: material properties, fabrication and stability (includes nano scale devices). Organic solar cells.

TEXTBOOK:

Wenham S R, “Applied Photovoltaics”, 2nd ed., Earthscan Publications Ltd., (2007).

REFERENCES:

1. Peter Wurfel, “Physics of Solar Cells”, 2nd Ed., Wiley VCH (2005).
2. S O Kasap, “Principles of Electronic Materials and Devices”, McGraw-Hill, New York (2005).

15PHY248 PHYSICS OF LASERS AND APPLICATIONS 3 0 0 3

Unit 1

Review of some basic concepts and principle of laser.

Introduction to light and its properties: Reflection, refraction, interference, diffraction and polarization. Photometry – calculation of solid angle. Brewster's law. Snell's law and, its analysis.

Introduction to LASERS: Interaction of radiation with matter - induced absorption, spontaneous emission, stimulated emission. Einstein's co-efficient (derivation). Active material. Population inversion – concept and discussion about different techniques. Resonant cavity.

Unit 2

Properties of LASERS

Gain mechanism, threshold condition for PI (derivation), emission broadening - line width, derivation of FWHM natural emission line width as deduced by quantum mechanics - additional broadening process: collision broadening, broadening due to dephasing collision, amorphous crystal broadening, Doppler broadening in laser and broadening in gases due to isotope shifts. Saturation intensity of laser, condition to attain saturation intensity.

Properties – coherency, intensity, directionality, monochromaticity and focussibility. LASER transition – role of electrons in LASER transition, levels of LASER action: 2 level, 3 level and 4 level laser system.

Unit 3

Types of LASERS

Solid state LASER: (i) Ruby LASER – principle, construction, working and application. (ii) Neodymium (Nd) LASERS. gas LASER: (i) He-Ne LASER - principle, construction, working and application. (i) CO2 LASER - principle, construction, working and application.

Liquid chemical and dye LASERS. Semiconductor LASER: Principle, characteristics, semiconductor diode LASERS, homo-junction and hetero-junction LASERS, high power semi conductor diode LASERS.

Applications in Communication field:

LASER communications: Principle, construction, types, modes of propagation, degradation of signal, analogue communication system, digital transmission, fiber optic communication.

Applications of LASERS in other fields:

Holography: Principle, types, intensity distribution, applications. laser induced fusion. Harmonic generation. LASER spectroscopy. LASERS in industry: Drilling, cutting and welding. Lasers in medicine: Dermatology, cardiology, dentistry and ophthalmology.

Course Outcomes

CO 1- Understand, Comprehend and acquaint with concepts of NanoPhysics

CO2- To familiarize the material's property changes with respect to the dimensional confinements.

CO3- Acquire knowledge on the modern preparation process and analysis involved in the nanomaterial's research

CO4- To learn about the technological advancements of the nano-structural materials and devices in the engineering applications

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3	2												
CO2	2	3												
CO3				3										
CO4						3	2					1		

REFERENCES:

1. William T Silfvast, "Laser Fundamentals", Cambridge University Press, UK (2003).
2. B B Laud, "Lasers and Non linear Optics", New Age International (P) Ltd., New Delhi.
3. Andrews, "An Introduction to Laser Spectroscopy (2e)", Ane Books India (Distributors).
4. K R Nambiar, "Lasers: Principles, Types and Applications", New Age International (P) Ltd., New Delhi.
5. T Suhara, "Semiconductor Laser Fundamentals", Marcel Dekker (2004).

15PHY250 QUANTUM PHYSICS AND APPLICATIONS 3 0 0 3

Unit 1

Review of Planck's relation, De-Broglie relation and uncertainty principle basic concepts - Schrodinger equation: probabilistic interpretation of wave function, one dimension problems – particle in a box, harmonic oscillator, potential barrier and tunneling. Hydrogen atom, electrons in a magnetic field - X-ray spectra - periodic table.

Unit 2

Bosons and Fermions - symmetric and antisymmetric wavefunctions - elements of statistical physics: density of states, fermi energy, Bose condensation - solid state physics: Free electron model of metals, elementary discussion of band theory and applications to semiconductor devices.

Einstein coefficients and light amplification - stimulated emission - optical pumping and laser action.

Unit 3

Operation of He-Ne laser and Ruby laser - laser in science and Industry - Raman effect and applications.

Nuclear physics: nuclear properties - binding energy and mass formula - nuclear decay with applications - theory of alpha decay - nuclear forces – fission - principle of nuclear reactor - elementary particles - leptons, hadrons, quarks, field bosons - the standard model of elementary particles.

TEXTBOOK:

A Beiser, Perspectives in Modern Physics, McGraw Hill

REFERENCES;

1. Arthur Beiser, Concepts of Modern Physics, 6th Edition Tata McGraw Hill
2. S H Patil, Elements of Modern Physics, Tata Mc Graw Hill, 1989
3. K Krane, Modern Physics, John Weiley, 1998.
4. K Thyagarajan, A K Ghatak, Lasers-Theory and Applications, Macmillan, 1991

15PHY251 THIN FILM PHYSICS 3 0 0 3

Unit 1

Introduction and preparation of thin film: Difference between thin and thick film. Appreciation of thin film technology in modern era. Deposition technology: Physical methods, chemical methods, other new techniques, vacuum technology: Vacuum pumps & pressure gauges.

Defects in thin film: General concepts, nature of defect, microscopic defect and dislocation. Boundary defects. Defect and energy states - donar acceptor levels, trap and recombination centers, excitons, phonons.

Unit 2

Thin film analysis: Structural studies: XRD and electron diffraction. Surface studies: electron microscopy studies on film (SEM, TEM, AFM) Film composition: X-ray photoelectron spectroscopy (XPS), Rutherford Back Scattering spectroscopy (RBS) and Secondary Ion Mass Spectroscopy (SIMS).

Properties of thin film: Optical behaviors: transmission, reflection, refractive index, photoconductivity, and photoluminescence.

Unit 3

Electrical behaviors: sheet resistivity, electron mobility and concentration, Hall effect, conduction in MIS structure.

Mechanical behaviors: stress, adhesion, hardness, stiffness.

Applications of thin films in various fields: Antireflection coating, FET, TFT, resistor, thermistor, capacitor, solar cell, and MEMs fabrication of silicon wafer: Introduction. preparation of the silicon wafer media, silicon wafer processing steps.

TEXTBOOK:

K. L. Chopra, “Thin Film Phenomena”, McGraw Hill, New York, 1969

REFERENCES:

1. L. T. Meissel and R. Glang, “Hand book of thin film technology”, McGraw Hill, 1978.

2. Goswami, “Thin Film Fundamentals“, New Age International, Pvt Ltd, New Delhi, 1996.
3. O. S. Heavens "optical Properties of Thin Films" by, Dover Publications, Newyork 1991.
4. Milton Ohring “Materials science of thin films deposition and structures”, Academic press, 2006.
5. Donald L. Smith “Thin Film deposition principle and Practice”, McGraw Hill international Edition, 1995.

15PHY331 ASTRONOMY 3 0 0 3

Unit 1

Astronomy, an Observational Science: Introduction - Indian and Western Astronomy

– Aryabhatta - Tycho Brahe’s observations of the heavens - The laws of planetary motion - Measuring the astronomical unit - Isaac Newton and his Universal Law of Gravity - Derivation of Kepler’s third law - The Sun - The formation of the solar system - Overall properties of the Sun - The Sun’s total energy output - Black body radiation and the sun’s surface temperature - The Fraunhofer lines in the solar spectrum and the composition of the sun - Nuclear fusion - The proton– proton cycle - The solar neutrino problem - The solar atmosphere: photosphere, chromosphere and corona - Coronium - The solar wind- The sunspot cycle - Solar The Planets - Planetary orbits - Orbital inclination - Secondary atmospheres - The evolution of the earth’s atmosphere.

Unit 2

Observational Astronomy

Observing the Universe - The classic Newtonian telescope - The Cassegrain telescope - Catadioptric telescopes - The Schmidt camera - The Schmidt–Cassegrain telescope - The Maksutov–Cassegrain telescope - Active and adaptive optics - Some significant optical telescopes - Gemini North and South telescopes - The Keck telescopes - The South Africa Large Telescope (SALT) - The Very Large Telescope (VLT) - The Hubble Space Telescope (HST) - The future of optical astronomy - Radio telescopes - The feed and low noise amplifier system - Radio receivers - Telescope designs - Large fixed dishes - Telescope arrays - Very Long Baseline Interferometry (VLBI) - The future of radio astronomy - Observing in other wavebands – Infrared – Sub-millimetre wavelengths - The Spitzer space telescope - Ultraviolet, X-ray and gamma-ray observatories - Observing the universe without using electromagnetic radiation - Cosmic rays - Gravitational waves.

Unit 3

The Properties of Stars: Stellar luminosity - Stellar distances - The hydrogen spectrum - Spectral types - Spectroscopic parallax - The Hertzsprung–Russell Diagram - The main sequence - The giant region - The white dwarf region - The stellar mass – luminosity relationship - Stellar lifetimes - Stellar Evolution – White dwarfs - The evolution of a sun-like star - Evolution in close binary systems – Neutron stars and black holes - The discovery of pulsars - Black holes: The Milky Way - Open star clusters - Globular clusters - Size, shape and structure of the Milky Way – observations of the hydrogen line - Other galaxies - Elliptical galaxies - Spiral galaxies - The Hubble classification of galaxies - The universe - The Cepheid variable distance scale - Starburst galaxies - Active galaxies - Groups and clusters of galaxies

Superclusters - The structure of the universe - Cosmology – the Origin and Evolution of the Universe - The expansion of the universe - The cosmic microwave background - The hidden universe: dark matter and dark energy - The Drake equation - The Search for Extra Terrestrial Intelligence (SETI) - The future of the universe.

TEXTBOOK:

Introduction to Astronomy and Cosmology, Ian Morison, Wiley (UK), 2008

REFERENCE BOOK:

Astronomy: Principles and Practice, 4th Edition (Paperback), D. C. Clarke, A. E. RoyInstitute of Physics Publishing

15PHY333 CONCEPTS OF NANOPHYSICS AND NANOTECHNOLOGY3 0 0 3

Unit 1

Introduction

Introduction to nanotechnology, comparison of bulk and nanomaterials – change in band gap and large surface to volume ratio, classification of nanostructured materials. Synthesis of nanomaterials - classification of fabrication methods – top down and bottom up methods.

Concept of quantum confinement and phonon confinement

Basic concepts – excitons, effective mass, free electron theory and its features, band structure of solids. Bulk to nano transition – density of states, potential well - quantum confinement effect – weak and strong confinement regime. Electron confinement in infinitely deep square well, confinement in two and three dimension. Blue shift of band gap - effective mass approximation. Vibrational properties of solids - phonon confinement effect and presence of surface modes.

Unit 2

Tools for characterization:

Structural – X-ray diffraction, transmission electron microscope, scanning tunneling microscope, atomic force microscope. Optical - UV – visible absorption and photoluminescence techniques, Raman spectroscopy.

Nanoscale materials – properties and applications:

Carbon nanostructures – structure, electrical, vibration and mechanical properties. Applications of carbon nanotubes

Unit 3

Field emission and shielding – computers – fuel cells – chemical sensors – catalysis

– mechanical reinforcement. Quantum dots and Magnetic nanomaterials – applications.

Nanoelectronics and nanodevices:

Impact of nanotechnology on conventional electronics. Nanoelectromechanical systems (NEMSs) – fabrication (lithography) and applications. Nanodevices - resonant tunneling diode, quantum cascade lasers, single electron transistors – operating principles and applications.

TEXTBOOKS:

1. Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, Nanoscale Science and Technology, John Wiley and Sons Ltd 2004.
2, W. R. Fahrner (Ed.), Nanotechnology and Nanoelectronics, Springer 2006.

15PHY335 MEDICAL PHYSICS 3 0 0 3

Unit 1

Ultrasonics - production methods and properties - acoustic impedance - Doppler velocimetry - echo cardiography – resolution – speckle - ultrasound imaging - therapeutic use of ultrasound - use in diagnostics of cardiac problems.

X-rays – production – intensity - hard and soft X-rays - characteristic and continuous X-ray spectrum - attenuation of x-rays by hard and soft tissues – resolution – contrast X-ray imaging - fluoroscopy modes of operation - image quality - fluoroscopy suites - radiation dose – computed-aided tomography (CAT).

Unit 2

Nuclear medicine - principles of nuclear physics – natural radioactivity, decay series, type of radiation and their applications, artificially produced isotopes and its application, accelerator principles; Nuclear Isomerism, internal conversion - ideal energy for radiotherapy based on interactions. Radionuclide used in medicine - radioisotope production – dosimetry – safety - radiation hazards – PET.

Nuclear magnetic resonance physics - magnetic moment – magnetization – relaxation - nuclear magnetic resonance spectroscopy.

Unit 3

Nuclear magnetic resonance imaging (MRI) – principle - chemical shift - magnetic resonance signal induction and relaxation - pulse sequencing and spatial encoding.

Laser physics – characteristics of laser radiation, mode locking - power of laser radiation - lasers as diagnostic tool - lasers in surgery - laser speckle, biological effects, laser safety management.

TEXTBOOK:

Hendee W R and Rittenour E E, "Medical Imaging Physics", John Wiley & Sons, Chicago, 2001.

REFERENCE BOOKS

1. Glasser. O. Medical Physics Vol.1, 2, 3 Book Publisher Inc Chicago, 1980

2. Jerraold T Bush Berg et al, The essentials physics of medical imaging, Lippincott Williams and Wilkins (2002)

15PHY338 PHYSICS OF SEMICONDUCTOR DEVICES 3 0 0 3

Unit 1

Introduction: Unit cell, Bravais lattices, crystal systems, crystal planes and Miller indices, symmetry elements. Defects and imperfections – point defects, line defects, surface defects and volume defects.

Electrical conductivity: Classical free electron theory – assumptions, drift velocity, mobility and conductivity, drawbacks. quantum free electron theory – Fermi energy, Fermi factor, carrier concentration. Band theory of solids – origin of energy bands, effective mass, distinction between metals, insulators and semiconductors.

Unit 2

Theory of semiconductors: Intrinsic and extrinsic semiconductors, band structure of semiconductors, carrier concentration in intrinsic and extrinsic semiconductors, electrical conductivity and conduction mechanism in

semiconductors, Fermi level in intrinsic and extrinsic semiconductors and its dependence on temperature and carrier concentration. Carrier generation - recombination, mobility, drift-diffusion current. Hall effect.

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

Unit 3

Bipolar junction transistor, p-n-p and n-p-n transistors: principle and modes of operation, current relations. V-I characteristics. Fundamentals of MOSFET, JFET. Heterojunctions – quantum wells.

Semiconducting devices: Optical devices: optical absorption in a semiconductor, e--hole generation. Solar cells – p-n junction, conversion efficiency, heterojunction solar cells. Photo detectors – photo conductors, photodiode, p-i-n diode. Light emitting diode (LED) – generation of light, internal and external quantum efficiency.

Modern semiconducting devices: CCD - introduction to nano devices, fundamentals of tunneling devices, design considerations, physics of tunneling devices.

TEXTBOOKS:

1. C Kittel, “Introduction to Solid State Physics”, Wiley, 7th Edn., 1995.

2. D A Neamen, “Semiconductor Physics and Devices”, TMH, 3rd Edn., 2007.

REFERENCES:

1. S M Sze, “Physics of Semiconductor Devices”, Wiley, 1996.

2. P Bhattacharya, “Semiconductor Opto- Electronic Devices”, Prentice Hall, 1996.

3. M K Achuthan & K N Bhat, “Fundamentals of Semiconductor Devices”, TMH, 2007.

4. J Allison, “Electronic Engineering Materials and Devices”, TMH, 1990.

15PHY532 ASTROPHYSICS 3 0 0 3

Unit 1

Historical introduction: Old Indian and western – astronomy - Aryabhatta, Tycho Brahe, Copernicus, Galileo - Olbers paradox - solar system – satellites, planets, comets, meteorites, asteroids.

Practical astronomy - telescopes and observations & techniques – constellations, celestial coordinates, ephemeris.

Celestial mechanics - Kepler's laws - and derivations from Newton's laws.

Sun: Structure and various layers, sunspots, flares, faculae, granules, limb darkening, solar wind and climate.

Unit 2

Stellar astronomy: H-R diagram, color-magnitude diagram - main sequence - stellar evolution

– red giants, white dwarfs, neutron stars, black holes - accretion disc - Schwartzchild radius - stellar masses Saha–Boltzman equation - derivation and interpretation.

Variable stars: Cepheid, RR Lyrae and Mira type variables - Novae and Super novae. Binary and multiple star system - measurement of relative masses and velocities. Interstellar clouds - Nebulae.

Unit 3

Galactic astronomy: Distance measurement - red shifts and Hubble's law – age of the universe, galaxies – morphology - Hubble's classification - gravitational lens, active galactic nuclei (AGNs), pulsars, quasars.

Relativity: Special theory of relativity - super-luminal velocity - Minkowski space - introduction to general theory of relativity – space - time metric, geodesics, space-time curvature. Advance of perihelion of Mercury, gravitational lens.

Cosmology: Comic principles, big bang and big crunch – cosmic background radiation - Nucleo-synthesis - plank length and time, different cosmic models - inflationary, steady state. Variation of G. anthropic principle.

COURSE OUTCOMES (CO):

After completion of the course students should be able to

CO1: Get a broad knowledge of scientific and technical methods in astronomy and astrophysics.

CO2: Apply mathematical methods to solve problems in astrophysics.

CO3: Develop critical/logical thinking, scientific reasoning and skills in the area of modern

astrophysics.

CO-PO Mapping:

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

REFERENCES:

1. "Textbook of Astronomy and Astrophysics with elements of Cosmology", V. B. Bhatia, Narosa publishing 2001.
2. William Marshall Smart, Robin Michael Green "On Spherical Astronomy", (Editor) Carroll, Bradley W Cambridge University Press ,1977
3. Bradley W.Carroll and Dale A. Ostlie. "Introduction to modern Astrophysics" Addison-Wesley, 1996.
4. Bradley W.Carroll and Dale A. Ostlie, "An Introduction to Modern Astrophysics" Addison-Wesley Publishing Company,1996
5. 'Stellar Astronomy' by K. D Abhayankar.
6. 'Solar Physics' by K. D Abhayankar.

15PHY535 EARTH'S ATMOSPHERE 3 0 0 3

Unit 1

Earth's atmosphere: overview and vertical structure. Warming the earth and the atmosphere: temperature and heat transfer; absorption, emission, and equilibrium; incoming solar energy. Air temperature: daily variations, controls, data, human comfort, measurement. Humidity, condensation, and clouds: circulation of water in the atmosphere; evaporation, condensation, and saturation; dew and frost; fog.

Unit 2

Cloud development and precipitation: atmospheric stability & determining stability, cloud development and stability,

precipitation processes, collision and coalescence, precipitation types, measuring precipitation. Air pressure and winds: atmospheric pressure, pressure measurement, surface and upper-air charts, surface winds, winds and vertical air motions, measuring and determining winds. Atmospheric circulations: scales of atmospheric motion, eddies, local wind systems, global winds, global wind patterns and the oceans.

Unit 3

Air masses, fronts, and mid-latitude cyclones. Weather forecasting: acquisition of weather information, forecasting methods and tools, forecasting using surface charts. Thunderstorms: ordinary (air-mass) thunderstorms, mesoscale convective complexes, floods and flash floods, distribution of thunderstorms, lightning and thunder. Tornadoes: severe weather and Doppler radar, waterspouts.

Unit 4

Hurricanes (cyclones, typhoons): tropical weather; anatomy, formation, dissipation and naming of hurricanes. Air pollution: a brief history, types and sources, factors that affect air pollution, the urban environment, acid deposition. Global climate: climatic classification; global pattern of climate.

Unit 5

Climate change: possible causes; carbon dioxide, the greenhouse effect, and recent global warming. Light, colour, and atmospheric optics: white and colours, white clouds and scattered light; blue skies and hazy days, red suns and blue moons; twinkling, twilight, and the green flash; the mirage; halos, sundogs, and sun pillars; rainbows; coronas and cloud iridescence.

TEXTBOOK:

C. Donald Ahrens: Essentials of Meteorology: An Invitation to the Atmosphere (6th edition), Brooks-Cole, 2010.

REFERENCE:

Frederick K. Lutgens & Edward J. Tarbuck: The Atmosphere, An Introduction to Meteorology (11th Edition), Prentice Hall, 19 January, 2009

15PHY536 EARTH'S STRUCTURE AND EVOLUTION 3 0 0 3

Unit 1

Introduction: geologic time; earth as a system, the rock cycle, early evolution, internal structure & face of earth, dynamic earth. Matter and minerals: atoms, isotopes and radioactive decay; physical properties & groups of minerals; silicates, important nonsilicate minerals, resources. Igneous rocks: magma, igneous processes, compositions & textures; naming igneous rocks; origin and evolution of magma, intrusive igneous activity, mineral resources and igneous processes.

Unit 2

Volcanoes and volcanic hazards: materials extruded, structures and eruptive styles, composite cones and other volcanic landforms, plate tectonics and volcanic activity. W eathering and soils: earth's external processes; mechanical & chemical weathering, rates; soils, controls of formation, profile, classification, human impact, erosion, weathering and ore deposits. Sedimentary rocks: the importance and origins of sedimentary rocks; detrital & chemical sedimentary rocks, coal, converting sediment into sedimentary rock; classification & structures, nonmetallic mineral & energy resources. Metamorphism and metamorphic rocks: metamorphic textures, common metamorphic rocks, metamorphic environments & zones.

Unit 3

Mass wasting: gravity, mass-wasting and landform development, controls and triggers, classification of mass-wasting processes, slump, rockslide, debris flow, earthflow, slow movements. Running water: hydrologic cycle, running water, streamflow, work of running water, stream channels, base level and graded streams, shaping stream valleys, depositional landforms, drainage patterns, floods and flood control. Groundwater: importance and distribution, water table, factors influencing storage and movement, springs, wells, artesian wells, environmental problems, hot springs and geysers, geothermal energy, geologic work. Glaciers and glaciation: formation and movement, erosion & landforms, deposits, other effects, causes. Deserts and wind: distribution and causes, geologic processes, basin and range, wind transport, erosion & deposits.

Unit 4

Shorelines: coastal zone, waves & erosion, sand movement, shoreline features & stabilization; erosion problems along U.S. coasts, hurricanes, coastal classification, tides. Earthquakes and earth's interior: faults, seismology, locating the source of an earthquake, measuring intensity, belts and plate boundaries, destruction, damage east of the Rocky Mountains, earthquake prediction, earth's interior. Plate tectonics: continental drift, divergent boundaries, convergent boundaries, transform fault boundaries, testing the plate tectonics model, the breakup of Pangaea, measuring plate motion, what drives plate motions, plate tectonics in the future.

Unit 5

Origin and evolution of the ocean floor: continental margins, features of deep-ocean basins, anatomy of oceanic ridge, oceanic ridges and seafloor spreading, nature of oceanic crust, continental rifting, destruction of oceanic lithosphere.

Crustal deformation and mountain building: structures formed by ductile & brittle deformation, mountain building at subduction zones, collisional mountain belts, fault-block mountains, vertical movements of the crust. Geologic time: time scales, relative dating, correlation of rock layers; dating with radioactivity, the geologic time scale, difficulties in dating. Earth's evolution: birth of a planet, origin of the atmosphere and oceans, Precambrian (formation of continents); Phanerozoic (formation of modern continents & earth's first life); Paleozoic (life explodes); the Mesozoic (dinosaurs); Cenozoic era (mammals). Global climate change: climate & geology, climate system, detecting change; atmospheric basics & heating the atmosphere; natural & human causes; carbon dioxide, trace gases, and climate change; climate-feedback mechanisms, aerosols, some possible consequences.

TEXTBOOK:

Frederick K. Lutgens, Edward J. Tarbuck & Dennis G. Tasa: Essentials of Geology (11th edition), Prentice Hall, 8 March, 2012.

REFERENCE:

Graham R. Thompson & Jonathan Turk: Introduction to Physical Geology (2nd Edition), Brooks Cole, 23 June, 1997.

15PHY540 NON-LINEAR DYNAMICS 3 0 0 3

Unit 1

Introduction: examples of dynamical systems, driven damped pendulum, ball on oscillating floor, dripping faucet, chaotic electrical circuits.

One-dimensional maps: the logistic map, bifurcations in the logistic map, fixed points and their stability, other one-dimensional maps.

Non-chaotic multidimensional flows: the logistic differential equation, driven damped harmonic oscillator, Van der Pol equation, numerical solution of differential equations.

Dynamical systems theory: two-dimensional equilibrium and their stability, saddle points, are contraction and expansion, non-chaotic three-dimensional attractors, stability of two-dimensional maps, chaotic dissipative flows.

Unit 2

Lyapunov exponents: for one- and two-dimensional maps and flows, for three-dimensional flows, numerical

calculation of largest Lyapunov exponent, Lyapunov exponent spectrum and general characteristics, Kaplan-Yorke dimension, numerical precautions.

Strange attractors: general properties, examples, search methods, probability of chaos and statistical properties of chaos, visualization methods, basins of attraction, structural stability.

Bifurcations: in one-dimensional maps and flows, Hopf bifurcations, homoclinic and heteroclinic bifurcations, crises.

Hamiltonian chaos: Hamilton's equations and properties of Hamiltonian systems, examples, three-dimensional conservative flows, symplectic maps.

Unit 3

Time-series properties: examples, conventional linear methods, a case study, time-delay embeddings.

Nonlinear prediction and noise-reduction: linear predictors, state-space prediction, noise reduction, Lyapunov exponents from experimental data, false nearest neighbours.

Fractals: Cantor sets, curves, trees, gaskets, sponges, landscapes.

Calculations of fractal dimension: similarity, capacity and correlation dimensions, entropy, BDS statistic, minimum mutual information, practical considerations.

Fractal measure and multifractals: convergence of the correlation dimension, multifractals, examples and numerical calculation of generalized dimensions.

Non-chaotic fractal sets: affine transformations, iterated functions systems, Mandelbrot and Julia sets.

Spatiotemporal chaos and complexity: examples, cellular automata, coupled map lattices, self-organized criticality.

TEXTBOOK:

Hilborn, R. C., Chaos and Nonlinear Dynamics, Second Edition, Oxford University Press, 2000

REFERENCES:

1. Sprott, J. C., Chaos and Time Series Analysis, Oxford University Press, 2003

2. Strogatz, S. H., Nonlinear Dynamics and Chaos, Westview Press, 2001

3. Solari, H. G., Natiello, M. A., and Mindlin, G. B., Nonlinear Dynamics, Overseas Press (India) Private Limited, 2005

15PHY542 OPTOELECTRONIC DEVICES 3 0 0 3

Unit 1

Properties of semiconductors: Electron and photon distribution: density of states, effective mass and band structure, effect of temperature and pressure on band gap, recombination processes.

Basics of semiconductor optics: Dual nature of light, band structure of various semiconductors, light absorption and emission, photoluminescence. electroluminescence, radioactive and non-radiative recombination, wave trains.

Unit 2

Semiconductor light-emitting diodes: Structure and types of LEDs and their characteristics, guided waves and optical modes, optical gain, confinement factor, internal and external efficiency, semiconductor heterojunctions, double-heterostructure LEDs.

Semiconductor lasers: Spontaneous and stimulated emission, principles of a laser diode, threshold current, effect of temperature, design of an edge-emitting diode, emission spectrum of a laser diode, quantum wells, quantum-well laser diodes.

Unit 3

Semiconductor light modulators: Modulating light (direct modulation of laser diodes, electro-optic modulation, acousto-optic modulation), isolating light (magneto-optic isolators), inducing optical nonlinearity (frequency conversion, switching)

Semiconductor light detectors: I-V characteristics of a p-n diode under illumination, photovoltaic and photoconductive modes, load line, photocells and photodiodes, p-i-n photodiodes, responsivity, noise and sensitivity, photodiode materials, electric circuits with photodiodes, solar cells.

REFERENCES:

3. Semiconductor Optoelectronics: Physics and Technology, Jasprit Singh, McGraw Hill Companies, ISBN 0070576378

4. Optoelectronics, E. Rosencher and B. Vinter, Cambridge Univ. Press, ISBN 052177813.

5. Photonic Devices, J. Liu, Cambridge Univ. Press, ISBN 0521551951.

6. Semiconductor Optoelectronic Devices 2nd Edition", P. Bhattacharya, Prentice Hall, ISBN 0134956567.
7. Physics of Semiconductor Devices, by S. M. Size (2nd Edition, Wiley, New York, 1981).

HUMANITIES ELECTIVES

15CUL230 ACHIEVING EXCELLENCE IN LIFE - AN INDIAN PERSPECTIVE 2 0 0 2

OBJECTIVES: *The course offers to explore the seminal thoughts that influenced the IndianMind on the study of human possibilities for manifesting excellence in life. This course presents to the students, an opportunity to study the Indian perspective of Personality Enrichment through pragmatic approach of self analysis and application.*

Unit 1

Goals of Life – Purusharthas

What are Purusharthas (Dharma, Artha, Kama, Moksha); Their relevance to Personal life; Family life; Social life & Professional life; Followed by a Goal setting workshop;

Yogic way of Achieving Life Goals – (Stress Free & Focused Life)

Introduction to Yoga and main schools of Yoga; Yogic style of Life & Time Management (Work Shop);

Experiencing life through its Various Stages

Ashrama Dharma; Attitude towards life through its various stages (Teachings of Amma);

Unit 2

Personality Development

What is Personality – Five Dimensions – Pancha Kosas (Physical / Energy / Mental / Intellectual / Bliss); Stress Management & Personality; Self Control & personality; Fundamental Indian Values & Personality;

Learning Skills (Teachings of Amma)

Art of Relaxed Learning; Art of Listening; Developing 'Shraddha' – a basic qualification for obtaining Knowledge;

Communication Skills - An Indian Perspective;

Unit 3

Developing Positive Attitude & Friendliness - (Vedic Perspective);

Achieving Work Excellence (Karma Yoga by Swami Vivekananda & teachings based on Amma);

Leadership Qualities – (A few Indian Role models & Indian Philosophy of Leadership);

REFERENCE BOOKS:

1. *Awaken Children (Dialogues with Sri Mata Amritanandamayi) Volumes 1 to 9*
2. *Complete works of Swami Vivekananda (Volumes 1 to 9)*
3. *Mahabharata by M. N Dutt published by Parimal publications – New Delhi (Volumes 1 to 9)*
4. *Universal message of Bhagavad-Gita (An exposition of Gita in the light of modern thought and Modern needs) by Swami Ranganathananda. (Vols.1 to 3)*
5. *Message of Upanishads, by Swami Ranaganathananda published by Bharatiya Vidya Bhavan, Bombay.*
6. *Personality Development – Swami Vivekananda published by Advaitha Ashram, Kolkatta.*
7. *Art of Man Making - Swami Chinmayananda published by Chinmaya Mission, Bombay*
8. *Will Power and its Development- Swami Budhananda published by Advaitha Ashram, Kolkatta*
9. *Ultimate Success - Swami Ramakrishnananada Puri published by Mata Amritanandamayi Math, Kollam*
10. *Yoga In Daily Life - Swami Sivananda – published by Divine Life Society*
11. *Hindu Dharma - H. H. Sri Chandrasekharandra Saraswati published by Bharatiya Vidya Bhavan, Bombay*
12. *All about Hinduism – Swami Sivananda - Published by Divine Life Society*
13. *The Mind and its Control by Swami Budhananda published by Advaitha Ashram, Kolkatta*
14. *Krida Yoga - Vivekananda Kendra, Publication.*
15. *Valmiki Ramayana – Four volumes- published by Parimal Publications, Delhi*
16. *New perspectives in Stress Management - Dr H R Nagendra & Dr R Nagaratna published by Swami Vivekananda Yoga Prakashana, Bangalore.*
17. *Mind Sound Resonance Technique (MSRT) Published by Swami Vivekananda Yoga Prakashana, Bangalore.*
18. *Yoga & Memory - Dr H R Nagendra & Dr. Shirley Telles, published by Swami Vivekananda Yoga Prakashana, Bangalore.*

15CUL231 EXCELLENCE IN DAILY LIFE 2 0 0 2

Unit 1

1 The anatomy of 'Excellence'. What is 'excellence'? Is it judged by external factors like wealth?
2 The Great Flaw. The subject-object relationship between individual and world. Promote subject enhance excellence.
3 To work towards excellence, one must know where he is. Our present state...
An introspective analysis. Our faculties within.

Unit 2

4 The play of the mind. Emotions – convert weakness into strength.
5 The indispensible role of the intellect. How to achieve and apply clear thinking?
6 The quagmire of thought.The doctrine of Karma – Law of Deservance.
7 Increase Productivity, reduce stress..work patterning.

Unit 3

8 The art of right contact with the world.assessment, expectations.
9 Myths and Realities on key issues like richness, wisdom, spirituality.
10 Collect yourself, there is no time to waste. The blue-print of perfect action.

REFERENCES:

The Bhaja Govindam and the Bhagavad Gita.

15CUL232 EXPLORING SCIENCE AND TECHNOLOGY IN ANCIENT INDIA 2 0 0 2

OBJECTIVES: *This course offers a journey of exploration through the early developments inIndia of astronomy, mathematics, technologies and perspectives of the physical world. With the help of many case studies, the students will be equipped to understand concepts as well as well as actual techniques.*

Unit 1

1. General introduction: principles followed and sources;
2. Astronomy & mathematics from the Neolithic to the Indus civilization;
3. Astronomy & mathematics in Vedic literature;
4. Vedanga Jyotisha and the first Indian calendars;
5. Shulba Sutras and the foundations of Indian geometry;

Unit 2

6. Astronomy & mathematics in Jain and Buddhist literature;
7. The transition to the Siddhantic period; Aryabhata and his time;
8. The Aryabhatiya: concepts, content, commentaries;
9. Brahmagupta and his advances; 10.Other great Siddhantic savants;
11. Bhaskara II and his advances;

Unit 3

12. The Kerala school of mathematics;
13. The Kerala school of astronomy;
14. Did Indian science die out?;
15. Overview of recent Indian scientists, from S. Ramanujan onward;
16. Conclusion: assessment and discussion;

TEXTBOOK:

Indian Mathematics and Astronomy: Some Landmarks, by S. Balachandra Rao

REFERENCE:

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

15CUL233 YOGA PSYCHOLOGY 2 0 0 2

OBJECTIVES: *This course offers the foundation necessary to understand Eastern approachesto psychology and spirituality. The course includes experiential components centering on meditation and spiritual practice.*

Unit 1

Introduction

Introduction to Modern Psychology

A short history of Modern Psychology - Major Schools of Modern Psychology - The three major forces in W estern Psychology - Freudian Psychoanalysis; Behaviourism; Humanistic Psychology.

Introduction to Indian Psychology

What is Yoga? - Rise of Yoga Psychology tradition - Various schools of Yoga Psychology - Universal Goal of all Yoga-schools.

Patanjali Yoga Sutra – 1

Introduction to Rishi Patanjali - Bird view of Yoga-Sutra - Definition of Yoga – Vrittis.

Patanjali Yoga Sutra – 2

Five Kinds of Vrittis - Pramanam - sources of right knowledge - Viparyayah – unfolded belief - Vikalpah – Unfolded belief - Smriti – Memory.

Unit 2

Patanjali Yoga Sutra – 3

Two formulae - Necessity of Abhyasah and Vairagyah - Foundation of Abhyasah - Foundation of Vairagyah.

Patanjali Yoga Sutra – 4

Introduction to Samadhi - Samprajnata-Samadhi - Reasoning in S.amprajnata-Samadhi - Reflection in Samprajnata-Samadhi - Bliss in Samprajnata-Samadhi - Sense of Individuality in Samprajnata-Samadhi.

Patanjali Yoga Sutra – 5

Main obstacles in the path of Yoga - other obstructions - removal of obstacles by one – pointedness; by controlling Prana - by observing sense experience - by inner illumination - by detachment from matter - by knowledge of dream and sleep - by meditation as desired.

Patanjali Yoga Sutra – 6

How to make mind peaceful? - Cultivating opposite virtues: happiness – friendliness - misery – compassion - virtue

– gladness - vice – indifference.

Patanjali Yoga Sutra – 7
Five causes of Pain - avidya – ignorance (Root Cause) - asmita – 'I-Feeling' - raga
– attraction - dwesha – repulsion - abhinivesha – clinging to life.

Unit 3
Patanjali Yoga Sutra – 8
Necessity of Yoga practice - eight parts of Yoga practice - five Yamas: ahimsa – satya – asteya – brahmacharyam – aparigraha.

Patanjali Yoga Sutra – 9
Five Niyamas: Soucha – Santhosha – Tapas – Swadyah – Ishwara - Pranidhanam.

Patanjali Yoga Sutra – 10
Asanam – Pranayamah - various kinds of Pranayamah - Pratyaharah - Mastery over the senses.

Report review

Conclusion

REFERENCES:

- *The course book will be "The four chapters of Freedom" written by Swami Satyananda Saraswati of Bihar School of Yoga, Munger, India.*
- *"The message of Upanishads" written by Swami Ranganathananda. Published by Bharathiya Vidya Bhavan.*
- *Eight Upanishads with the commentary of Sankaracharya, Translated by Swami Gambhirananda, Published by Advaita Ashram, Uttaranjal.*
- *'Hatha Yoga Pradipika' Swami Muktibodhananda, Yoga Publications Trust, Munger, Bihar, India*

15ENG230 BUSINESS COMMUNICATION 1 0 2 2

Course Objectives

To introduce business vocabulary

T o introduce business style in writing and speaking

To expose students to the cross-cultural aspects in a globalised world

To introduce the students to the art of persuasion and negotiation in business contexts

Course Outcomes

CO1	Familiarize and use appropriate business vocabulary and etiquettes in verbal communication in the professional context
CO2	Understand organizational structures, pay structures and performance assessments
CO3	Apply language skills in drafting various business documents and other necessary communications in the business context
CO4	Understand and address cross cultural differences in the corporate environment
CO5	Participate in planned and extempore enactments of various business situations

CO-PO Mapping

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

Syllabus

Unit 1:

Business Vocabulary - Writing: Drafting Notices, Agenda, and Minutes - Reading: Business news, Business articles

Unit 2:

Writing: Style and vocabulary - Business Memorandum, letters, Press Releases, reports – proposals – **Speaking**: Conversational practice, telephonic conversations, addressing a gathering, conducting meetings

Unit 3:

Active Listening: Pronunciation – information gathering and reporting **- Speaking**: Cross-Cultural Issues, Group Dynamics, negotiation& persuasion techniques

Activities

Case studies & role-plays

Books recommended:

1. Jones, Leo & Richard Alexander. *New International Business English*. CUP. 2003.
2. Horner, David & Peter Strutt. *Words at Work*. CUP. 1996.
3. Levi, Daniel. *Group Dynamics for Teams*. 3 ed. Sage Publications India Pvt. Ltd. New Delhi, 2011.
4. Owen, Roger. *BBC Business English*. BBC. 1996.
5. Henderson, Greta Lafollette & Price R Voiles. *Business English Essentials*. 7th Edition. Glencoe / McGraw Hill.
6. Sweeney, Simon. *Communicating in Business*. CUP. 2000.

15ENG231 INDIAN THOUGHT THROUGH ENGLISH 1 0 2 2

OBJECTIVES: *To expose the students to the greatness of Indian Thought in English; to developa sense of appreciation for the lofty Indian Thought; to develop an understanding of the eclectic Indian psyche; to develop an understanding about the societal changes in the recent past.*

Unit 1 Poems

Rabindranath Tagore's Gitanjali (1-10); Nizzim Ezekiel's Enterprise; A. K. Ramanujam's Small-Scale Reflections on a Great House.

Unit 2 Prose

Khushwant Singh's The Portrait of a Lady; Jhumpa Lahiri's Short Story - Interpreter of Maladies.

Unit 3 Drama and Speech

Vijay Tendulkar's Silence, the Court is in Session; Motivational speeches by Jawaharlal Nehru/ S. Radhakrishnan / A. P. J. Abdul Kalam's My Vision for India etc. (any speech).

REFERENCES:

1. Lahiri, Jhumpa. Interpreter of Maladies, Harper Collins Publications, 2000.
2. Ramanujan A. K. ed. K. M. George, Modern Indian Literature: An Anthology, Vol. I, Sahitya Akademi, 1992.

3. *Singh, Khushwant. The Portrait of a Lady: Collected Stories, Penguin, 2009.*
4. *Tagore, Rabindranath. Gitanjali, Penguin Books India Pvt. Ltd, 2011.*
5. *Tendulkar, Vijay. Five Plays, Oxford University Press, 1996.*

15ENG232 INSIGHTS INTO LIFE THROUGH ENGLISH LITERATURE 1 0 2 2

OBJECTIVES: *To expose the students to different genres of Literature; to hone reading skills;to provide deeper critical and literary insights; to enhance creative thinking; to promote aesthetic sense.*

Unit 1 Poems
1. W. H. Auden: Refugee Blues; 2. A. K. Ramanujan: Obituary; 3. William Blake: The Little Black Boy; 4. Gieve Patel: Grandparents at a Family Get–together.

Unit 2 Short Stories
1. Chinua Achebe: Marriage is a Private Affair; 2. Ruskin Bond: The Thief; 3. Isai Tobolsky: Not Just Oranges; 4. K A Abbas: The Refugee

Unit 3 Prose
1. A G Gardiner: On The Philosophy Of Hats; 2. Robert Lynd: Mispronunciation

Practicals:
Role plays: The Proposal, Chekov / Remember Ceaser, Gordon Daviot / Final Solutions, Mahesh Dattani, Book reviews, Movie reviews.

SUGGESTED READING: The Old Man and the Sea, Hemingway / Any one of the novels of R. K. Narayan, etc.

15ENG233 TECHNICAL COMMUNICATION 1 0 2 2

Course Objectives:

To introduce the students to the elements of technical style

To introduce the basic elements of formal correspondence

To introduce technical paper writing skills and methods of documentation

To improve oral presentation skills in formal contexts

Course Outcomes: After the completion of the course the student will be able to:

CO1	Understand and use the basic elements of formal correspondence and methods of documentation
CO2	Learn to edit technical content for grammatical accuracy and appropriate tone and style
CO3	Use the library and internet recourses for research purposes
CO4	Demonstrate the ability to communicate effectively through group mock-technical presentations and other activities

Mapping of course outcomes with program outcomes:

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

Syllabus:

Unit 1

Mechanics of writing: Grammar rules – punctuation - spelling rules - tone and style- graphical Representation

Unit 2

Different kinds of written documents: Definitions - descriptions- instructions-recommendations- manuals - reports – proposals; Formal Correspondence: Letter Writing including job applications with Resume

Unit 3

Technical paper writing: Library research skills- documentation style - document editing – proof reading - formatting

Practice in oral communication: Practice in Oral communication and Technical presentations

References

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

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

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

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

15ENG234 INDIAN SHORT STORIES IN ENGLISH 1 0 2 2

OBJECTIVES: *To help the students learn the fine art of story writing; to help them learn thetechniques of story telling; to help them study fiction relating it to the socio- cultural aspects of the age; to familiarize them with different strategies of reading short stories; to make them familiar with the morals and values held in high esteem by the ideals of Indianness.*

Unit 1
Introduction: Differences between novel and short stories – origin and development of short stories - Rabindranath Tagore: Kabuliwallah; Mulk Raj Anand: The Gold Watch.

Unit 2
R. K. Narayan: Sweets for Angels; K. A. Abbas: The Refugee; Khushwant Singh: The Mark of Vishnu.

Unit 3
Masti Venkatesha Iyengar: The Curds-Seller; Manohar Malgonkar: Upper Division Love; Romila Thapar: The Spell; Premchand: The Voice of God.

TEXT:
M. G. Narasimha Murthy (ed), Famous Indian Stories. Hyderabad: Orient Black Swan, 2014
REFERENCE;
Mohan Ramanan (Ed), English and the Indian Short Story: Essays in Criticism, Hyderabad, Orient BlackSwan, 2000.

15FRE230 PROFICIENCY IN FRENCH LANGUAGE (LOWER) 1 0 2 2

Unit 1 Population - Identity
How to introduce yourself (name, age, address, profession, nationality); Numbers; How to ask questions;

Grammar – Pronouns - subjects; Regular verbs of 1st group (er) in the present; Être (to be) and avoir (to have) in the present; Interrogative sentence; Gender of adjectives.

Unit 2 The suburbs - At the train station
Introduce someone; Buy a train ticket or a cinema ticket; Ask for information; Official time; Ask for a price; The city

(church, town hall, post office…)

Grammar – Pronouns - subjects (continuation); Gender of adjectives (continuation); Plural of nouns and adjectives; Definite and indefinite articles; Interrogative adjectives; I would like (Je voudrais).

Unit 3 Paris and the districts - Looking for a room
Locate a room and indicate the way; Make an appointment; Give a price; Ordinal numbers; Usual time; Ask for the time.

Grammar - Imperative mode; Contracted articles (au, du, des); negation.

TEXTBOOK:

Metro St Michel - Publisher: CLE international

15FRE231 **PROFICIENCY IN FRENCH LANGUAGE (HIGHER) 1 0 2 2**

Unit 1 The first room of a student
A party to celebrate the 1st room; Description of a room; furniture; Locate objects: prepositions (devant, derrière, dans…), Read advertisement; Appreciation (I like, I prefer,).

Grammar - Perfect past tense with avoir; Possessive adjectives (mon, ton, son…); Demonstrative adjectives (ce, cet, cette); Yes (oui, si).

Unit 2 Small jobs
Conversation on the phone; Give Time indications; Answer a job offer; Describe a job; Suggest a meeting time.

Grammar - Perfect past tense with être and avoir (continuation); Possessive adjectives (notre, votre, leur); Prepositions (à, pour, avec …); Pronoun as direct object (le, la, l', les).

Unit 3 University Restaurant
Inquiry; Express an opinion; Ask questions (continuation); Food, meals, taste, preferences; Nutrition, diet, choose a menu or diet, Expression of quantities (beaucoup, peu).

Grammar - Partitif (expressing quantity) (du, de la, pas de….); Comparison (plus
...que, moins….que, autant …que); Interrogation (continuation), inversion, Est-ce que, qu'est-ce que?.

TEXTBOOK:
Metro St Michel - Publisher: CLE International

15GER230 GERMAN FOR BEGINNERS I 1 0 2 2

Unit 1

Greetings; Introducing one-self (formal and informal context), saying their name, origin, living place, occupation.

Numbers 1-100; Saying the telephone number.

Countries and Languages.

Grammar: Structure – W - Questions and Yes/No questions and statements, personal pronouns, verb conjugations. Articles.

Vocabulary: Professions.

Unit 2

Giving the personal details. Name, age, marital status, year of birth, place of birth, etc.

Numbers till 1000. Saying a year.

Alphabets – spelling a word.

Filling up an application form; In the restaurant – making an order.

Grammar: Definite, indefinite and negative article in nominative. Accusative: indefinite and negative Article

Vocabulary: Food items

Unit 3

Numbers above 1000. Orientation in Shopping plazas: asking the price, where do I find what, saying the opinion.

Grammar: Accusative – definite article. Adjectives and plural forms.

Vocabulary: Furniture and currencies.

15GER231 GERMAN FOR BEGINNERS II 1 0 2 2

Unit 1

Shopping and orientation in supermarket; Conversation between the customer and salesman; W here one finds what in supermarket; Asking for requests and suggestions.

Grammar: Dative of personal pronouns. Imperative form.

Vocabulary: Consumables and measurements;

Unit 2

Appointments; Work and leisure time activities; Time, weekdays, months and seasons; saying the date; fixing up an appointment.

Grammar: Model verbs; Prepositions with time and place; Ordinal numbers.

Vocabulary: Leisure activities, weekdays, months and seasons.

Unit 3

Family and household; Family and relations; household and daily routine.

Grammar: Possessive articles; Divisible and indivisible verbs.

Vocabulary: Family circle; Household articles.

15GER232 PROFICIENCY IN GERMAN LANGUAGE (LOWER) 1 0 2 2

To have an elementary exposure to German language; specifically

3. to have some ability to understand simple spoken German, and to be able to speak it so as to be able to carry on life in Germany without much difficulty (to be able to do shopping, etc.);
4. to be able to understand simple texts, and simple forms of written communication;
5. to have a basic knowledge of German grammar;
6. to acquire a basic vocabulary of 500 words;
7. to be able to translate simple letters with the use of a dictionary; and
8. to have some familiarity with the German life and culture.

(This will not be covered as part of the regular classroom teaching; this is to be acquired by self-study.)

Some useful websites will be given.

15GER233 PROFICIENCY IN GERMAN LANGUAGE (HIGHER) 1 0 2 2

The basic vocabulary and grammar learned in the earlier course is mostly still passive knowledge. The endeavour of this course is to activate this knowledge and develop the skill of communication.

Topics are: Airport, railway station, travelling; shopping; invitations, meals, meeting people; around the house; the human body; colours; professions.

Past and future tenses will be introduced. Applying genitive, dative and accusative.

Some German culture. Films.

15HIN101 HINDI I 1 0 2 2

To teach Hindi for effective communication in different spheres of life:- Social context , Education, Research & Media.

Course Outcomes: After the completion of the course the student will be able to:

CO1 Gain knowledge about the nature and culture of Hindi language

CO2 Understand the structural aspects of Hindi language

CO3 Apply the knowledge of the grammatical structures to communicate in Hindi

CO4 Analyse the social significance of modern literature.

CO5 Develop the ability to translate a given text to Hindi

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1									**2**	**3**				
CO2									**2**	**3**				
CO3									**2**	**3**				
CO4										**3**				
CO5									**2**					

Syllabus

Unit-1

Introduction to Hindi Language, -National Language, Official Language, link Language etc.. S Introduction to Hindi language , Devanagari script and Hindi alphabet.
Shabda Bhed , Roopanthar ki Drishti se- Bhasha – Paribhasha aur Bhed - Sangya - Paribhasha Aur Bhed- Sangya ke Roopanthar- kriya.

Unit-2

Common errors and error corrections in Parts of Speech with emphasis on use of pronouns, Adjective and verb in different tenses – Special usage of adverbs, changing voice and conjunctions in sentences, gender& number - General

vocabulary for conversations in given context –understanding proper pronunciation – Conversations, Interviews, Short speeches.

Unit -3

Poems – Kabir Ist 8 Dohas, Surdas 1st 1 Pada; Tulsidas 1st 1 Pada; Meera 1st 1 Pada

Unit- 4

Letter writing – personal and Formal –Translation from English to Hindi

Unit- 5

Kahani –Premchand : Kafan , Abhilasha, Vidroh, Poos ki rath, Juloos

Text Books :

1. Prem Chand Ki Srvashrestha Kahaniyam: Prem Chand ; Diamond Pub Ltd. New Delhi
2. Vyavaharik Hindi Vyakaran ,Anuvad thaha Rachana : Dr. H. Parameswaran, Radhakrishna publishing House,New Delhi
3. Kamtha Prasad Guru : Hindi Vyakaran, Best Book pub House, New Delhi
4. Poetry : Kavya Ras-Ed: T.V. Basker- Pachouri Press; Mathura

15HIN111 HINDI II 1 0 2 2

Appreciation and assimilation of Hindi Literature - both *drishya* and *shravya* - using the best specimens provided as anthology.

Course Outcomes: After the completion of the course the student will be able to:

CO1	Understand the grammatical structures of Hindi
CO2	and the post modern trends of literature
CO3	e critical thinking and writing skills
CO4	and analyse different literary and audio-visual material
CO5	ndamental knowledge of Hindi in formal and informal writing

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									**1**	**2**				

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

Syllabus:

Unit -1

Kavya Tarang;-Dhumil ke Anthim Kavitha[Poet-Dhumil],Dhabba[Poet-Kedarnath Singh],Proxy[Poet-Venugopal],Vakth[Poet-Arun Kamal],Maachis[Poet-Suneeta Jain].

Unit -2

Communicative Hindi - Moukhik Abhivyakthi

Unit -3

Audio- Visual –Media in Hindi – Movies like Tare Zameen par , Paa, Black etc., appreciation and evaluation . News reading and presentations in Radio and TV channels in Hindi .

Unit -4

Gadya Manjusha –Budhapa , Kheesa, Sadachar ka Thavis

Unit -5

Translation: Theory and Practice - Letter writing: Formal and Personal – Introduction to Hindi Software.

Text Books:

1. Kavay Tarang : Dr. Niranjan , Jawahar Pusthakalay , Mathura.
2. Gadya Manjusha: Editor: Govind , Jawahar Pusthakalay , Mathura
3. Prem Chand Ki Srvashrestha Kahaniyam: Prem Chand ; Diamond Pub Ltd. New Delhi
4. Kamtha Prasad Guru : Hindi Vyakaran, Best Book pub House, New Delhi
5. 5.Poetry : Kavya Ras-Ed: T.V. Basker- Pachouri Press; Mathura

15HUM230 EMOTIONAL INTELLIGENCE 2 0 0 2

Unit 1

Emotional Intelligence: Concept of Emotional Intelligence, Understanding the history and origin of Emotional Intelligence, Contributors to Emotional Intelligence, Science of Emotional Intelligence, EQ and IQ, Scope of Emotional Intelligence.

Unit 2

Components of Emotional Intelligence: Self-awareness, Self-regulation, Motivation, Empathy, Social skills. Emotional Intelligence Competencies, Elements of Emotional Intelligence, Models of Emotional Intelligence: The Ability-based Model, The Trait Model of Emotional Intelligence, Mixed Models of Emotional Intelligence.

Unit 3

Emotional Intelligence at Work place: Importance of Emotional Intelligence at Work place? Cost–savings of Emotional Intelligence, Emotionally Intelligent Leaders, Case Studies Measuring Emotional Intelligence: Emotionally Intelligence Tests, Research on Emotional Intelligence, Developing Emotional Intelligence.

REFERENCES:

1. *Daniel Goleman (1996). Emotional Intelligence- Why it can Matter More than IQ. Bantam Doubleday Dell Publishing Group*
2. *Daniel Goleman (2000). Working with Emotional Intelligence. Bantam Doubleday Dell Publishing Group*
3. *Liz Wilson, Stephen Neale & Lisa Spencer-Arnell (2012). Emotional Intelligence Coaching. Kogan Page India Private Limited*

15HUM231 GLIMPSES INTO THE INDIAN MIND:THE GROWTH OF MODERN INDIA 2 0 0 2

Unit 1

Introduction

General Introduction; 'His + Story' or 'History' ?; The concepts of 'nation', 'national identity' and 'nationalism'; Texts and Textualities: Comparative Perspectives.

Unit 2

Selected writings / selections from the complete works of the following authors will be taken up for study in a chronological order:

Raja Ram Mohan Roy; Dayananda Saraswati; Bal Gangadhar Tilak; Rabindranath Tagore;

Unit 3

Selected writings / selections from the complete works of the following authors will be taken up for study in a chronological order:

Swami Vivekananda; Sri Aurobindo; Ananda K. Coomaraswamy; Sister Nivedita; Mahatma Gandhi; Jawaharlal Nehru; B.R. Ambedkar; Sri Chandrasekharendra Saraswati, the Paramacharya of Kanchi; Dharampal; Raja Rao; V.S. Naipaul.

Conclusion.

REFERENCES:

5. *Tilak, Bal Gangadhar.The Orion / Arctic Home in the Vedas.*
6. *Tagore, Rabindranath. The History of Bharatavarsha / On Nationalism / Greater India.*
7. *Vivekananda, Swami. "Address at the Parliament of Religions"/"The Future of India"/"In Defence of Hinduism" from Selections from the Complete Works of Swami Vivekananda.*
8. *Aurobindo, Sri. The Renaissance in India / On Nationalism.*
9. *Coomaraswamy, Ananda K. Essays in Indian Idealism (any one essay) / Dance of Shiva.*
10. *Nivedita, Sister. "Noblesse Oblige: A Study of Indian Caste" / "The Eastern Mother" from The Web of Indian Life.*
11. *Gandhi, Mahatma. Hind Swaraj.*
12. *Nehru, Jawaharlal. "The Quest" from Discovery of India.*
13. *Ambedkar, B. R. "Buddha and His Dhamma" from Collected Works.*
14. *Saraswati, Chandrasekharendra. "The Sastras and Modern Life" from The Hindu Dharma.*
15. *Dharampal. Bharatiya Chitta, Manas and Kala / Understanding Gandhi.*
16. *Naipaul, V. S. India: A Wounded Civilization / India: A Million Mutinies Now.*

15HUM232 GLIMPSES OF ETERNAL INDIA 2 0 0 2

Unit 1

Introduction

A peep into India's glorious past

Ancient India – the vedas, the vedic society and the Sanatana Dharma – rajamandala and the Cakravartins – Ramarajya – Yudhisthira's ramarajya; Sarasvati - Sindhu Civilization and the myth of the Aryan Invasion; Classical India – Dharma as the bedrock of Indian society – Vaidika Brahmanya Dharma and the rise of Jainism and Buddhism – the sixteen Mahajanapadas and the beginning of Magadhan paramountcy

– Kautilya and his Arthasastra – Chandragupta Maurya and the rise of the Mauryan empire – Gupta dynasty Indian art and architecture – classical sanskrit literature – Harsavardhana; Trade and commerce in classical and medieval India and the story of Indian supremacy in the Indian ocean region; The coming of Islam – dismantling of the traditional Indian polity – the Mughal empire – Vijayanagara samrajya and days of Maratha supremacy.

Unit 2

India's contribution to the world: spirituality, philosophy and sciences

Indian Philosophy – the orthodox (Vaidika) and the heterodox (atheistic) schools; Ramayana and Mahabharata; Bhagavad Gita; Saints and sages of India; Ancient Indian medicine: towards an unbiased perspective; Ancient Indian mathematics; Ancient Indian astronomy; Ancient Indian science and technology.

The arrival of Europeans, British paramountcy and colonization

What attracted the rest of the world to India?; India on the eve of the arrival of European merchants; The story of colonization and the havoc it wrecked on Indian culture and civilization; Macaulay and the start of the distortion of Indian education and history; Indian economy – before and after colonization: a brief survey; The emergence of modern India.

Unit 3

Women in Indian society

The role and position of women in Hindu civilization; Gleanings from the Vedas, Brihadarnyaka Upanishad, Saptasati Devi Mahatmyam, Ramayana, Mahabharata, Manusmriti, Kautilya's Arthasastra and Mrichchhakatikam of Sudraka; The role and position of Indian women vis-a-vis Islam and European cultures; The great women of India.

Modern India

The national movement for freedom and social emancipation; Swami Vivekananda, Sri Aurobindo, Rabindranath Tagore; Understanding Mahatma Gandhi; A new nationis born as a republic – the pangs of birth and growth; India since Independence – the saga of socio-political movements; Problems facing the nation today; Globalization and Indian Economy; Bharatavarsha today and the way ahead: Regeneration of Indian National Resources.

Conclusion

The Wonder that was India; The 'politics' and 'purpose' of studying India.

REFERENCES:

3. *Parameswaran, S. The Golden Age of Indian Mathematics. Kochi: Swadeshi Science Movement.*
4. *Somayaji, D. A. A Critical Study of Ancient Hindu Astronomy. Dharwar: 1972.*
5. *Sen, S. N. & K. V. Sarma eds. A History of Indian Astronomy. New Delhi, 1985.*
6. *Rao, S. Balachandra. Indian Astronomy: An Introduction. Hyderabad: Universities Press, 2000.*
7. *Bose, D. M. et. al. A Concise History of Science in India. New Delhi: 1971.*
8. *Bajaj, Jitendra & M. D. Srinivas. Indian Economy and Polity. Chennai: Centre for Policy Studies.*
9. *Bajaj, Jitendra & M. D. Srinivas. Timeless India, Resurgent India. Chennai: Centre for Policy Studies.*
10. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre for Policy Studies, 2008.*
11. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*
12. *Vivekananda, Swami. Selections from the Complete Works of Swami Vivekananda. Kolkata: Advaita Ashrama.*
13. *Mahadevan, T. M. P. Invitations to Indian Philosophy. Madras: University of Madras.*
14. *Hiriyanna, M. Outlines of Indian Philosophy. Motilal Banarsidass.*
15. *Tagore, Rabindranath. The History of Bharatavarsha / On Nationalism / Greater India.*
16. *Majumdar, R. C. et. al. An Advanced History of India. Macmillan.*
17. *Mahajan, V. D. India Since 1526. New Delhi: S. Chand & Company.*
18. *Durant, Will. The Case for India. Bangalore: Strand Book Stall, 2008.*
19. *Aurobindo, Sri. The Indian Renaissance / India's Rebirth / On Nationalism.*
20. *Nivedita, Sister. The Web of Indian Life. Kolkata: Advaita Ashrama.*
21. *Durant, Will. The Story of Civilization. Volume 1 – Our Oriental Heritage. New York: Simon & Schuster.*
22. *Ranganathananda, Swami. Eternal Values for A Changing Society. Bombay: Bharatiya Vidya Bhavan.*
23. *Ranganathananda, Swami. Universal Message of the Bhagavad Gita. Kolkata: Advaita Ashrama.*
24. *Seturaman, V. S. Indian Aesthetics. Macmillan.*
25. *Coomaraswamy, Ananda K. The Dance of Shiva. New Delhi: Sagar Publications.*
26. *Coomaraswamy, Ananda K. Essays on Indian Idealism. New Delhi: Munshiram Manoharlal.*

27. *Danino, Michel. The Invasion That Never Was.*
28. *Kautilya. Arthasastra.*
29. *Altekar, A. S. State and Government in Ancient India. New Delhi: Motilal Banarsidass.*
30. *Altekar, A. S. The Position of Women in Hindu Civilization. New Delhi: Motilal Banarsidass.*
31. *Sircar, D. C. Studies in the Religious Life of Ancient and Medieval India. New Delhi: Motilal Banarsidass.*
32. *Sircar, D. C. Studies in the Political and Administrative Systems in Ancient and Medieval Times.New Delhi: Motilal Banarsidass.*
33. *Madhavananda, Swami & R. C. Majumdar eds. The Great Women of India. Kolkata: Advaita Ashrama.*
34. *Dutt, R. C. The Economic History of India. London, 1902.*
35. *Dharampal. Collected Works.*
36. *Dharampal. Archival Compilations (unpublished)*

15HUM233 GLIMPSES OF INDIAN ECONOMY AND POLITY 2 0 0 2

Unit 1

Introduction

General Introduction; Primitive man and his modes of exchange – barter system; Prehistoric and proto-historic polity and social organization.

Ancient India – up to 600 B.C.

Early India – the vedic society – the varnashramadharma – socio-political structure of the various institutions based on the four purusarthas; The structure of ancient Indian polity – Rajamandala and Cakravartins – Prajamandala; Socio-economic elements from the two great Epics – Ramayana and Mahabharata – the concept of the ideal King (Sri Rama) and the ideal state (Ramarajya) – Yudhisthira's ramarajya; Sarasvati - Sindhu civilization and India's trade links with other ancient civilizations; Towards chiefdoms and kingdoms – transformation of the polity: kingship – from gopati to bhupati; The mahajanapadas and the emergence of the srenis – states and cities of the Indo-Gangetic plain.

Unit 2

Classical India: 600B.C. – 1200 A.D.

The rise of Magadha, emergence of new religions – Buddhism and Jainism – and the resultant socio-economic impact; The emergence of the empire – the Mauryan Economy and Kautilya's Arthasastra; of Politics and trade – the rise of the Mercantile Community; Elements from the age of the Kushanas and the Great Guptas; India's maritime trade; Dharma at the bedrock of Indian polity – the concept of Digvijaya: dharma-vijaya, lobha-vijaya and asura-vijaya; Glimpses into the south Indian economies: political economies of the peninsula – Chalukyas, Rashtrakutas and Cholas

Medieval India: 1200 A.D. – 1720 A.D.

Advent of Islam – changes in the social institutions; Medieval India – agrarian economy, non-agricultural production and urban economy, currency system; Vijayanagara samrajya and maritime trade – the story of Indian supremacy in the Indian Ocean region; Aspects of Mughal administration and economy; The Maratha and other provincial economies.

Unit 3

Modern India: 1720 - 1947

the Indian market and economy before the arrival of the European traders; Colonisation and British supremacy (dismantling of everything that was 'traditional' or 'Indian') – British attitude towards Indian trade, commerce and economy and the resultant ruining of Indian economy and business – man-made famines – the signs of renaissance: banking and other business undertakings by the natives (the members of the early Tagore family, the merchants of Surat and Porbander, businessmen of Bombay, etc. may be referred to here) – the evolution of the modern banking system; Glimpses into British administration of India and administrative models; The National movement and nationalist undertakings in business and industry: the Tatas and the Birlas; Modern India: the growth of large-scale industry – irrigation and railways – money and credit – foreign trade; Towards partition – birth of two new nations – division of property; The writing of the Indian Constitution – India becomes a democratic republic – a new polity is in place.

Independent India – from 1947

India since Independence – the saga of socio-political movements; Indian economy since Independence – the fiscal system – the five year plans – liberalisation – the GATT and after; Globalisation and Indian economy; Impact of science and (new/ emerging) technology on Indian economy; Histories of select Indian business houses and business entrepreneurship.

Conclusion

REFERENCES:

1. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*
2. *Kautilya. Arthasastra.*
3. *Altekar, A. S. State and Government in Ancient India. New Delhi: Motilal Banarsidass.*
4. *Sircar, D. C. Studies in the Political and Administrative Systems in Ancient and Medieval Times. New Delhi: Motilal Banarsidass.*
5. *Dutt, R. C. The Economic History of India. London, 1902.*
6. *Dharampal. Collected Works (Volumes IV & V).*
7. *Dharampal. Archival Compilations (unpublished).*
8. *Bajaj, Jitendra & M. D. Srinivas. Indian Economy and Polity. Chennai: Centre for Policy Studies.*
9. *Bajaj, Jitendra & M. D. Srinivas. Timeless India, Resurgent India. Chennai: Centre for Policy Studies.*
10. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre for Policy Studies, 2008.*
11. *Tripathi, Dwijendra. The Oxford History of Indian Business. New Delhi: Oxford University Press, 2004.*
12. *McGuire, John, et al, eds. Evolution of World Economy, Precious Metals and India. New Delhi: Oxford University Press, 2001.*
13. *Tripathi, Dwijendra and Jyoti Jumani. The Concise Oxford History of Indian Business. New Delhi: Oxford University Press, 2007.*
14. *Kudaisya, Medha M. The Life and Times of G. D. Birla. New Delhi: Oxford University Press, 2003.*
15. *Raychaudhuri, Tapan and Irfan Haib, eds. The Cambridge Economic History of India. Volume*
    - *New Delhi: Orient Longman, 2004.*

16. *Kumar, Dharma, ed. The Cambridge Economic History of India. Volume 2. New Delhi: Orient Longman, 2005.*
17. *Sabavala, S. A. and R. M. Lala, eds. J. R. D. Tata: Keynote. New Delhi: Rupa & Co., 2004.*
18. *Mambro, Arvind ed. J. R. D. Tata: Letters. New Delhi: Rupa & Co., 2004.*
19. *Lala, R. M., For the Love of India: The Life and Times of Jamsetji Tata. New Delhi: Penguin, 2006.*
20. *Thapar, Romila. The Penguin History of Early India: From the Origins to AD 1300. New Delhi Penguin, 2002.*
21. *Majumdar, R. C., et. al. An Advanced History of India. Macmillan.*

15HUM234 HEALTH AND LIFE STYLE 1 0 2 2

Unit 1 Introduction to Health

Health is wealth; Role of lifestyle habits on health; Importance of adolescence; Stages, Characteristics and changes during adolescence; Nutritional needs during adolescence why healthy lifestyle is important for adolescence. Eating Habits - eating disorders, skipping breakfast, junk food consumption.

Practicals - Therapeutic Diets

Unit 2 Food and Nutritional Requirements during Adolescence

Fluid intake; nutrition related problems; lifestyle related problems, Role of physical activity; resting pattern and postures, Personal habits – alcoholism, and other tobacco products, electronic addiction etc

Practicals - Ethnic Foods

Unit 3 Need for a Positive Life Style Change

Peer pressure & procrastination, Stress, depression, suicidal tendency, Mini project review and viva, Whole portions revision.

Practical - Cooking without Fire or Wire-healthy Snacks

TEXTBOOKS:

1. *B. Srilakshmi, "Dietetics", New age international (P) ltd, publishers, 2010.*
2. *"Nutrient requirement and Recommended Dietary Allowances for Indians", published by Indian Council of Medical Research, ICMR, 2010.*

REFERENCE BOOKS:

1. K Park "Textbook of preventive and social medicine", 2010.
WHO Report on Adolescent Health: 2010

15HUM235 INDIAN CLASSICS FOR THE TWENTY-FIRST CENTURY 2 0 0 2

Unit 1
Introductory study of the Bhagavad Gita and the Upanishads.

Unit 2
The relevance of these classics in a modern age.

Unit 3
Goals of human life - existential problems and their solutions in the light of these classics etc.

REFERENCE:
The Bhagavad Gita, Commentary by Swami Chinmayananda

15HUM236 INTRODUCTION TO INDIA STUDIES 2 0 0 2

PREAMBLE: *This paper will introduce the students to the multiple dimensions of the contributionof India to the fields of philosophy, art, literature, physical and social sciences. The paper intends to give an insight to the students about the far-reaching contributions of India to world culture and thought during the course of its long journey from the hoary antiquity to the present times. Every nation takes pride in its achievements and it is this sense of pride and reverence towards the achievements that lays the foundation for its all-round progress.*

Unit 1
A brief outline of Indian history from prehistoric times to the present times.

Contributions of India to world culture and civilization: Indian Philosophy and Religion;Art and Literature; Physical and Social Sciences.

Unit 2
Modern India: Challenges and Possibilities.

Scientific and technological progress in post-independence era; Socio-cultural and political movements after independence; Challenges before the nation today - unemployment – corruption – degradation of cultural and moral values - creation of a new system of education; Creation of a modern and vibrant society rooted in traditional values.

Unit 3
Modern Indian Writing in English: Trends in Contemporary Indian Literature in English.

TEXTBOOK:
Material given by the Faculty

BACKGROUND LITERATURE:
1 *Selections from The Cultural Heritage of India, 6 volumes, Ramakrishna Mission Institute of Culture (Kolkata) publication.*
2 *Selections from the Complete Works of Swami Vivekananda, Advaita Ashrama publication.*

3 Invitations to Indian Philosophy, T. M. P. Mahadevan, University of Madras, Chennai.
4 Outlines of Indian Philosophy, M. Hiriyanna, MLBD.
5 An Advanced History of India, R. C. Majumdar et al, Macmillan.
6 India Since 1526, V. D. Mahajan, S. Chand & Company
7 The Indian Renaissance, Sri Aurobindo.
8 India's Rebirth, Sri Aurobindo.
9 On Nationalism, Sri Aurobindo.
10 The Story of Civilization, Volume I: Our Oriental Heritage, Will Durant, Simonand Schuster, New York.
11 Eternal Values for a Changing Society, Swami Ranganathananda, Bharatiya Vidya Bhavan.
12 Universal Message of the Bhagavad Gita, Swami Ranganathananda, Advaita Ashrama.
13 Awaken Children: Conversations with Mata Amritanandamayi
14 Indian Aesthetics, V. S. Seturaman, Macmillan.
15 Indian Philosophy of Beauty, T. P. Ramachandran, University of Madras, Chennai.
16 Web of Indian Thought, Sister Nivedita
17 Essays on Indian Nationalism, Anand Kumaraswamy
18 Comparative Aesthetics, Volume 2, Kanti Chandra Pandey, Chowkhamba, Varanasi
19 The Invasion That Never Was, Michel Danino
20 Samskara, U. R. Ananthamurthy, OUP.
21 Hayavadana, Girish Karnard, OUP.
22 Naga-Mandala, Girish Karnard, OUP.

15HUM237 INTRODUCTION TO SANSKRIT LANGUAGE AND LITERATURE **2 0 0 2**

OBJECTIVES: *To familiarize students with Sanskrit language; to introduce students to variousknowledge traditions in Sanskrit; to help students appreciate and imbibe India's ancient culture and values.*

Unit 1

Sanskrit Language – Vakya Vyavahara (वाक्यव्यवहार) - Introduction to Sanskrit language - Devanagari script and Sanskrit alphabet - Vowels and Consonants – Pronunciation - Classification of Consonants – Samyukthakshara Words – Nouns and Verbs - Cases – Introduction to Numbers and Time – Verbs: Singular, Dual and Plural –Sarva Namas: First Person, Second Person, Third Person – Tenses: Past, Present and Future -Words for Communication – Selected Slokas – Moral Stories – Subhashithas – Riddles.

Unit 2

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

Unit 3

Introduction to Sanskrit Classical Literature – KavyaTradition – Drama Tradition - Stotra Tradition – Panchatantra Stories.

Unit 4

Introduction to Sanskrit Technical Literature – Astronomy – Physics – Chemistry – Botany – Engineering – Aeronautics – Ayurveda – Mathematics – Medicine – Architecture - Tradition of Indian Art – Administration – Agriculture.

Unit 5

Indology Studies – Perspectives and Innovations.

TEXTBOOKS AND REFERENCE BOOKS:

1. *Vakya Vyavahara - Prof. Vempaty Kutumba Sastri, Rashtriya Sanskrit Sansthan, New Delhi*
2. *The Wonder that is Sanskrit - Dr. Sampadananda Mishra, New Delhi*
3. *Science in Sanskrit – Samskritha Bharathi, New Delhi*

15HUM238 NATIONAL SERVICE SCHEME 2 0 0 2

Unit 1

Introduction to Basic Concepts of NSS: History, philosophy, aims and objectives of NSS, Emblem, flag, motto, song, badge etc., Organisational structure, roles and responsibilities of various NSS functionaries.

NSS Programmes and Activities: Concept of regular activities, special campaigning, Day Camps, Basis of adoption of village / slums, methodology of conducting survey, financial pattern of the scheme, other youth programme/schemes of GOI, Coordination with different agencies, Maintenance of the Diary.

Unit 2

Volunteerism and Shramdan: Indian Tradition of volunteerism, Needs and importance of volunteerism, Motivation and Constraints of volunteerism, Shramdan as part of volunteerism, Amalabharatam Campaign, Swatch Bharath.

Unit 3

Understanding youth: Definition, profile and categories of youth, Issues, challenges and opportunities for youth, Youth as an agent of social change.

Youth and Yoga: History, philosophy and concept of Yoga, Myths and misconceptions about Yoga, Different Yoga traditions and their impacts, Yoga as a preventive and curative method, Yoga as a tool for healthy life style

Unit 4

Youth Development Programmes in India: National Youth Policy, Youth development programmes at the national level, state level and voluntary sector, youth-focused and youth-led organizations.

Youth and Crime: Sociological and psychological factors influencing youth crime, Peer mentoring in preventing crimes, Awareness about Anti-Ragging, Cyber Crime and its prevention, Juvenile Justice.

Unit 5

Environmental Issues: Environment conservation, enrichment and sustainability, climate change, waste management, rain water harvesting, energy conservation, waste land development.

Project Work / Practical

15HUM239 PSYCHOLOGY FOR EFFECTIVE LIVING 2 0 0 2

Course Objectives

1. To help students acquire the basic knowledge of behavior and effective living
2. To create an awareness of the hazards of health compromising behaviours
3. To develop and strengthen the tools required to handle the adversities of life

Course Outcome

CO 1: Understand thebasicconcepts of Behavioral Psychology
CO 2: Demonstrate self reflective skillsthrough activities
CO 3: Apply the knowledge of psychology to relieve stress
CO 4: Analyse the adverse effects of health compromising behaviours.
CO 5: Evaluate and use guided techniquesto overcome and cope with stress related problems.

CO-PO Mapping

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

Syllabus

Unit 1

SELF AWARENESS & SELF MOTIVATION
Definition of motivation-Maslow's hierarchy of motivation-Self-analysis through SWOT and Johari window - Importance of self-esteem and Enhancement of self-esteem-techniques and Strategies for self-motivation.

Unit 2

THE NATURE AND COPING OF STRESS

Definition of stress, stressors, eustress, distress-PTSD-stress among college students- stress assessment-coping with stress-progressive muscle relaxation-RET-guided imagery-bio feedback-religious and spiritual way of coping with stress

Unit 3

APPLICATION OF HEALTH PSYCHOLOGY

Health compromising behaviors-smoking and alcoholism-biological and psychological effects of addiction-deaddiction-behavior modifications-CBT in handling problem behavior-cancer risks-AIDS.

Text Book(s)

V.D.Swaminathan&K.V.Kaliappan, Psychology for Effective living-An introduction to Health

Reference(s)

1.S.Sunder. (2002). Textbook of Rehabilitation,2nd edition,Jaypee Brothers,New Delhi.

2.Weiben&Lloyd. (2004). Psychology applied to Modern Life,Thompson Learning,Asia Ltd.

15HUM240 PSYCHOLOGY FOR ENGINEERS 2 0 0 2

Course Objectives

1. To strengthen the fundamental knowledge of human behavior
2. To strengthen the ability to understand the basic nature and behavior of humans in organizations as a whole
3. To connect the concepts of psychology to personal and professional life

Course Outcome

CO 1: Understand the fundamental processes underlying human behavior such as learning, motivation, individual differences, intelligence and personality.
CO 2: Apply the principles of psychology in day- to- day life for a better understanding of oneself and others.
CO 3: Apply the knowledge ofPsychology to improve study skills and learning methods
CO 4: Apply the concepts of defense mechanisms to safeguard against abusive relationships and to nurture healthy relationships.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

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

Unit 1

PSYCHOLOGY OF ADOLESCENTS

Psychology-definition-scope-adolescence-characteristics-developmental tasks-physical and psychological changes-interests-family relationships-emotions-peer pressure-positive and Negative effects of peer pressure-types of friends-choice of friends

Unit 2

LEARNING, MEMORY AND STUDY SKILLS

Definitions-Classical conditioning-Operant conditioning-Insight learning-reinforcement-its principles and its effects-role of reward and punishment in learning-forgetting-causes-techniques for improving study skills-Mnemonics-Intelligence-Emotional and social intelligence

Unit 3

ATTENTION & PERCEPTION

Definition-types of attention-span of attention-division of attention- factors determining

attention-perception-difference between sensation and perception-laws of perception-errors in

perception-illusion and hallucination

Text Book(s)

S.K.Mangal General Psychology,Sterling Publishers Pvt.Ltd.2007

Reference(s)

1.Elizabeth B. Hurlock, Developmental Psychology - A Life span approach,6th edition

2.Cliffordm Organ, Richard King, John Scholper, Introduction to Psychology, Tata McGraw

Hill, Pvt Ltd 2004.

15HUM241 SCIENCE AND SOCIETY – AN INDIAN PERSPECTIVE 2 0 0 2

Unit 1

Introduction

Western and Indian views of science and technology

Introduction; Francis Bacon: the first philosopher of modern science; The Indian tradition in science and technology: an overview.

Unit 2

Indian sciences

Introduction; Ancient Indian medicine: towards an unbiased perspective; Indian approach to logic; The methodology of Indian mathematics; Revision of the traditional Indian planetary model by Nilakantha Somasutvan in circa 1500 AD.

Science and technology under the British rule

Introduction; Indian agriculture before modernization; The story of modern forestry in India; The building of New Delhi

Unit 3

Science and technology in Independent India

Introduction; An assessment of traditional and modern energy resources; Greenrevolution: a historical perspective; Impact of modernisation on milk and oilseeds economy; Planning without the spirit and the determination.

Building upon the Indian tradition

Introduction; Regeneration of Indian national resources; Annamahatmyam and Annam Bahu Kurvita: recollecting the classical Indian discipline of growing and sharing food in plenty and regeneration of Indian agriculture to ensure food for all in plenty.

Conclusion

REFERENCES:

1. *Joseph, George Gheverghese. The Crest of the Peacock: Non-European Roots of Mathematics. London: Penguin (UK), 2003.*
2. *Iyengar, C. N. Srinivasa. History of Hindu Mathematics. Lahore: 1935, 1938 (2 Parts).*
3. *Amma, T. A. Saraswati. Geometry in Ancient and Medieval India. Varanasi: Motilal Banarsidass, 1979.*
4. *Bag, A. K. Mathematics in Ancient and Medieval India. Varanasi: Motilal Banarsidass, 1979.*
5. *Sarma K. V. & B. V. Subbarayappa. Indian Astronomy: A Source-Book. Bombay: Nehru Centre, 1985.*
6. *Sriram, M. S. et. al. eds. 500 Years of Tantrasangraha: A Landmark in the History of Astronomy. Shimla: Indian Institute of Advanced Study, 2002.*
7. *Bajaj, Jitendra & M. D. Srinivas. Restoring the Abundance: Regeneration of Indian Agriculture to Ensure Food for All in Plenty.Shimla: Indian Institute of Advanced Study, 2001.*
8. *Bajaj, Jitendra ed. Report of the Seminar on Food for All: The Classical Indian Discipline of Growing and Sharing Food in Plenty. Chennai: Centre for Policy Studies, 2001.*
9. *Bajaj, Jitendra & M. D. Srinivas. Annam Bahu Kurvita: Recollecting the Indian Discipline of Growing and Sharing*

Food in Plenty. Madras: Centre for Policy Studies, 1996.

10. *Parameswaran, S. The Golden Age of Indian Mathematics. Kochi: Swadeshi Science Movement.*
11. *Somayaji, D. A. A Critical Study of Ancient Hindu Astronomy. Dharwar: 1972.*
12. *Sen, S. N. & K. V. Sarma eds. A History of Indian Astronomy. New Delhi, 1985.*
13. *Rao, S. Balachandra. Indian Astronomy: An Introduction. Hyderabad: Universities Press, 2000.*
14. *Bose, D. M. et. al. A Concise History of Science in India. New Delhi: 1971.*
15. *Bajaj, Jitendra & M. D. Srinivas. Indian Economy and Polity. Chennai: Centre for Policy Studies.*
16. *Bajaj, Jitendra & M. D. Srinivas. Timeless India, Resurgent India. Chennai: Centre for Policy Studies.*
17. *Joshi, Murli Manohar. Science, Sustainability and Indian National Resurgence. Chennai: Centre for Policy Studies, 2008.*
18. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*

** The syllabus and the study material in use herein has been developed out of a 'summer programme' offered by the Centre for Policy Studies (CPS), Chennai at the Indian Institute ofAdvanced Study (IIAS), Rashtrapati Nivas, Shimla, sometime ago. The same has been very kindly made available to us by Professors Dr M.D. Srinivas (Chairman) and Dr J.K. Bajaj (Director) of the CPS.*

15HUM242 THE MESSAGE OF BHAGAVAD GITA 2 0 0 2

Unit 1

Introduction: Relevance of Bhagavad Gita today – Background of Mahabharatha.

Arjuna Vishada Yoga: Arjuna's Anguish and Confusion – Symbolism of Arjuna's Chariot.

Sankhya Yoga: Importance of Self-knowledge – Deathlessness: Indestructibility of Consciousness – Being Established in Wisdom – Qualities of a Sthita-prajna.

Unit 2

Karma Yoga: Yoga of Action – Living in the Present – Dedicated Action without Anxiety over Results - Concept of Swadharma.

Dhyana Yoga: Tuning the Mind – Quantity, Quality and Direction of Thoughts – Reaching Inner Silence.

Unit 3

Bhakti Yoga: Yoga of Devotion – Form and Formless Aspects of the Divine – Inner Qualities of a True Devotee.

Gunatraya Vibhaga Yoga: Dynamics of the Three Gunas: Tamas, Rajas, Sattva – Going Beyond the Three Gunas – Description of a Gunatheetha.

TEXTBOOKS / REFERENCES:

1. Swami Chinmayananda, "The Holy Geeta", Central Chinmaya Mission Trust, 2002.

2. Swami Chinmayananda, "A Manual of Self Unfoldment", Central Chinmaya Mission Trust, 2001.

15HUM243 THE MESSAGE OF THE UPANISHADS 2 0 0 2

OBJECTIVES: *To give students an introduction to the basic ideas contained in the Upanishads;and explores how their message can be applied in daily life for achieving excellence.*

Unit 1

An Introduction to the Principal Upanishads and the Bhagavad Gita - Inquiry into the mystery of nature - Sruti versus Smrti - Sanatana Dharma: its uniqueness - The Upanishads and Indian Culture - Upanishads and Modern Science.

Unit 2

The challenge of human experience & problems discussed in the Upanishads – the True nature of Man – the Moving power of the Spirit – The Message of Fearlessness – Universal Man - The central problems of the Upanishads – Ultimate reality – the nature of Atman - the different manifestations of consciousness.

Unit 3

Upanishad Personalities - episodes from their lives and essential teachings: Yajnavalkya, Aruni, Uddalaka, Pippalada, Satyakama Jabala, Svetaketu, Nachiketas, Upakosala, Chakrayana Ushasti, Raikva, Kapila and Janaka. Important verses from Upanishads - Discussion of Sage Pippalada's answers to the six questions in Prasnopanishad.

REFERENCES:

1. The Message of the Upanishads by Swami Ranganathananda, Bharatiya Vidya Bhavan
2. Eight Upanishads with the commentary of Sankaracharya, Advaita Ashrama
3. Indian Philosophy by Dr. S. Radhakrishnan, Oxford University Press
4. Essentials of Upanishads by R L Kashyap, SAKSI, Bangalore
5. Upanishads in Daily Life, Sri Ramakrishna Math, Mylapore.
6. Eternal stories of the Upanishads by Thomas Egenes and Kumuda Reddy
7. Upanishad Ganga series – Chinmaya Creations

15HUM244 UNDERSTANDING SCIENCE OF 1 0 2 2 FOOD AND NUTRITION

Course Objectives:

- To introduce the significance of food, nutrients, locally available food resources, synergic food combinations, good cooking methods and importance of diversity in foods
- To understand nutritional imbalances and chronic diseases associated with the quality of food.
- To gain awareness about the quality of food - Organic food, genetically modified food, adulterated food, allergic food, , food poisoning and food safety.
- To understand food preservation processing, packaging and the use of additives.

Course Outcome:

CO1: Acquire knowledge about the various food and food groups

CO2: Understand nutritional imbalances and chronic diseases prevailing among different age groups.

CO3: Understand the significance of safe food and apply the food safety standards

CO4: Demonstrate skills of food processing, preservation and packaging methods with or without additives
CO5: Evaluate the quality of food based on the theoretical knowledge ofFood and Nutrition

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1		1	1			1	2	1	1	1	1	3
CO 2		1	1			1	1	1	1	1	1	3
CO 3		1	1			1	1	1	1	1	1	3
CO 4		1	1			1	1	1	1	1	1	3
CO 5		1	1			1	2	1	2	1	1	3

1. **UNIT I: FOOD AND FOOD GROUPS:**Introduction to foods, food groups, Identifying locally available foods and plant nutrients. Nutrients and its variety. Cooking methods, effects of cooking on nutritive value of foods, while preparation and preservation of foods, cooking utensils & instruments. Synergy between foods, Do and Don'ts while cooking. Science behind foods.Food allergies, food poisoning, food safety standards.

2. **UNIT II: NUTRIENTS AND NUTRITION:**Nutrition through life cycle, RDA intake for all age groups. Nutrition in disease – Malnutrition (under & over), other diseases. Adulteration of foods & Food additives. Packaging and labeling of foods, certification, logo & symbols.

3. **UNIT III: INTRODUCTION TO FOOD BIOTECHNOLOGY:**Future foods- Organic foods and genetically modified foods, Fortification of foods, bio fortification of foods, value addition of foods, functional foods, nutraceuticals, weaning foods/supplementary. Processing and preservation of foods, applications of food technology in daily life, and your prospects associated with food industry – Nanoparticles, biosensors, advanced research.

Reference Books:

- C. Gopalanetal, **Nutritive Value of Indian Foods**, National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, 2017.
- B.SriLakhmi, **Dietetics**, New age international, 2015.

- N, ShakuntalaManay, M. Shadaksharaswamy, **Foods Facts and Principles**, New Age International, New Delhi, 2008.
- Sumati.RMudamri, and M.V.Rajagopal, **Fundamental of foods, Nutrition and Diet Therapy**, New Age International, New Delhi, 2008.

15JAP230 PROFICIENCY IN JAPANESE LANGUAGE (LOWER) 1 0 2 2

This paper will introduce the basics of Japanese language. Students will be taught the language through various activities like writing, reading, singing songs, showing Japanese movies etc. Moreover this paper intends to give a thorough knowledge on Japanese scripts that is Hiragana and Katakana. Classes will be conducted throughout in Japanese class only. Students will be able to make conversations with each other in Japanese. Students can make self-introduction and will be able to write letters in Japanese. All the students will be given a text on Japanese verbs and tenses.

Students can know about the Japanese culture and the lifestyle. Calligraphy is also a part of this paper. Informal sessions will be conducted occasionally, in which students can sing Japanese songs, watch Japanese movies, do Origami – pattern making using paper.

15JAP231 PROFICIENCY IN JAPANESE LANGUAGE (HIGHER) 1 0 2 2

Students will be taught the third and the most commonly used Japanese script, Kanji. Students will be taught to write as well as speak.

Students will be given detailed lectures on Calligraphy.

This version of the course includes a new project where the students should make a short movie in Japanese language selecting their own topics.

By the end of the semester they the students will master the subject in all means. They will be able to speak Japanese as fluently as they speak English. Students will be encouraged to write stories and songs in Japanese language themselves.

15KAN101 KANNADA I 1 0 2 2

OBJECTIVES: *To enable the students to acquire basic skills in functional language; to developindependent reading skills and reading for appreciating literary works; to analyse language in context to gain an understanding of vocabulary, spelling, punctuation and speech.*

Unit 1

Adalitha Kannada: bhashe, swaroopa, belavanigeya kiru parichaya Paaribhaashika padagalu
Vocabulary Building

Unit 2

Prabhandha – Vyaaghra Geethe - A. N. Murthy Rao

Prabhandha – Barededi…barededi, Baduku mugiyuvudilla allige…- Nemi Chandra Paragraph writing – Development: comparison, definition, cause & effect Essay – Descriptive & Narrative

Unit 3

Mochi – Bharateepriya

Mosarina Mangamma – Maasti Venkatesh Iyengar

Kamalaapurada Hotelnalli – Panje Mangesh Rao Kaanike – B. M. Shree

Geleyanobbanige bareda Kaagada – Dr. G. S. Shivarudrappa Moodala Mane – Da. Ra. Bendre

Swathantryada Hanate – K. S. Nissaar Ahmed

Unit 4

Letter Writing - Personal: Congratulation, thanks giving, invitation, condolence

Unit 5

Reading Comprehension; nudigattu, gaadegalu

Speaking Skills: Prepared speech, pick and speak

REFERENCES:

5. H. S. Krishna Swami Iyangar – Adalitha Kannada – Chetana Publication, Mysuru

6. A. N. Murthy Rao – Aleyuva Mana – Kuvempu Kannada Adyayana Samste

7. Nemi Chandra – Badhuku Badalisabahudu – Navakarnataka Publication

8. Sanna Kathegalu - Prasaranga, Mysuru University , Mysuru

9. B. M. Shree – Kannadada Bavuta – Kannada Sahitya Parishattu

10. K. S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna Book House (P) Ltd.

11. Dr. G. S. Shivarudrappa – Samagra Kavya – Kamadhenu Pustaka Bhavana

15KAN111 KANNADA II 1 0 2 2

OBJECTIVES: *To enable the students to acquire basic skills in functional language; to developindependent reading skills and reading for appreciating literary works; to develop functional and creative skills in language; to enable the students to plan, draft, edit & present a piece of writing.*

Unit 1

Official Correspondence: Adhikrutha patra, prakatane, manavi patra, vanijya patra

Unit 2

Nanna Hanate - Dr. G. S. Shivarudrappa

Mankuthimmana Kaggada Ayda bhagagalu – D. V. Gundappa (Padya Sankhye 5, 20, 22, 23, 25, 44, 344, 345, 346,

601)
Ella Marethiruvaga - K. S. Nissaar Ahmed Saviraru Nadigalu – S Siddalingayya

Unit 3
Sayo Aata – Da. Ra. Bendre

Unit 4
Sarva Sollegala turtu Maha Samelana - Beechi
Swarthakkaagi Tyaga - Beechi

Unit 5
Essay writing: Argumentative & Analytical
Précis writing

REFERENCES:

1. *H. S. Krishnaswami Iyangar – Adalitha Kannada – Chetan Publication, Mysuru*
2. *Dr. G. S. Shivarudrappa – Samagra Kavya. - Kamadhenu Pustaka Bhavana*
3. *Shrikanth - Mankuthimmana Kagga – Taatparya – Sri Ranga Printers & Binders*
4. *K. S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna book house*
5. *Dr. Da. Ra. Bendre – Saayo Aata – Shri Maata Publication*
6. *Beechi – Sahukara Subbamma – Sahitya Prakashana*

15MAL101 MALAYALAM I 1 0 2 2

Course Objectives:

To teach Malayalam for effective communication in different spheres of life:- Social context , Education, Research & Media

Course Outcome : After the completion of the course the student will be able to:

CO1	Understand and inculcate philosophical thoughts and practices
CO2	Understand and appreciate the post modern trends of literature.
CO3	Analyse the literary texts and comprehend the cultural diversity of Kerala
CO4	Distinguish the different genres in Malayalam literature
CO5	Demonstrate the ability to effectively communicate in Malayalam

CO-PO Mapping Mapping of course outcomes with program outcomes:

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

Unit 1

Ancient poet trio:*Adhyatmaramayanam*,*LakshmanaSwanthanam (Lines: valsasoumitre… mungikidakayal),*Ezhuthachan -Medieval period classics – *Jnanappana(Lines: kalaminnu… vilasangalingane*),Poonthanam.

Unit 2

Modern Poet trio: *EnteGurunathan,* VallatholNarayanaMenon- Critical analysis of the poem.

Unit 3

Short stories from period 1/2/3:*Poovanpazham*-VaikaomMuhammedBasheer-Literary & Cultural figures of Kerala and about their literary contributions.

Unit 4

Literary Criticism: *BharathaParyadanam-VyasanteChiri*–Ithihasa studies-KuttikrishnaMararu-Outline of literary Criticism in Malayalam Literature-Introduction to KuttikrishnaMararu& his outlook towards literature &life.

Unit 5

Error-freeMalayalam: **1**.Language; **2**.Clarity of expression; **3**.Punctuation-Thettillatha

Malayalam – Writing-**a**. Expansion of ideas; **b**.PrecisWriting; **c**. Essay Writing; **d**.Letter writing; **e**.RadioSpeech;**f**.Script/Feature/Script Writing;**g**.NewsEditing;**h**.Advertising;**i.**Editing;j.EditorialWriting;**k**.Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

1. Prof. PanmanaRamachandranNair(Edited),*Thunjanpadhanangal*, Current Books, 2012.

2. Prof. G.Balakrishnan Nair,.*JnanappanayumHarinamaKeerthanavum*, N.B.S, 2005.

3..Dr. M.N.Karasseri,*BasheerintePoonkavanam*, D.C.Books, 2008.

4 Prof. M.N.Vijayan, *MarubhoomikalPookkumbol,*D.C.Books, 2010.

5..Prof. M.ThomasMathew,*LavanyanubhavathinteYukthisasthram*, Kerala Sahitya Academy, 2006.

6. Dr. .M.Leelavathy,*KavithaSahityacharitram,* Kerala Sahitya Academy, 1996.

7. ThayattuSankaran, *VallatholNavayugathinteKavi*,VallatholVidyapeetham

15MAL111 MALAYALAM II 1 0 2 2

Course Objectives

- To appreciate the aesthetics and understand the cultural implications in Malayalam Literature
- To enhance creative thinking in Malayalam
- To equip the students to read and write effectively in Malayalam
- To acquire pronunciation skills

Course Outcome:

After the completion of the course the student will be able to:

CO1	Understand the different cultural influences in linguistic translation
CO2	Identify and appreciate the Romantic elements of modern literature
CO3	Analyze the genre of autobiographical writing
CO4	Critically evaluate the significance of historical, political and socio cultural aspects in literature
CO5	Demonstrate good writing skills in Malayalam

CO-PO Mapping Mapping of course outcomes with program outcomes:

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

CO4	-	-	-	-	-	-	-	-	-	**3**	-	-
CO5	-	-	-	-	-	-	-	-	**1**	**1**	-	-

Unit1

Ancient poet trio: *Kalayanasougandhikam,(Lines: kallummarangalum… namukkennarikavrikodara),*KunjanNambiar - Critical analysis of his poetry-Ancient Drama: *Kerala Sakunthalam* (Act 1), Kalidasan (Transilated by Attor Krishna Pisharody).

Unit 2

Modern/romantic/contemporary poetry: *Manaswini,* Changampuzha Krishna Pillai –Romanticism – modernism.

Unit 3

Anthology of short stories from period 3/4/5: *NinteOrmmayku*, M.T.Vasudevan Nair-literary contributions of his time.

Unit 4

Partof an autobiography/travelogue: *KannerumKinavum*, Chapter: Valarnnuvarunnoratmavu, V.T.Bhattathirippadu-Socio-cultural literature-historical importance.

Unit 5

Error-free Malayalam-**1**.Language; **2**.Clarity of expression; **3**.Punctuation-Thettillatha Malayalam-Writing-**a**.Expansion of ideas;**b**.PrécisWriting;**c.** Essay Writing; **d**.Letter writing;**e**.RadioSpeech;**f**.Script/Feature/ScriptWriting;**g**.NewsEditing;**h.**Advertising;**i**.Editing; **j**.EditorialWriting;**k**.Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

1. Prof.P.K.NarayanaPillai.,(SahityaPanchanan), *Vimarsanathrayam,* Kerala Sahitya Academy,2000.

2. Prof.M.P. SankunniNair.,*ChathravumChamaravum,* D.C.Books, 2004.

3.Prof.M.K.Sanu, *Changampuzha: Nakshatrangalude Snehabhajanam*,N.B.S.,1989.

4. Prof.S.GupthanNair,*AsthiyudePookkal*, D.C Books.2005.

5. Prof. PanmanaRamachandranNair,*ThettillathaMalayalam*,*Sariyumthettum etc*., D.C.Book, 2006.

6. Prof.M. Achuthan, *Cherukatha-Innale, innu*, National Book Stall, 1998.

7. Prof.N.KrishnaPillai,*KairaliyudeKatha*,National Book Stall, 2001.

15SAN101 SANSKRIT I 1 0 2 2

OBJECTIVES: *To familiarize students with Sanskrit language and literature; to enable them toread and understand Sanskrit verses and sentences; to help them acquire expertise for self-study of Sanskrit texts and communication in Sanskrit; to help the students imbibe values of life and Indian culture as propounded in scriptures.*

Unit 1

Introduction to Sanskrit language, Devanagari script - Vowels and consonants, pronunciation, classification of consonants, conjunct consonants, words – nouns and verbs, cases – introduction, numbers, Pronouns, communicating time in Sanskrit. Practical classes in spoken Sanskrit

Unit 2

Verbs- Singular, Dual and plural – First person, Second person, Third person.

Tenses – Past, Present and Future – Atmanepadi and Parasmaipadi - kartharipraYoga

Unit 3

Words for communication, slokas, moral stories, subhashithas, riddles (from the books prescribed)

Unit 4

Selected slokas from Valmiki Ramayana, Kalidasa's works and Bhagavad Gita.

Ramayana – chapter VIII - verse 5, Mahabharata - chapter 174, verse -16, Bhagavad Gita – chapter - IV verse 8, Kalidasa's Sakuntalam Act IV – verse 4

Unit 5

Translation of simple sentences from Sanskrit to English and vice versa.

ESSENTIAL READING:

4. Praveshaha; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore - 560 085
5. Sanskrit Reader I, II and III, R. S. Vadhyar and Sons, Kalpathi, Palakkad
6. Prakriya Bhashyam written and published by Fr. John Kunnappally
7. Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston
5, Sabdamanjari, R. S. Vadyar and Sons, Kalpathi, Palakkad
6. Namalinganusasanam by Amarasimha published by Travancore Sanskrit series
7. Subhashita Ratna Bhandakara by Kashinath Sharma, published by Nirnayasagar press

15SAN111 SANSKRIT II 1 0 2 2

OBJECTIVES: *To familiarize students with Sanskrit language and literature; to enable them toread and understand*

Sanskrit verses and sentences; to help them acquire expertise for self-study of Sanskrit texts and communication in Sanskrit; to help the students imbibe values of life and Indian culture as propounded in scriptures.

Unit 1
Seven cases, indeclinables, sentence making with indeclinables, Saptha karakas.

Unit 2
Ktavatu Pratyaya, Upasargas, Ktvanta, Tumunnanta, Lyabanta. Three Lakaras – brief introduction,
Lot lakara.

Unit 3
W ords and sentences for advanced communication. Slokas, moral stories (Pancatantra) Subhashitas, riddles.

Unit 4
Introduction to classical literature, classification of Kavyas, classification of Dramas - The five Mahakavyas, selected slokas from devotional kavyas - Bhagavad Gita
– chapter - II verse 47, chapter - IV verse 7, chapter - VI verse 5, chapter - VIII verse 6, chapter - XVI verse 21, Kalidasa's Sakuntala act IV – verse 4, Isavasyopanishat 1st Mantra, Mahabharata chapter 149 verses 14 - 120, Neetisara chapter - III

Unit 5
Translation of paragraphs from Sanskrit to English and vice versa.

ESSENTIAL READING:

1. *Praveshaha; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560 085*
2. *Sanskrit Reader I, II and III, R. S. Vadhyar and Sons, Kalpathi, Palakkad*
3. *Prakriya Bhashyam written and published by Fr. John Kunnappally*
4. *Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston*
5. *Sabdamanjari, R. S. Vadyar and Sons, Kalpathi, Palakkad*
6. *Namalinganusasanam by Amarasimha published by Travancore Sanskrit series*
7. *Subhashita Ratna Bhandakara by Kashinath Sharma, published by Nirnayasagar Press.*

15SWK230 CORPORATE SOCIAL RESPONSIBILITY 2 0 0 2

Unit 1
Understanding CSR - Evolution, importance, relevance and justification. CSR in the Indian context, corporate strategy. CSR and Indian corporate. Structure of CSR - In

the Companies Act 2013 (Section 135); Rules under Section 13; CSR activities, CSR committees, CSR policy, CSR expenditure CSR reporting.

Unit 2

CSR Practices & Policies - CSR practices in domestic and international area; Role and contributions of voluntary organizations to CSR initiatives. Policies; Preparation of CSR policy and process of policy formulation; Government expectations, roles and responsibilities. Role of implementation agency in Section 135 of the Companies Act, 2013. Effective CSR implementation.

Unit 3

Project Management in CSR initiatives - Project and programme; Monitoring and evaluation of CSR Interventions. Reporting - CSR Documentation and report writing. Reporting framework, format and procedure.

REFERENCES:

1. *Corporate Governance, Ethics and Social Responsibility, V Bala Chandran and V Chandrasekaran, PHI learning Private Limited, New Delhi 2011.*
2. *White H. (2005) Challenges in evaluating development effectiveness: Working paper 242, Institute of Development Studies, Brighton.*
3. *UNDP (nd) Governance indicators: A users guide. Oslo: UNDP*
4. *Rao, Subbha (1996) Essentials of Human Resource Management and Industrial Relations, Mumbai, Himalaya*
5. *Rao, V. S. L. (2009) Human Resource Management, New Delhi, Excel Books,*

15SWK231 WORKPLACE MENTAL HEALTH 2 0 0 2

Unit 1

Mental Health – concepts, definition, Bio-psycho-social model of mental health. Mental health and mental illness, characteristics of a mentally healthy individual, Signs and symptoms of mental health issues, presentation of a mentally ill person.

Work place – definition, concept, prevalence of mental health issues in the work place, why invest in workplace mental health, relationship between mental health and productivity, organizational culture and mental health. Case Study, Activity.

Unit 2

Mental Health Issues in the Workplace: Emotions, Common emotions at the workplace, Mental Health issues - Anger, Anxiety, Stress & Burnout, Depression, Addictions – Substance and Behavioural, Psychotic Disorders - Schizophrenia, Bipolar Disorder, Personality disorders. Crisis Situations - Suicidal behavior, panic attacks, reactions to traumatic events. Stigma and exclusion of affected employees. Other issues –work-life balance, Presenteeism, Harassment, Bullying, Mobbing. Mental Health First Aid - Meaning. Case Study, Activity.

Unit 3

Strategies of Help and Care: Positive impact of work on health, Characteristics of mentally healthy workplace, Employee and employer obligations, Promoting mental health and well being - corporate social responsibility (CSR), an inclusive work environment, Training and awareness raising, managing performance, inclusive recruitment, Supporting individuals-talking about mental health, making reasonable adjustments, Resources and support for employees - Employee Assistance Programme / Provider (EAP), in house counsellor, medical practitioners, online resources and telephone support, 24 hour crisis support, assistance for colleagues and care givers, Legislations. Case

Study, Activity.

REFERENCES:

1. *American Psychiatric Association. "Diagnostic and statistical manual of mental disorders: DSM-IV 4th ed." www.terapiacognitiva.eu/dwl/dsm5/DSM-IV.pdf*
2. *American Psychiatric Association. (2000) www.ccsa.ca/Eng/KnowledgeCentre/OurDatabases/ Glossary/Pages/index.aspx.*
3. *Canadian Mental Health Association, Ontario "Workplace mental health promotion, A how to guide"wmhp.cmhaontario.ca/*
4. *Alberta Health Services Mental Health Promotion. (2012). Minding theWorkplace: Tips for employees and managers together. Calgary: Alberta Health Services.http:// www.mentalhealthpromotion.net/resources/minding-the-workplace-tips-for-employees-and-managers-together.pdf*
5. *Government of Western Australia, Mental Health Commission. (2014) "Supporting good mental health in the work place." http://www.mentalhealth.wa.gov.au/Libraries/pdf_docs/ supporting_good_mental_health_in_the_workplace_1.sflb.ashx*
6. *Mental Health Act 1987 (India) www.tnhealth.org/mha.htm*
7. *Persons with disabilities Act 1995 (India) socialjustice.nic.in*
8. *The Factories Act 1948 (India) www.caaa.in/Image/19ulabourlawshb.pdf*

15TAM101 TAMIL I 2 0 0 2

Course Objectives

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

Course Outcomes

CO 1: To understand the Sangam literature

CO 2: To understand the creative literature

CO 3: To understand the literary work on religious scriptures

CO 4: To improve the communication and memory skills

CO 5: To understand the basic grammar components of Tamil language and their usage and applications.

CO 6: Understand creative writing aspects and apply them.

CO-PO Mapping

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

Syllabus

Unit1

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

Unit 2

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

Unit 3

tamiḻ ilakkaṇam: Vākkiya vakaikaḷ – taṉviṉai piṟaviṉai – nērkkūṟṟu ayaṟkūṟṟu

Unit 4

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

Unit 5

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

Textbooks:

- http:/Www.tamilvu.trg/libirary/libindex.htm.
- http:/Www.tunathamizh.tom/2013/07/blog0post_24.html
- Mu.Varatarācaṉ "tamiḻ ilakkiya varalāṟu" cāhitya akaṭemi papḷikēṣaṉs, 2012
- nā.Vāṉamāmalai "paḻaṅkataikaḷum, paḻamoḻikaḷum" niyū ceñcuri puttaka veḷiyīṭṭakam, 1980,2008
- nā.Vāṉamāmalai, "tamiḻar nāṭṭuppāṭalkaḷ" niyū ceñcuri puttaka veḷiyīṭṭakam 1964,2006
- poṉ maṇimāṟaṉ "aṭōṉ tamiḻ ilakkaṇam "aṭōṉ papḷiṣiṅ kurūp, vañciyūr, tiruvaṉantapuram, 2007.

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15TAM111 TAMIL II 2 0 0 2

Course Objectives

- To learn the history ofTamilliterature.
- To analyze different styles of Tamil Language.
- To strengthen thecreativity in communication, Tamilbasicgrammar and use of computer on Tamil Language.

Course Outcomes

CO 1: Understand the history of Tamil literature.

CO 2: Apply practical and comparative analyses on literature.

CO 3: Understand thinai literature, literature on justice, Pathinenkeelkanaku literature.

CO 4: Understand the tamil scholars' service to Tamil language and society.

CO 5: Understand components of Tamil grammar and its usage

CO 6: Understand creative writing aspects and apply them

CO-PO Mapping

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

Syllabus

Unit 1

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

Unit 2

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

Unit 3

tamiḻ ilakkaṇam: Vākkiya vakaikaḷ – taṉviṉai piṟaviṉai – nērkkūṟṟu ayaṟkūṟṟu

Unit 4

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

Unit 5

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

Text Books / References

http:/Www.tamilvu.trg/libirary/libindex.htm.

http:/Www.tunathamizh.tom/2013/07/blog0post_24.html

Mu.Varatarācaṉ “tamiḻ ilakkiya varalāṟu” cāhitya akaṭemi papḷikēṣaṉs, 2012

nā.Vāṉamāmalai “paḻaṅkataikaḷum, paḻamoḻikaḷum” niyū ceñcuri puttaka veḷiyīṭṭakam, 1980,2008

nā.Vāṉamāmalai, “tamiḻar nāṭṭuppāṭalkaḷ” niyū ceñcuri puttaka veḷiyīṭṭakam 1964,2006

poṉ maṇimāṟaṉ “aṭōṉ tamiḻ ilakkaṇam “aṭōṉ papḷiṣiṅ kurūp, vañciyūr, tiruvaṉantapuram, 2007.